Research Report

On

INNOVATIVE APPROACHES IN ICT AND EMERGING TECHNOLOGIES FOR INTEGRATING 4IR IN TRAINING AND MONITORING OF PHYSICAL & MENTAL HEALTH UTILIZING MACHINE LEARNING, DATA MINING, NLP AND BIO-ENGINEERING FROM THE PERSPECTIVE OF NACTAR AND SMART BANGLADESH

Submitted to

The Director

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Chapter-1

Introduction & Literature Review

Introduction

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1.1. Introduction

In today's interconnected world, Information and Communication Technology (ICT) has transformed the way we communicate, work, and access information. With its global impact, ICT has revolutionized various aspects of society, enabling seamless communication, enhancing productivity, fostering innovation, and driving economic growth. This introduction highlights the significance of ICT on a global scale, emphasizing its role in connecting individuals and businesses, promoting digital literacy, and contributing to economic development. It also highlights the growing importance of ICT in Bangladesh, where the government is actively investing in ICT infrastructure and policies to drive digital transformation and address societal challenges. By harnessing the power of ICT, Bangladesh is poised to unlock new opportunities, improve access to education and healthcare, and foster an inclusive and transparent society.

1.2. Background Study

Information and Communication Technology (ICT) has become increasingly necessary from a global perspective, as it has revolutionized the way we communicate, work, learn, and access information. ICT has enabled the world to become more interconnected, providing a platform for individuals and businesses to collaborate, exchange information, and interact with each other regardless of geographical boundaries. ICT has improved the efficiency and speed of communication, reducing the time and cost involved in transmitting data. This has resulted in increased productivity, better informed decision-making, and enhanced customer satisfaction.

Additionally, ICT has contributed significantly to the global economy, providing a fertile ground for innovation, entrepreneurship, and job creation. It has enabled the development of new business models and industries, and has helped in overcoming challenges related to sustainability and economic growth. ICT has also played a critical role in bridging the digital divide and providing access to information and educational resources to people in remote and underdeveloped regions, thus promoting digital literacy and empowering people around the world.

Information and Communication Technology (ICT) has become an indispensable aspect of modern society, with its reach and impact spreading across the world. In Bangladesh, the importance of ICT is becoming increasingly clear as the country works to develop its economy

and improve the standard of living for its citizens. From a global perspective, ICT plays a crucial role in connecting countries and facilitating the exchange of information, goods, and services. It also acts as a catalyst for economic growth and job creation, particularly in the tech industry.

In Bangladesh, the government is making significant investments in ICT infrastructure and policies to drive digital transformation and build a modern economy. The country has made considerable progress in recent years in areas such as mobile phone and internet penetration, digital financial services, and e-commerce. These developments have the potential to unlock new economic opportunities and bring greater convenience to people's lives.

Furthermore, ICT can play a key role in addressing some of the country's biggest challenges, such as poverty, healthcare, and education. For instance, ICT-based solutions can be used to reach remote and underserved communities, improve access to quality education, and deliver healthcare services more efficiently. The use of ICT can also help to build a more inclusive and democratic society by empowering citizens with information and promoting greater transparency.

Table 1.1: Sustainable Development Goals (SDGs) specified by United Nation in 2015.

Sl.	Goal Name	Description
1.	No Poverty	End poverty in all its forms everywhere.
2.	Zero Hunger	End hunger, achieve food security and improved nutrition and promote sustainable agriculture.
3.	Good Health and Well-being	Ensure healthy lives and promote well-being for all at all ages.
4.	Quality Education	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.
5.	Gender Equality	Achieve gender equality and empower all women and girls.
6.	Clean Water and Sanitation	Ensure availability and sustainable management of water and sanitation for all.
7.	Affordable and clean energy	Ensure access to affordable, reliable, sustainable and modern energy for all.
8.	Decent work and economic growth	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.
9.	Industry, innovation and infrastructure	Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.
10.	Reduced Inequalities	Reduce inequality within and among countries.

11.	Sustainable cities and communities	Make cities and human settlements inclusive, safe, resilient and sustainable.
12.	Responsible Consumption and production	Ensure sustainable consumption and production patterns.
13.	Climate Action	Take urgent action to combat climate change and its impacts.
14.	Life Below Water	Conserve and sustainably use the oceans, seas and marine resources for sustainable development.
15.	Life on Land	Protect, restore and promote sustainable use of terrestrial ecosystems, sustainable manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.
16.	Peace, Justice and Strong Institutions	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.
17.	Partnerships for the Goals	Strengthen the means of implementation and revitalize the global partnership for sustainable development.

Information and Communication Technology (ICT) can play a crucial role in achieving the United Nations' Sustainable Development Goals (SDGs), mentioned in Table 1.1 (Assembly, 2015), as it can help facilitate communication, information dissemination, and knowledge-sharing, which are key elements for sustainable development. ICT can help in the following ways:

a) **Connecting people:** ICT can help bridge the digital divide by providing access to information and communication to remote and underserved communities, enabling people to connect and participate in the global community.
b) **Improving Healthcare:** ICT can improve the delivery of health services by providing remote access to medical advice and treatment, enabling the sharing of medical data, and reducing the time and cost of healthcare delivery.
c) **Promoting Education:** ICT can help increase access to education and improve the quality of learning by providing online courses, virtual classrooms, and access to educational resources.
d) **Supporting Environmental Sustainability:** ICT can help reduce energy consumption and promote sustainable development by facilitating remote collaboration and communication, reducing the need for travel, and promoting the use of clean and renewable energy.

e) **Promoting Economic Growth:** ICT can help create new businesses and jobs, improve efficiency and productivity, and provide access to global markets.

By incorporating ICT into development plans and initiatives, countries can work towards achieving the SDGs and promoting sustainable development.

The Fourth Industrial Revolution (4IR) (Skilton, 2018) refers to the current and ongoing development in the field of technology, characterized by the integration of advanced technologies such as artificial intelligence, robotics, Internet of Things, and autonomous systems. This revolution is different from the previous three industrial revolutions in its pace of development, the breadth of its impact and the level of interconnectivity it brings.

In order to lead the Fourth Industrial Revolution, Bangladesh must focus on leveraging Information and Communication Technology (ICT) to drive economic growth and improve the quality of life for its citizens. Bangladesh can make use of ICT to develop infrastructure and enhance its competitiveness by offering new products, services, and platforms to its customers. By investing in the development of digital infrastructure and digital literacy, Bangladesh can establish itself as a leading player in the digital economy, contributing to job creation and business growth.

Additionally, ICT can help Bangladesh achieve the Sustainable Development Goals (SDGs) by improving access to education, healthcare, and financial services for its citizens. By using technology to increase efficiency, reduce costs and improve outcomes in various sectors, ICT can play a critical role in the development of Bangladesh. The government of Bangladesh should consider investing in the development of a strong ICT ecosystem that will enable the country to leverage the full potential of the 4IR.

As a result of the preceding discussion, it is clear that technology integration in the education sector is required to achieve both the SDGs and the 4IR, as the modern economy is a knowledge-based economy that relies on people's knowledge and information to increase their skills, productivity, and ultimately, the country's growth rate (Norris 2001). That is why, in 2010, the government of Bangladesh included Information and Communication Technology (ICT) in the National Education Policy (National Education Policy, 2010). ICT as a complete course was initially launched for grade 6 in 2012 in order to give computer literacy and skills, and it was subsequently expanded to cover additional grades of secondary and higher secondary levels in Bangladesh.

Information and Communication Technology (ICT) is a scientific, technical, and engineering discipline and management technique for handling information, as well as its application and connection to social, economic, and cultural issues (Semenov et al., 2002). It is becoming an increasingly important aspect of the educational system. ICTs have changed the way people work today, and they are now changing education institutions (Watson, 2001). All industrialized nations, as well as many developing countries, are adding computer labs and Internet connections in their classrooms (Lin et al., 2011). The fast adoption of ICT applications has resulted in significant technological, societal, and economic changes. These shifts have forced educational institutions, administrators, and teachers to reconsider their responsibilities, instructional methods, and long-term visions. However, many instructors lack the essential IT skills and are uncomfortable using the new materials in the classroom. They also lack the necessary training (Carnoy, 2004).

Table 1.2: School management type, enrollment, and teachers (BENBEIS, 2017). Here, SPI, PTR, and TPI denote student per institution, pupil-teacher ratio, and teacher per institution respectively.

Type of Education	Management	Number of Institutions	Number of Students	Number of Teachers	SPI	PTR	TPI
Primary	Public	63,982	12,781,249	382,262	200	37	5
	Private	69,919	4,470,101	275,702	64	16	4
	Total	**133,901**	**17,251,350**	**623,964**	**129**	**28**	**5**
Secondary	Public	987	409,135	8876	415	46	9
	Private	19,480	9,921,560	235,004	509	42	12
	Total	**20,467**	**10,330,695**	**243,880**	**505**	**42**	**12**
Higher Secondary	Public	328	1,436,718	14,467	4380	99	44
	Private	4091	2,436,242	106,467	596	23	26
	Total	**4419**	**3,872,960**	**120,934**	**876**	**32**	**27**

According to the statistics provided by BANBEIS, there were approximately 17.25 million primary, 10.33 million secondary, and 3.87 million higher secondary students in Bangladesh in 2017. And the total number of teachers in primary, secondary and higher secondary was approximately 988 thousand. These statistics have been shown in Table 1.2 and the numbers have only increased in the past years. From these statistics, it is clear that there is a huge target audience in Bangladesh who needs proper ICT training every year.

Moreover, the information and communication technology (ICT) business is a relatively recent sector in the country's economy. It is an essential growing industry, even though it has yet to make meaningful contributions to the national economy. The Bangladesh Association of Software and Information Services (BASIS) was founded in 1997 to serve as the industry's national trade association. By 2009, the organization has expanded from 17 to 326 member firms. Bangladesh was placed first in software and IT services competitiveness and third in capabilities, after India and China, in research conducted by the Japan International Cooperation Agency in 2007-08 (Karim, 2010). In 2008 research, the World Bank predicted that Bangladesh's IT services and software exports will expand by triple digits (Karim, 2010). Gartner ranked Bangladesh as one of the top 30 countries for offshore services in 2010–2011 (Goasduff, 2012). In 2012, Internet penetration increased to 21.27 percent, up from 3.2 percent three years earlier (Bangladesh Sangbad Sangstha, 2013). Since 2009, the country's Information and Communications Technology (ICT) industry has averaged 57.21 percent export growth over the previous nine years (Latifee et al., 2018). In fiscal year (FY) 2016–17, Bangladesh's ICT sector generated export revenues of US$0.8 billion from the world market and US$1.54 billion from the local market, contributing roughly 1% to GDP (Latifee et al., 2018). So far, the ICT sector has generated roughly 300,000 job opportunities (Latifee et al., 2018). The government forecasts the IT industry to contribute 7.28 percent to GDP growth by 2021 as Internet usage grows (Bangladesh Sangbad Sangstha, 2013).

According to the statistics of Leveraging ICT for Growth Employment and Governance (LICT, website: lict.gov.bd), the total employment of IT-ITES industry has increased almost 3 times between 2013 and 2018 as shown in Table 1.3. According to LICT report of 2020, 5,85,000 people have been trained in ICT and among them 68,000 people have got jobs till 2020. According to the same report, by 2021 the number of total trained people will be 10 lakhs. Moreover, in 2020, 15,000 entrepreneurs have been introduced till 2020 and the number will increase to 65000 by 2021. Based on these statistics, it can be said that, training in ICT sectors is a very important aspect now.

Table 1.3: Total Employement of IT-ITES Industry (2013-18).

Year	2013	2014	2015	2016	2017	2018
Full Time Employment of IT/ITES Industry	23392	28615	35003	42817	52375	64067

Part Time Employment of IT/ITES Industry	22829	27925	34159	41785	51113	62524
Total Time Employment of IT/ITES Industry	46221	56540	69162	84602	103488	126591

Keeping this need in mind, to facilitate this huge audience, the National Academy for Computer Training and Research (NACTAR) is providing practical and pragmatic training on computer technology to create employability, skill development, and entrepreneurship under the Ministry of Education of the Government of People's Republic of Bangladesh. The institution has been established to develop technology and create skilled manpower through computer training in the context of the demands of the era. It offers various short-term and long-term courses for students as well as teachers in this sector. The objectives and activities of NACTAR clearly show how skill development efforts within the existing institutional arrangements are further linked to entrepreneurship, employability, and productivity.

1.3. Problem Identification

The challenges in ICT training can be multi-faceted and have a significant impact on the fitness and mental health of trainees. Some of these challenges include:

a) **Technological advancements:** The ICT sector is constantly evolving, and keeping up with new technologies and advancements can be challenging for trainees, leading to stress and burnout.
b) **Accessibility and Affordability:** Not everyone has access to the necessary technology and infrastructure to participate in ICT training, which can lead to a lack of inclusivity and inequality in the industry.
c) **Health and Well-being:** Spending extended periods of time sitting in front of a computer can have negative impacts on physical health, including eye strain, back pain, and obesity. The sedentary lifestyle can also lead to poor mental health, such as stress, anxiety, and depression.
d) **Lack of Job Opportunities:** Despite the growing demand for skilled ICT professionals, the job market can be competitive, and many trainees may struggle to find employment after completing their training, leading to stress and uncertainty.

e) **Poor Quality Training:** Training programs can vary greatly in quality, and inadequate or ineffective training can leave trainees feeling frustrated and discouraged.

It's important to address these challenges in order to promote a healthy and sustainable ICT training environment. This can be achieved through initiatives such as providing access to ergonomic equipment, encouraging regular breaks and physical activity, and promoting inclusive and effective training programs.

1.4. Research Objectives

This year, based on the research domains mentioned by NACTAR, we have specified the topic as "Innovative Approaches in ICT and Emerging Technologies for Integrating 4IR in Training and Monitoring of Physical & Mental Health Utilizing Machine Learning, Data Mining, NLP and Bio-Engineering from the Perspective of NACTAR and Smart Bangladesh". Based on the research conditions specified by NACTAR, the main objectives of this work are:

a) Design research plan by analyzing global trends in research fields aligned with NACTAR
b) Propose a service/product that contributes to the field of training
c) Impact of ICT on physical fitness and mental health of trainees
d) Solution of a problem related to Bengali language and Bangladesh
e) Offering a useful service in everyday life
f) Innovative initiatives in domains of Machine Learning, Deep Learning, Data Mining, Natural Language Processing and Bio-engineering

1.5. The Team

For fulfilling the research objectives, we had to create a team. The team was formed with two major members:

a) Principal Researcher: Prof. Dr. Md. Rabiul Islam, Ph.D., Dept. of CSE, RUET
b) Assistant Researcher: Md. Azmain Yakin Srizon, Lecturer, Dept. of CSE RUET

The curriculum vitae of both principal researcher and assistant researcher are attached in Appendix A and Appendix B.

1.5. Organization of the Book

The following chapters are organized as follows:

a) **Chapter 2 – Objective Based Research Plans:** Contains research plans for all six objectives with proper illustration.
b) **Chapter 3 – Data Collection Sources:** Contains details on the data collection sources i.e., questionnaire-based surveys, personalized interviews, review of existing data, review of documents, websites, analytics and statistics etc.
c) **Chapter 4 – Methodology:** Contains details explanation on statistical analysis, data mining, feature selection, machine learning approaches and performance evaluation.
d) **Chapter 5 – Survey Forms Designing:** Contains the forms that have been utilized in this study.
e) **Chapter 6 – Experimental Analysis and Results:** Contains all the experimental results of this research.
f) **Chapter 7 – Research Timeline and Budget:** Contains the detailed timeline, budget and work breakdown structure of this research project.
g) **Chapter 8 – Conclusion:** Contains a summarized conclusion including the limitation of the study.

1.6. Conclusion

This chapter mainly the background study and research objectives have been discussed. In the next chapter, emphasis will be on the objective based research plans.

Chapter-2

Objective Based Research Plans

Introduction

Objective 1 – Design research plan by analyzing global trends in research fields aligned with NACTAR

Objective 2 – Propose a service/product that contributes to the field of training

Objective 3 – Impact of ICT on physical fitness and mental health of trainees

Objective4 – Solution of a problem related to Bengali language and Bangladesh

Objective 5 – Offering a useful service in everyday life

Objective 6 – Innovative initiatives in domains of Machine Learning, Deep Learning, Data Mining, Natural Language Processing and Bio-engineering

Conclusion

2.1. Introduction

As mentioned earlier, we have made 6 objectives as per the objectives mentioned in NACTAR circular. To fulfill each of the objectives effectively, separate research plans have been designed.

2.2. Objective 1 – Design research plan by analyzing global trends in research fields aligned with NACTAR

To design an effective research plan, the following steps can be carried out:

a) **Step 1: Identify global research trends in the field of ICT training:** The design will begin by conducting a thorough literature review to identify the latest research trends in the field of ICT training. This will include research in areas such as blended learning, gamification, and mobile learning.
b) **Step 2: Analyze the research gaps:** After identifying the global research trends, the research gaps in the field of ICT training will be analyzed. This will include identifying areas where research is lacking and areas where there is a need for further investigation.
c) **Step 3: Define the research problem:** Based on the research gaps, the research problems will be defined that the study will aim to address. The research problem will be specific and clear, and will align with the research gaps identified in step 2.
d) **Step 4: Develop research objectives:** Based on the research problem, specific research objectives will be developed that the study will aim to achieve. The research objectives will be clear and measurable.
e) **Step 5: Design the research methodology:** Based on the research objectives, the research methodology will be designed. This will include the research design, data collection methods, and data analysis methods.
f) **Step 6: Identify the target population:** The target population will be identified that the study will aim to investigate. The target population will be clearly defined and accessible.
g) **Step 7: Develop data collection instruments:** Data collection instruments such as questionnaires, interviews, and observation forms will be developed that will be used to collect data from the target population.

h) **Step 8: Plan for data analysis:** Plan for data analysis will be prepared by identifying the statistical techniques that will be used to analyze the data. This will include techniques such as descriptive statistics, inferential statistics, and qualitative analysis.

i) **Step 9: Implement and report the results:** Next, the data analysis methods will be implemented and the results will be obtained. This will be achieved by utilizing modern research methodologies such as machine learning, deep learning, data mining, natural language processing and bio-engineering.

j) **Step 10: Plan recommendations:** After achieving and analyzing the obtained results, some effective recommendations will be made to be carried out by NACTAR for a achieving a better working process model.

This workflow diagram has been illustrated in Figure 2.1. In the previous NACTAR project, we collected around 1200 samples to determine the trends in ICT all over the world. Based on the analysis of data, we identified some major problems in this domain such as:

a) Lack of automated feedback assessment module.

b) Lack of awareness in terms of physical fitness and mental health of trainees.

c) Lack of attention towards the trainees with language barrier.

d) Lack of effective assessment strategies.

e) Lack of overall improvement plan.

To address these issues, the next objectives have been designed and it can be observed that the whole research plan has been developed based on the 10 steps mentioned previously.

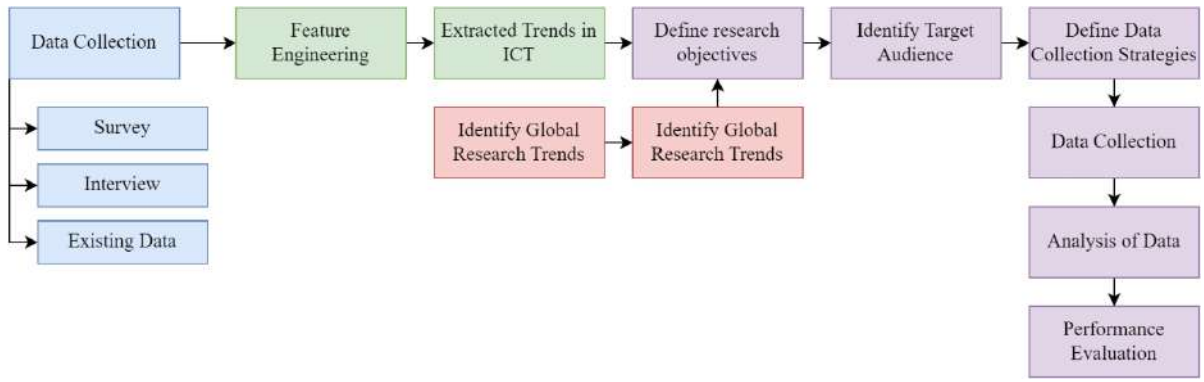

Figure 2.1: Workflow diagram for Objective 1.

2.3. Objective 2 – Propose a service/product that contributes to the field of training

Maintaining feedbacks while training ICT courses can be challenging for several reasons. Some of the challenges include:

a) **High volume of feedback:** With many trainees providing feedback, it can be difficult to keep track of all the comments and organize them in a meaningful way.
b) **Lack of structure:** Feedback can come in different forms such as written comments, ratings, or survey responses. It can be difficult to extract meaningful information from unstructured data.
c) **Time-consuming:** Collecting and analyzing feedback can be time-consuming, especially if it is done manually.
d) **Interpreting feedback:** Understanding the meaning behind the feedback can be challenging, especially if the comments are ambiguous or difficult to interpret.
e) **Lack of actionable insights:** Even if the feedback is collected and analyzed, it can be difficult to turn the information into actionable insights that can be used to improve the training.

That's why to simplify the task of maintaining the feedbacks faster and efficiently, we are proposing a software module that can effectively reduce the above-mentioned problems. The module will provide two services:

a) Based on numerical feedback, suggest whether a review in needed for the course
b) Based on textual feedback, suggest whether the feedback is positive, negative or neutral to quickly sort out the concerns

To achieve the first goal, a dataset can be built considering the answers of some questions such as the followings:

a) How would you rate the overall quality of the training?
b) How did the training meet your expectations?
c) Was the training content relevant to your job?
d) How would you rate the effectiveness of the training materials?

e) How would you rate the effectiveness of the trainer?

f) How would you rate the overall experience of the training?

The answers of the questions will lead to one of the class labels: positive or negative. Then, these labeled data can be used to train a model which can be used to perform real-time effectiveness prediction. That means, the module will be able to predict the score (positive or negative) in real time.

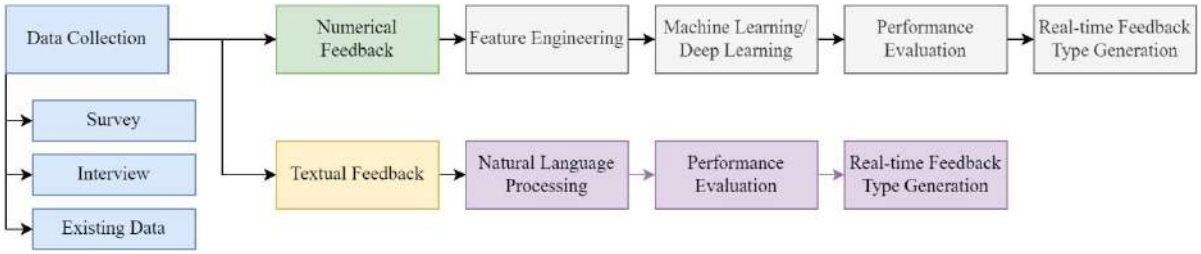

Figure 2: Workflow diagram for Objective 2.

To achieve the second goal, we will use the Natural Language Processing models which will enable the textual feature extraction that will further be used for predicting the positive, negative or neutral feedbacks. Figure 2 illustrates the workflow diagram to successfully carry out objective 2.

2.4. Objective 3 – Impact of ICT on physical fitness and mental health of trainees

The impact of ICT (Information and Communication Technologies) on physical fitness and mental health of trainees is a complex and multi-faceted issue. On the one hand, ICT can provide access to a wide range of resources and tools that can help trainees to improve their physical fitness and mental health, such as online exercise and fitness programs, mental health apps, and virtual reality therapy. However, there are also concerns that excessive use of ICT can have negative effects on physical fitness and mental health, such as reducing physical activity levels, increasing sedentary behavior, and contributing to sleep disorders, anxiety, and depression.

Machine learning, deep learning, data mining, and bio-engineering can all be used to assess the impact of ICT on physical fitness and mental health of trainees. These technologies can be used to analyze large amounts of data collected from various sources, such as wearable devices, mobile apps, and surveys. This data can be used to identify patterns and correlations between

ICT usage and physical fitness and mental health outcomes. For example, machine learning algorithms can be used to identify patterns in data from wearable devices that indicate when a trainee is becoming physically or mentally fatigued. Deep learning models can be used to analyze data from mobile apps and surveys to identify risk factors for poor physical and mental health outcomes. Bio-engineering can be used to design wearable devices and sensors that can collect data on physical activity, sleep, and other indicators of physical and mental well-being. Together, these technologies can provide a more comprehensive understanding of the impact of ICT on physical fitness and mental health and help design interventions to improve outcomes.

To assess the impact of ICT (Information and Communication Technology) on physical fitness and mental health of trainees, the following steps can be taken (as illustrated in Figure 2.3):

a) **Collect data:** Collect data on the physical fitness and mental health of trainees before and after they have been exposed to ICT interventions. This data can include measures such as body mass index (BMI), cardiovascular health, muscle strength, and mental health assessments such as the depression, anxiety, and stress scale (DASS).
b) **Label the data:** Label the data collected by classifying the trainees as either having improved or not improved in terms of physical fitness and mental health after being exposed to ICT interventions.
c) **Preprocess the data:** Preprocess the data by cleaning, normalizing, and transforming it as necessary to make it suitable for machine learning algorithms.
d) **Select a model:** Select an appropriate machine learning model for the task. Some popular models for classification tasks include decision trees, random forests, and neural networks.
e) **Train the model:** Train the model on the labeled data using techniques such as k-fold cross-validation to ensure that the model generalizes well to new data.
f) **Evaluate the model:** Evaluate the model using metrics such as accuracy, precision, recall, and F1-score to assess its performance on the test set.
g) **Use the model to make predictions:** Use the trained model to make predictions on new data to assess the impact of ICT interventions on the physical fitness and mental health of trainees.

h) **Interpret the model:** Interpret the model's predictions and the features that it used to make the predictions in order to understand the impact of ICT on physical fitness and mental health of trainees.

To fully interpret the impact of ICT on physical fitness and mental health of the trainees, the following attributes should be kept in mind while collecting or preparing the datasets:

a) **Personal Information:** Name, Age, Gender, Occupation, Education level, Height, Weight
b) **ICT Usage Information:** Average daily screen time (hours), Type of device(s) primarily used (e.g., smartphone, laptop, tablet), Purpose of device usage (e.g., work, leisure, communication), Frequency of device usage during physical activity or exercise, Frequency of device usage while eating, Frequency of device usage before bed
c) **Physical Fitness Information:** Average daily physical activity level (e.g., sedentary, light, moderate, vigorous), Average weekly exercise duration (hours), Types of physical activity or exercise regularly engaged in (e.g., running, weightlifting, yoga), Current physical fitness level (e.g., poor, fair, good, excellent)
d) **Mental Health Information:** Current stress level (e.g., low, moderate, high), Current mental health status (e.g., good, fair, poor), Perception of the impact of ICT on mental health (e.g., positive, neutral, negative), Any currently diagnosed mental health conditions

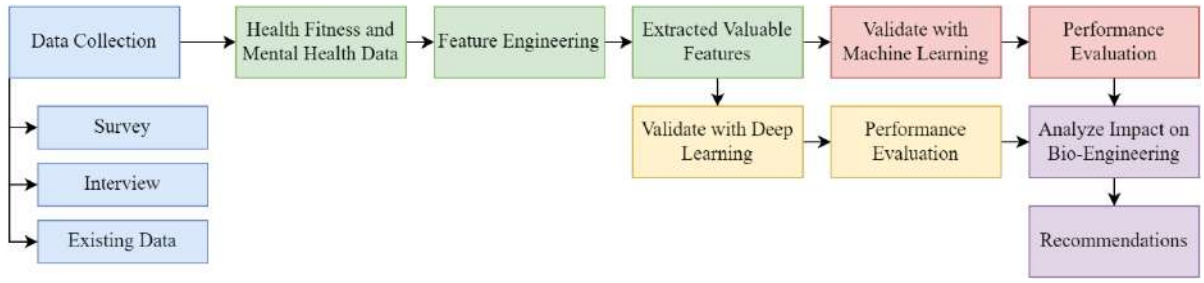

Figure 2.3: Workflow diagram for Objective 3.

In that case the labels of the dataset will be:

a) Physical fitness level (poor, fair, good, excellent)

b) Mental health status (good, fair, poor)

c) Impact of ICT on physical fitness and mental health (positive, neutral, negative)

2.5. Objective 4 – Solution of a problem related to Bengali language and Bangladesh

In Bangladesh, a significant portion of the population is not well-versed in the English language, particularly in its technical usage as found in many ICT books and materials. This language barrier poses a significant challenge for native Bangladeshi individuals when taking an ICT course. To address this issue, we will conduct in-depth interviews with both trainers and trainees to gain a comprehensive understanding of the underlying problems and develop effective solutions. Furthermore, we will analyze past documents and records to gather as much relevant information as possible, in order to provide a thorough assessment of the current situation. This will help us to better understand the specific challenges faced by the population and create targeted and effective strategies to improve the accessibility and success of ICT training for native Bengali speakers. The workflow diagram for fulfilling objective 4 has been illustrated in Figure 2.4.

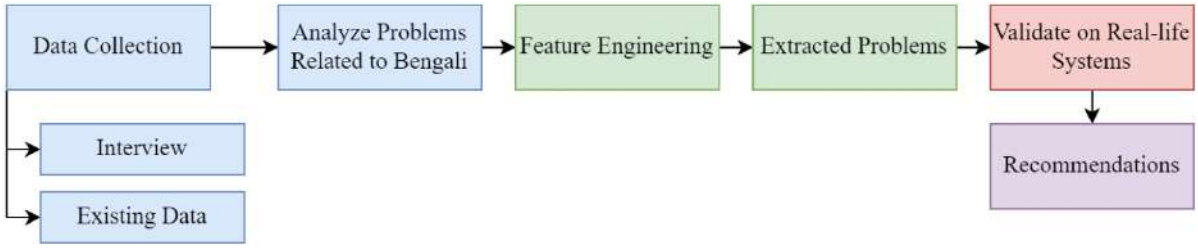

Figure 2.4: Workflow diagram for Objective 4.

2.6. Objective 5 – Offering a useful service in everyday life

Assessing the trainees in ICT courses can be a challenging task for trainers, as it requires them to have a deep understanding of the subject matter as well as the ability to effectively evaluate the performance of the trainees. One of the main difficulties faced by trainers is the diversity of skill levels among trainees. Some trainees may have a strong background in the subject matter, while others may be completely new to the field, making it difficult for the trainer to create a fair and effective assessment plan. Additionally, trainers may face difficulty in identifying the areas of improvement for individual trainees, as their understanding of the

subject matter may not be as advanced as the trainees. Furthermore, trainers must also navigate the complexity of different technologies and tools that are constantly evolving, which can make it difficult to design assessments that accurately measure the trainees' understanding and skills. Additionally, trainers may also face time constraints and budget constraints that can limit the resources available to them for assessment.

Outcome-based education (OBE) is a teaching approach that focuses on determining what students should know and be able to do upon completion of a course or program, and aligning instruction and assessment to meet these goals. This approach can help solve the issue of difficulties faced by trainers in assessing trainees in ICT courses by ensuring that the learning objectives and assessments are clearly defined and aligned with industry standards. Additionally, OBE also emphasizes on continuous assessment and feedback, which will help trainers to track the progress of trainees and provide necessary support and guidance. This way, trainers can ensure that the trainees are acquiring the required skills and knowledge for their future careers in the ICT field.

Therefore, to assist the trainers in their everyday professional life, we will recommend and provide some teaching-learning tools that will effectively enhance the assessment process. It will reduce assessment time and automate the continuous improvement of the courses taught by NACTAR. The workflow diagram for achieving objective 5 has been illustrated in Figure 5.

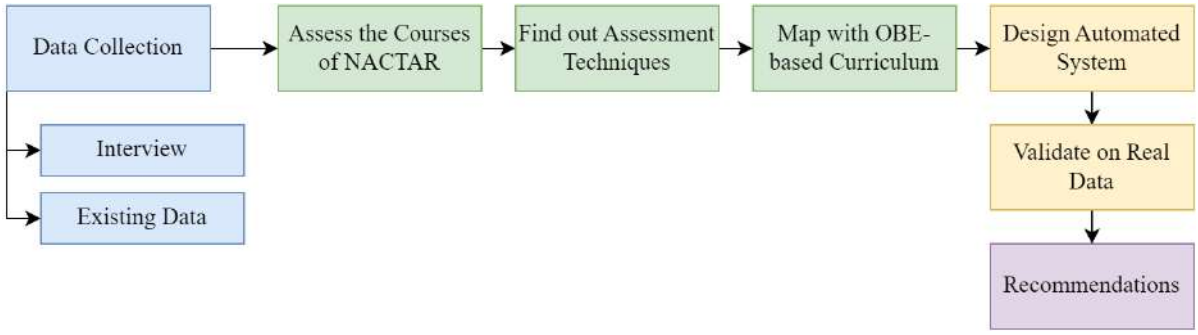

Figure 2.5: Workflow diagram for Objective 5.

2.7. Objective 6 – Innovative initiatives in domains of Machine Learning, Deep Learning, Data Mining, Natural Language Processing and Bio-engineering

For the previously-mentioned 5 objectives, so far, we have proposed five methodologies. Objective 6 will be achieved by focusing on the results obtained for fulfilling those five objectives. Objective 1 will provide the trends, advantages and problems in ICT by utilizing feature engineering and data mining. Next, objective 2 can be fulfilled by using natural language processing (NLP) techniques. To achieve objective 3, both the assistance of machine learning and deep learning are required. Moreover, dataset of objective 3 has the attributes of biomedical data, therefore, this is a problem of bio-engineering domain. Objective 4 will utilize different statistical methods for concluding with recommendations. Finally, objective 5 will utilizing educational data mining for producing an effective assessment strategy.

After utilizing machine learning, data mining, natural language processing and bio-engineering in this domain, the obtained results will be merged together to build the overall knowledge base. This knowledge-base will be utilized for producing high-level recommendations to be carried out by the upper management. The working process of the above-mentioned procedure has been illustrated in Figure 2.6.

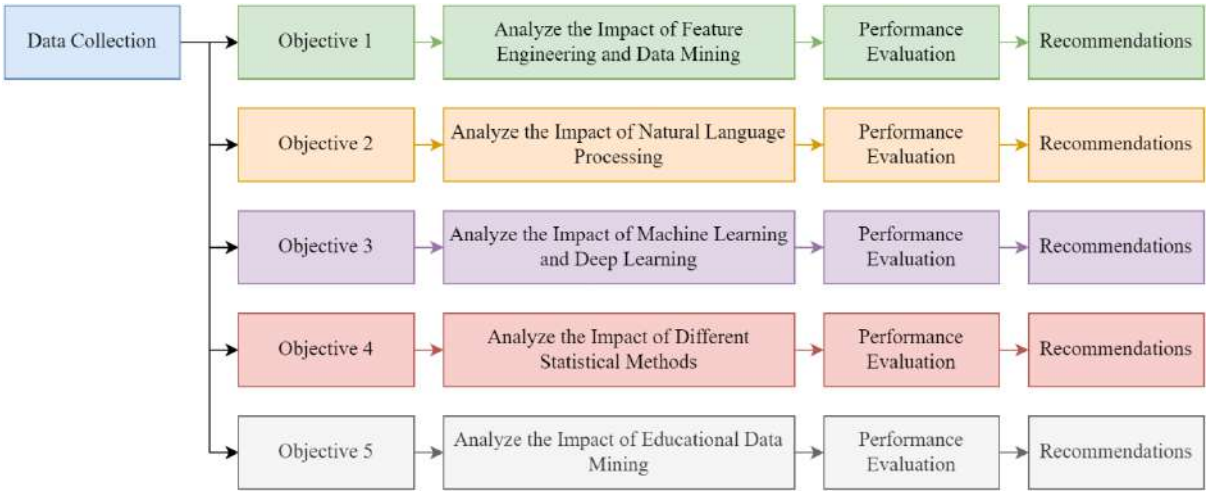

Figure 2.6: Workflow diagram for Objective 6.

2.8. Conclusion

In this chapter, we discussed on the objective based research plans and presented workflow diagram for each of the research plans.

Chapter-3

Data Collection Sources

Introduction

Questionnaire-based Surveys

Personalized Interviews

Review of Existing Data

Review of Documents, Websites, Analytics and Statistics

Qualitative vs. Quantitative Data Collection

Existing Datasets

Conclusion

3.1. Introduction

The data collection process for the objective-based research plan involves different methods of data collection for each specific objective. For example, for objective 1, objective 2 and objective 3, data will be collected through questionnaires-based survey, personalized interview and review of existing NACTAR documents. For objective 4, only personalized interviews and review of existing NACTAR documents will be used. However, for objective 5, the data will be collected through a combination of questionnaire-based survey, personalized interviews, review of research articles and labor market data. For objective 6, the main way of collecting data is through the review of relevant documents, but other methods may also be used if deemed necessary.

The four major ways of data collection include questionnaires-based survey, personalized interviews, review of existing data from NACTAR and other institutions, and review of research articles, websites, analytics, and statistics. The details of these methods are explained in the following sub-sections of the research plan.

3.2. Questionnaire-based Surveys

Surveys are an essential tool for collecting data in research. They come in two forms: online and offline. Online surveys are convenient as they can be conducted with ease and without the need for physical papers. On the other hand, offline surveys are more comprehensive as they reach places where online surveys may not be accessible, providing valuable insights. This research will make use of both online and offline surveys, whichever is more appropriate, based on the specific requirements of the study.

The online surveys will be conducted through Google Forms, a widely-used and reliable tool for collecting data online. The advantage of Google Forms is that it generates excel files directly from the data collected, providing a more organized and manageable format for the data. Additionally, Google Forms offers a range of analytics tools which can be extremely useful in analyzing the data.

In this research, the survey questionnaires will be designed with the objectives in mind. This means that there will be separate surveys for the participants, employers, and instructors involved in NACTAR and other training institutions. It is crucial to understand the perspectives of all three groups in order to meet the research objectives. The initial target for the number of samples to be collected is 400, however, the study aims to increase the sample size, if possible,

as more data will lead to a more comprehensive analysis. Figure 3.1 illustrates the data collection process using questionnaire-based surveys.

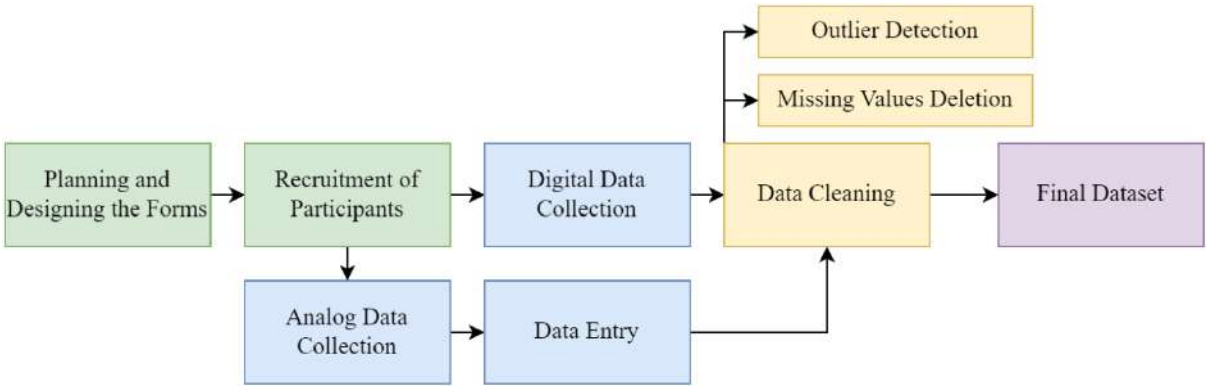

Figure 3.1: Workflow diagram for data collection using questionnaire-based surveys.

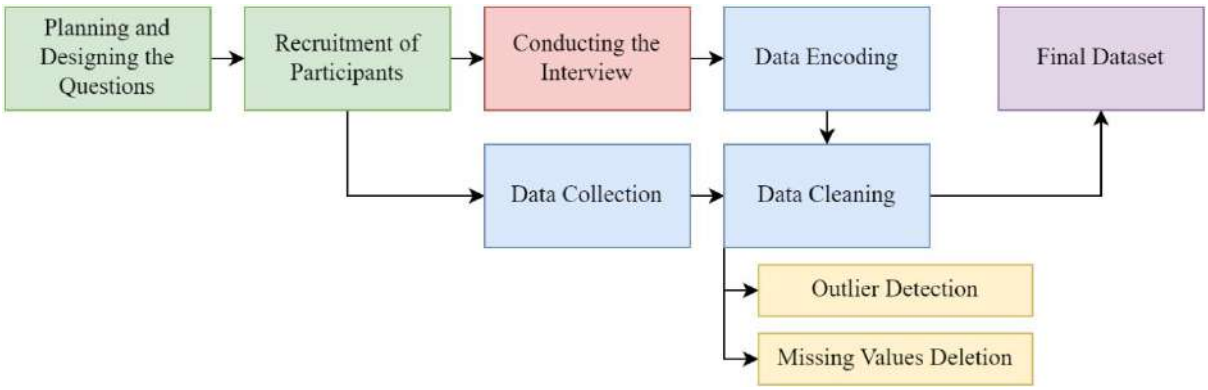

Figure 3.2: Workflow diagram for data collection using personalized interviews.

3.3. Personalized Interviews

The personalized interview will play a crucial role in assessing the impact of ICT on the physical fitness and mental health of trainees. During the interview, the participants will be asked a series of questions aimed at understanding their experiences and perceptions regarding the impact of ICT on their physical fitness and mental health. The questions will cover various aspects such as the amount of time spent on ICT activities, the impact of ICT activities on physical activity levels, the quality of sleep, and any other relevant factors that could impact their physical fitness and mental health. The answers obtained through the personalized

interview will provide valuable insights into the current state of trainees' physical fitness and mental health and will play a key role in developing recommendations to tackle any potential challenges. The data collected through the personalized interview will be analyzed using various data analytics tools to identify trends and correlations, helping to draw conclusions and recommendations to improve the overall physical fitness and mental health of trainees in the future.

3.4. Review of Existing Data

The review of existing data is a crucial step in assessing the impact of ICT on the physical fitness and mental health of trainees. This will provide us with a comprehensive understanding of the current trends and practices of ICT in the training industry. The existing data will be collected from various sources including reports, studies, and databases related to ICT and its impact on physical fitness and mental health. This information will be analyzed to identify patterns and trends and to determine the effectiveness of ICT in promoting physical fitness and mental well-being among trainees. The data collected will also inform the design of questionnaires and interviews aimed at further exploring this issue, thereby increasing the reliability and validity of our findings. The review of existing data will play a crucial role in shaping the research methodology and guiding the overall direction of the study.

3.5. Review of Documents, Websites, Analytics and Statistics

In order to accurately assess the impact of ICT on the physical fitness and mental health of trainees, it is essential to review a variety of relevant documents, websites, analytics, and statistics. These resources will provide valuable information about current trends and patterns in the use of ICT for training and learning. By reviewing websites such as LinkedIn, BDJOBS, and other online job boards, it will be possible to gather information about the specific skills that are being sought after by employers in the ICT sector. Additionally, previous studies, analytics, and statistics related to the impact of ICT on physical fitness and mental health can be reviewed and summarized to gain a more comprehensive understanding of the subject matter. The data obtained from this review process will play a critical role in shaping the recommendations provided by the research and will contribute to a more accurate assessment of the impact of ICT on physical fitness and mental health of trainees.

3.6. Qualitative vs. Quantitative Data Collection

When it comes to assessing the impact of ICT on physical fitness and mental health of trainees, both qualitative and quantitative data collection methods have their own benefits and limitations. Quantitative data collection involves collecting numerical data through methods such as surveys, questionnaires, and experiments, which can provide objective and reliable results that can be easily analyzed and compared. On the other hand, qualitative data collection involves collecting data in the form of words, images, or videos, and involves methods such as focus groups, in-depth interviews, and observations, which can provide rich and detailed information about the experiences and perspectives of the trainees. In this research, a combination of both qualitative and quantitative data collection methods will be used to provide a comprehensive understanding of the impact of ICT on physical fitness and mental health of trainees. The data collected through surveys and questionnaires will provide numerical data for analysis, while the data collected through in-depth interviews will provide a deeper understanding of the experiences and perspectives of the trainees.

3.7. Existing Datasets

Previously, in the NACTAR research, we focused on four objectives:

a) Analyze the recent trends in ICT based labor market.
b) Recommend some proper measures that will be effective in providing ICT training for the labor market by addressing the current trends.
c) Labor market and challenge-based review of existing ICT training.
d) Propose an overall action plan to address the challenges of future ICT training.

Based on the objectives, we collected more than 1200 samples to build the dataset. The dataset included many useful information regarding various courses of NACTAR and other reputable training institutions. The data were collected from the trainees and trainers of NACTAR and others. Therefore, these already existing dataset can also be utilized for this research for a finer outcome.

3.8. Conclusion

In this chapter, we focused on the description of the dataset collection sources. Each of the sources has been described here in details.

Chapter-4

Methodology

Introduction

Statistical Analysis/Data Mining

Feature Engineering

Machine Learning Approaches

Deep Learning

Natural Language Processing

Bioengineering

Performance Evaluation

Conclusion

4.1. Introduction

In this chapter, different methodologies have been discussed including statistical analysis or data mining, feature selection, machine learning approaches, deep learning, natural language processing, bioengineering, and performance evaluation.

4.2. Statistical Analysis / Data Mining

Statistical analysis / data mining refers to the usage of the basic tools of statistics and different statistical algorithms to find out valuable information from data. For this research, different statistical analyses will be conducted. Some of them are described below:

a) **Descriptive Statistical Analysis:** It mainly focuses on organizing and summarizing the data (Hafner, 1998). It can turn a big chunk of data into a valuable piece of information by utilizing its simple yet powerful tools such as the population mean, the sample mean, weighted mean, the sample mean of grouped data, mean deviation, population variance, population covariance, correlations and so on. Here are some of the most popular methods of descriptive statistics with proper formulas:

- **Population Mean:** The population mean (μ) is an average of a group attribute. The group can be a human, object, or thing, like "all the Chinese persons living in the Bangladesh" or "all thecat owners in Dhaka". For example: In a class of 250 students, the average GPA is 4.2.

$$\mu = \frac{\sum X_i}{N} \quad (1)$$

Here, μ is population average, X_i is individual values of a population and N is the count of individual values.

- **Mean Deviation/ Standard Deviation:** A standard deviation (σ) is a measure of data dispersion in proportion to the mean. Data are grouped around the mean when the standard deviation is low, while data are more spread out when the standard deviation is large.

$$\sigma = \frac{\sum |X_i - \mu|}{N} \quad (2)$$

Here, σ is the population mean deviation/standard deviation and the other signs hold the same meaning mentioned earlier.

- **Population Variance:** The population variance (σ^2) describes how data points in a given population are distributed. It's the squared sum of the distances between each data point in the population and the mean.

$$\sigma^2 = \frac{\sum(X_i - \mu)^2}{N} \quad (3)$$

Here, σ^2 is the population variance and the other signs hold the same meaning mentioned earlier.

- **Correlation:** Correlation is a statistical word that refers to the degree to which two variables move in lockstep. When two variables move in the same direction, it is said that they have a positive correlation. A negative correlation exists when they move in opposite directions.

$$r = \frac{\sum(X_i - \mu_X)(Y_i - \mu_Y)}{\sqrt{\sum(X_i - \mu_X)^2 \sum(Y_i - \mu_Y)^2}} \quad (4)$$

Here, r refers to correlation, X_i is the value of the X-variable, Y_i is the value of the Y-variable, μ_X is mean of the values of the X-variable and μ_Y is mean of the values of the Y-variable.

b) **Inferential Statistical Analysis:** When a hypothesis has to be evaluated, inferential statistical analysis is used to extract inferences using probabilities and create generalizations about the entire data set (Bingham et al., 1982). When the population data is large, this sort of technique is applied. Because there would be at least 400 samples in our scenario, doing inferential statistical analysis will be a wonderful option. Hypothesis testing, ANOVA, and other techniques are examples of such tools.

c) **Predictive Analysis:** As stated in the objectives, the study not only focuses on identifying current trends and patterns, but also on predicting future trends and patterns. Statistical approaches and machine learning algorithms are used in predictive analytics to characterize the likelihood of future outcomes, behavior, and trends based on recent and past data. Data mining, data modeling, artificial intelligence, machine learning, and

other approaches are commonly utilized in predictive analysis to create crucial predictions (Bos et al., 2014).

d) **Prescriptive Analysis:** For the purpose of making suggestions, a perspective analysis will be used (Fiet, 2007). Other statistical analyses may be used for driving exclusions, but this one delivers the real answer. Essentially, it is concerned with determining the best proposal for a decision-making process. It is, nonetheless, quite similar to descriptive and predictive analysis. Predictive analysis forecasts what could happen, whereas descriptive analysis explains data in terms of what has happened. And here, prescriptive analysis is concerned with making acceptable recommendations from among the given options.

e) **Exploratory Data Analysis (EDA):** EDA (Tukey, 1977), or exploratory data analysis, is a type of inferential statistics that is widely used by data analysts. It is usually the initial stage in the data analysis process, performed before any other statistical techniques are used. This strategy focuses entirely on studying data patterns in order to identify probable links. EDA may be used to find previously undiscovered correlations in data, evaluate missing data from gathered data for maximum insights, and test assumptions and hypotheses.

f) **Casual Analysis:** In general, causal analysis aids in understanding and discovering the reasons for "why" things happen or seem the way they do (Heise, 1975). For example, in today's commercial world, many ideas or enterprises fail as a result of unforeseen occurrences; in this situation, causal analysis determines the underlying cause of failures, or simply the basic reason why anything may occur.

4.3. Feature Engineering

Feature engineering is a crucial step in the process of data analysis and modeling. It involves the creation, selection, and transformation of variables that are relevant to the problem being solved. The goal of feature engineering is to convert raw data into meaningful information that can be used to train predictive models. This can involve a range of techniques such as dimensionality reduction, normalization, and feature scaling. The end result of feature engineering is a set of relevant features that can be used to train a model and make accurate

predictions. The quality of feature engineering can greatly impact the performance of the final model, and is therefore an important consideration in any data analysis project.

As mentioned earlier in the objectives-based research plan section, for obtaining different objectives, feature selections need to be done. It'll enable one to find out the most critical features that are responsible for a certain outcome. There are many approaches to feature selection in existence. These methods can be divided into 4 broad categories:

a) **Filter Methods:** In filter methods, first, the best subset is selected and then the learning algorithms are employed for performance measurement. Figure 4.1 illustrates the mechanism of filter methods. Some examples of filter methods are Pearson's Correlation/Correlation Coefficient (Sedgwick, 2012), Spearman's Rank Correlation Coefficient (Sedgwick, 2014), Chi-Square (McHugh, 2013), ANOVA Test (Cuevas et al. 2004), Variance Threshold, Mean Absolute Distance, Student's T-Test (Al-Achi et al., 2019), Wilcoxon Mann-Whitney Test (Fagerland et al., 2009), Kruskal-Wallis Test (Vargha et al., 1998), Fisher's Exact Test (Upton, 1992), Minimum Redundance Maximum Relevance (mRMR) (Radovic et al., 2017), Kendall's Feature Selection, etc. Some of them have been described briefly in later sections.

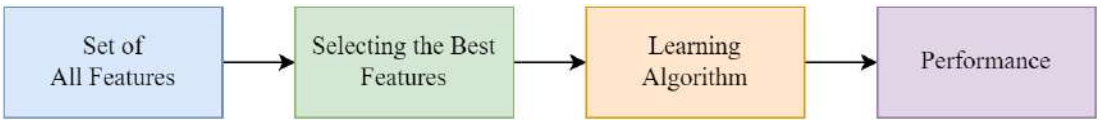

Figure 4.1: Filter methods

b) **Wrapper Methods:** Wrapper methods (El Aboudi et al., 2016) select a subset of features and calculate the performance. Then, they select another subset of features and calculate the performance again. If the performance is better the latter is chosen, otherwise, the first one is chosen. There are different wrapper methods. Some of them are Forward Feature Selection, Backward Feature Elimination, Exhaustive Feature Selection, Recursive Feature Elimination, etc. Figure 4.2 illustrates wrapper methods.

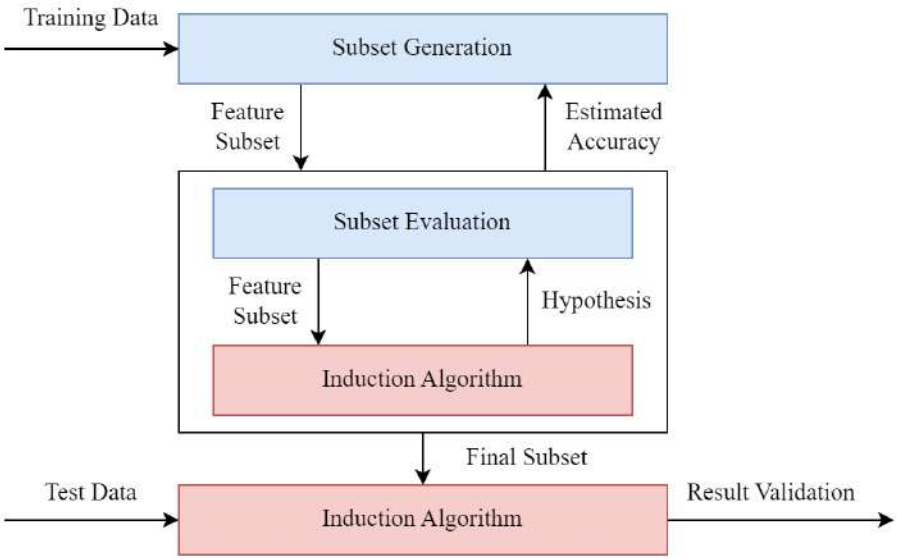

Figure 4.2: Wrapper methods

c) **Embedded Methods:** Embedded feature selection methods are those methods or techniques which has a feature selection technique embedded inside the algorithm. This type of method doesn't need any classification mechanisms. Rather, these are classification algorithms with feature selection embedded into them. In Figure 4.3, a diagram of embedded methods has been presented. Examples of such methods are ridge regression (Marquardt et al., 1975), lasso regression (Ranstam et al., 2018), decision tree (Myles et al., 2004), random forest (Rigatti, 2017), etc.

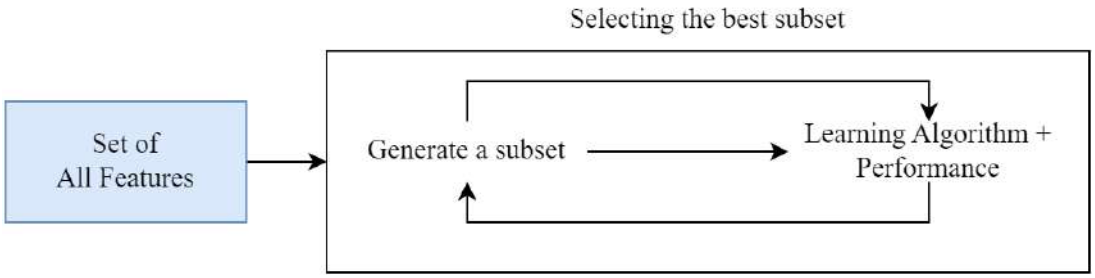

Figure 4.3: Embedded methods

d) **Hybrid Methods:** Hybrid feature selections refer to mixing multiple features together. It can be done in two ways. They are:

   i) Apply sequential feature selection methods

   ii) Apply parallel feature selection methods

All these feature selection approaches will be visited while analyzing the existing and collected training data to find out the best possible features that are correlated with the outcomes.

4.4. Machine Learning Approaches

Machine learning has become an increasingly important tool in the field of data analysis, especially when it comes to assessing the impact of ICT on physical fitness and mental health of trainees. With the ever-growing amount of data being collected, it has become challenging to extract meaningful insights from such large datasets. However, machine learning algorithms have the ability to automatically identify patterns, relationships and correlations in data, thereby allowing for efficient and accurate analysis. By leveraging machine learning techniques, it becomes possible to model complex relationships and make predictions about the impact of ICT on physical fitness and mental health of trainees. This can be useful in developing targeted interventions and identifying potential risk factors that may be affecting the well-being of the trainees. The use of machine learning algorithms can greatly enhance the accuracy and validity of the results, and make it possible to generalize the findings to larger populations. In conclusion, machine learning plays a critical role in the assessment of the impact of ICT on physical fitness and mental health of trainees, as it enables us to extract insights and make informed decisions based on the data.

For some of the experiments, machine learning approaches need to be applied to prove the hypothesis. For this research, the following machine learning approaches will be utilized:

a) **Decision Tree Classifier:** A decision tree is one of the most reliable approaches for predicting and classifying data. It's a tree structure that looks like a flowchart. It's a supervised learning method. The method tries to answer the problem by utilizing tree illustration. Each interior node in the decision tree algorithm represents a test on a characteristic, each branch a result of the test, and each end or leaf node a class label.

b) **K-Nearest Neighbors Classifier:** It's a two-in-one approach that may be used for classification and regression (Peterson, 2009). This algorithm's main task is to categorize new objects based on their properties and to train humans. According to the k training samples, which are the closest near neighbors to the test person are

determined, this algorithm predicts the test sample's level, and finds the outcome with the highest-level possible.

c) **Linear Discriminant Analysis Classifier:** LDA (Linear Discriminant Analysis) (Izenman, 2013), sometimes known as Normal Discriminant Analysis, is a dimensionality reduction technique. It's commonly used to represent organizational variations and supervised classification challenges. It's a compression of dimensions. It achieves an efficient linear transformation to optimize class separability.

d) **Logistic Regression Classifier:** Logistic Regression (Wright, 1995) is a classification methodology that may be used as a predictive analytic tool. It is based on the concept of probability. It's used to solve categorization problems. This method generates a discrete binary result between 0 and 1.

e) **Naïve Bayes Classifier:** Naïve Bayes (Webb et al., 2010) is a machine learning and data mining learning technique that is both efficient and powerful. This method is a set of Bayes Theorem-based classification approaches. It is a class conditional independent algorithm since it is not a single algorithm but a set of algorithms that all engage in a common law and each pair of features being studied is independent of the other.

f) **Random Forest Classifier:** Because it can handle missing conditions and handle continuous, categorical, and binary data, Random Forest is an approach for high-dimensional data modeling. It's a way of gathering data that involves putting together numerous decision trees. For bootstrapping and ensemble design, random forest is a strategy that overcomes the overfitting concern.

g) **Support Vector Machine Classifier:** Another categorization approach is the Support Vector Machine (SVM) (Noble, 2006). SVM is a supervised machine learning technique that outperforms other machine learning algorithms in real-world classification problems and nonlinear function prediction challenges.

h) **Convolutional Neural Network (CNN):** Unlike other traditional machine learning algorithms, a convolutional neural network doesn’t need rigorous feature engineering (Albawi et al, 2017). Rather it discovers important features on its own. Experiments will be done based on CNN also and the results will be reported.

i) **Regression Analysis:** Regression analysis (Freund et al., 2006) is a collection of statistical techniques for evaluating the connections between dependent variables in statistical modeling. The most popular type of regression analysis is linear regression, which involves finding the line that best fits the data based on a set of mathematical criteria. Ordinary least squares, for example, finds the single line or hyperplane that minimizes the sum of squared differences between the genuine data and that line or hyperplane.

4.5. Deep Learning

Deep Learning is a subfield of machine learning that is inspired by the structure and function of the brain, known as artificial neural networks. It utilizes multiple layers of non-linear processing units to learn from large amounts of data and make decisions or predictions based on that data. Deep learning algorithms are able to automatically extract features from data and can be applied to a variety of tasks, including image recognition, natural language processing, speech recognition, and many others. Unlike traditional machine learning algorithms that rely on hand-engineered features, deep learning algorithms are able to automatically learn relevant features from the data. This makes deep learning particularly useful for solving complex problems with large amounts of data, where it can achieve higher accuracy and generalization performance than traditional methods.

Deep learning and machine learning are both subfields of artificial intelligence (AI), but they differ in their approach to solving problems. Machine learning is a broad field that focuses on the development of algorithms and models that can learn from data without being explicitly programmed. It includes techniques such as supervised learning, unsupervised learning, reinforcement learning, and others. Machine learning models are trained on large datasets and can be used to make predictions or classify data.

Deep learning, on the other hand, is a subset of machine learning that specifically focuses on the use of neural networks to model and solve complex problems. Deep learning models, also known as artificial neural networks, consist of multiple layers of interconnected nodes that can learn patterns in data through the optimization of their weights and biases. Unlike traditional machine learning models, deep learning models can automatically extract features from raw

data, making them particularly well-suited for tasks such as image recognition, natural language processing, and speech recognition.

4.5.1. Convolutional Neural Network

Convolutional Neural Network (CNN) is a type of deep learning algorithm that is primarily used in the field of computer vision. It is designed to process and analyze images, videos and other visual data. The architecture of a CNN consists of several layers of interconnected neurons, where each layer performs a specific function such as edge detection, pattern recognition, and feature extraction. The key feature of a CNN is its use of convolutional layers, which perform convolution operations on the input data to detect patterns and features. The convolutional layers use filters that slide over the input data, performing element-wise multiplications and additions to extract relevant information. The output from these layers is then passed through activation functions and pooling layers to reduce the spatial dimensionality of the data and make it more manageable. The final layers in a CNN are typically fully connected layers that perform classification or regression tasks. CNNs have been very successful in various computer vision tasks such as image classification, object detection, and semantic segmentation.

Convolutional Neural Networks (CNNs) have been successful in various computer vision tasks. However, they are not immune to challenges. Here are some common challenges and potential solutions:

a) **Overfitting:** Overfitting occurs when a model becomes too complex and starts to memorize the training data, leading to poor generalization to new, unseen data. One potential solution to overfitting is to use regularization techniques such as dropout or weight decay.
b) **Computational Complexity:** CNNs can be computationally expensive, requiring a large amount of memory and processing power. One solution is to use lighter models with fewer parameters or to use hardware acceleration such as GPUs or TPUs.
c) **Data Scarcity:** CNNs often require large amounts of labeled training data. This can be a challenge for many tasks, especially in domains where data is scarce. One solution is to use transfer learning, where a model pre-trained on a large dataset can be fine-tuned on a smaller task-specific dataset.

d) **Data Bias:** Data bias can be introduced when a model is trained on a dataset that is not representative of the real-world data distribution. One solution is to carefully curate training datasets to be more diverse and reflective of the real-world.

4.5.2. LSTM Models

LSTM (Long Short-Term Memory) is a type of Recurrent Neural Network (RNN) that is designed to handle sequential data. RNNs are neural networks that are designed to process sequences of data, such as time-series data, sequences of words in text, etc. However, traditional RNNs suffer from the vanishing gradients problem, meaning that they struggle to preserve long-term dependencies in sequences. This makes them unsuitable for tasks like language translation, where context from earlier words in a sentence is important for understanding the meaning of later words.

LSTMs were specifically designed to address this issue by introducing memory cells that can preserve information for longer periods of time. The memory cells, along with input, output, and forget gates, help LSTMs decide what information to store, what to discard, and what to output. This makes LSTMs particularly useful for tasks that require understanding of long-term dependencies and sequential information, such as natural language processing, speech recognition, and even stock price prediction.

LSTMs are trained using a variant of backpropagation called backpropagation through time (BPTT), which computes gradients for each time step and then accumulates gradients for each sequence. The combination of memory cells, gates, and BPTT make LSTMs a powerful tool for handling sequential data, and they have been widely used in various state-of-the-art models in natural language processing, speech recognition, and other applications.

4.6. Natural Language Processing

Natural Language Processing (NLP) is a field of study and technology focused on enabling computers to understand, interpret, and generate human language. NLP is an interdisciplinary area that brings together computer science, computational linguistics, and artificial intelligence to develop algorithms and models that can process, analyze, and generate human language. The

goal of NLP is to create systems that can analyze, understand, and generate human language in a way that is similar to the way a human would.

NLP is used in a wide range of applications, including machine translation, sentiment analysis, chatbots, text classification, and summarization. The field is constantly evolving, with new models and techniques being developed to improve performance and increase accuracy. NLP is also a crucial component of many larger AI systems, such as voice assistants and personalized recommendation systems.

The challenges of NLP stem from the complexity and ambiguity of human language. Humans are capable of using language in many different ways, and NLP systems must be able to handle this diversity and variability. Additionally, the vast amount of text data that must be processed by NLP systems is also a challenge. To overcome these challenges, NLP researchers and engineers must use advanced techniques such as deep learning, transfer learning, and unsupervised learning. These techniques allow NLP systems to learn from large amounts of data, extract meaningful patterns and relationships, and generate accurate results.

4.7. Bio-engineering

Bio-engineering refers to the application of engineering principles and techniques to the study and design of biological systems and living organisms. It combines the fields of biology, physics, chemistry, mathematics, and engineering to develop new technologies, systems, and devices to solve complex biological problems and improve human health. This interdisciplinary field of study involves the development of new materials, technologies, and methods for understanding and manipulating biological systems, such as cells, tissues, and organisms, at the molecular, cellular, and tissue levels. Examples of bio-engineering applications include the development of artificial organs, medical devices, and therapies for diseases, as well as the use of engineering approaches to address environmental and sustainability issues. The field of bio-engineering is rapidly evolving and holds great promise for advancing medical research and healthcare, as well as for addressing global challenges related to energy, the environment, and food security.

4.8. Performance Evaluation

Confusion matrix is a table that summarizes the performance of a machine learning model by comparing the actual class labels of the data with the predicted class labels by the model. From the confusion matrix, several performance matrices can be calculated to evaluate the accuracy of the model and its behavior in different scenarios. Some of the commonly used performance matrices are:

a) Accuracy: It is the ratio of the number of correctly predicted instances to the total number of instances in the data. It represents the overall performance of the model.

b) Precision: It is the ratio of the number of true positive predictions to the total number of positive predictions made by the model. It reflects the model's ability to make correct positive predictions.

c) Recall or Sensitivity: It is the ratio of the number of true positive predictions to the total number of actual positive instances in the data. It reflects the model's ability to identify all positive instances.

d) F1-Score: It is the harmonic mean of precision and recall. It provides a balance between precision and recall and is a good indicator of the overall performance of the model.

e) Specificity: It is the ratio of the number of true negative predictions to the total number of actual negative instances in the data. It reflects the model's ability to identify all negative instances.

These performance matrices can be used to evaluate the performance of the model and identify its strengths and weaknesses. Based on the results of these matrices, the model can be improved and optimized for better performance.

4.6. Conclusion

In this chapter, we have discussed all the used methodologies in details. In the next chapter data collections forms have been presented.

Chapter-5

Survey Forms Designing

Introduction

Designing Forms

Conclusion

5.1. Introduction

In this chapter, we have mentioned the forms we designed for this project. We have created both online forms and offline forms for proper data collection.

3.2. Online Forms

Two forms have been created for collecting data to fulfill three objectives.

a) From-1: In this form we focused on Objective-3 (Impact of ICT on physical fitness and mental health of trainees) and Objective-4 (Solution of a problem related to Bengali language and Bangladesh).
b) Form-2: In this form we focused on Objectiv-1 (Design research plan by analyzing global trends in research fields aligned with NACTAR)

The forms have been attached in Appendix 1.

5.4. Conclusion

In this chapter, we discussed on both the designed forms. In the next chapter, we have presented the experimental analysis and results.

Chapter-6

Experimental Analysis and Results

Introduction

Objective 1 – Design research plan by analyzing global trends in research fields aligned with NACTAR

Objective 2 – Propose a service/product that contributes to the field of training

Objective 3 – Impact of ICT on physical fitness and mental health of trainees

Objective4 – Solution of a problem related to Bengali language and Bangladesh

Objective 5 – Offering a useful service in everyday life

Objective 6 – Innovative initiatives in domains of Machine Learning, Deep Learning, Data Mining, Natural Language Processing and Bio-engineering

Conclusion

6.1. Introduction

In this chapter the experimental results for each of the objectives have been presented and based on the results some recommendations have been suggested. Here we have focused on all six objectives and the results for the objectives have been presented one by one. The data has been collected from two parties: trainees of NACTAR and trainees of other institutions.

6.2. Objective 1 – Design research plan by analyzing global trends in research fields aligned with NACTAR

To analyze the global trends in research fields aligned with NACTAR, we have collected 110 samples from the employers. The following figures showcases the recent trends in ICT.

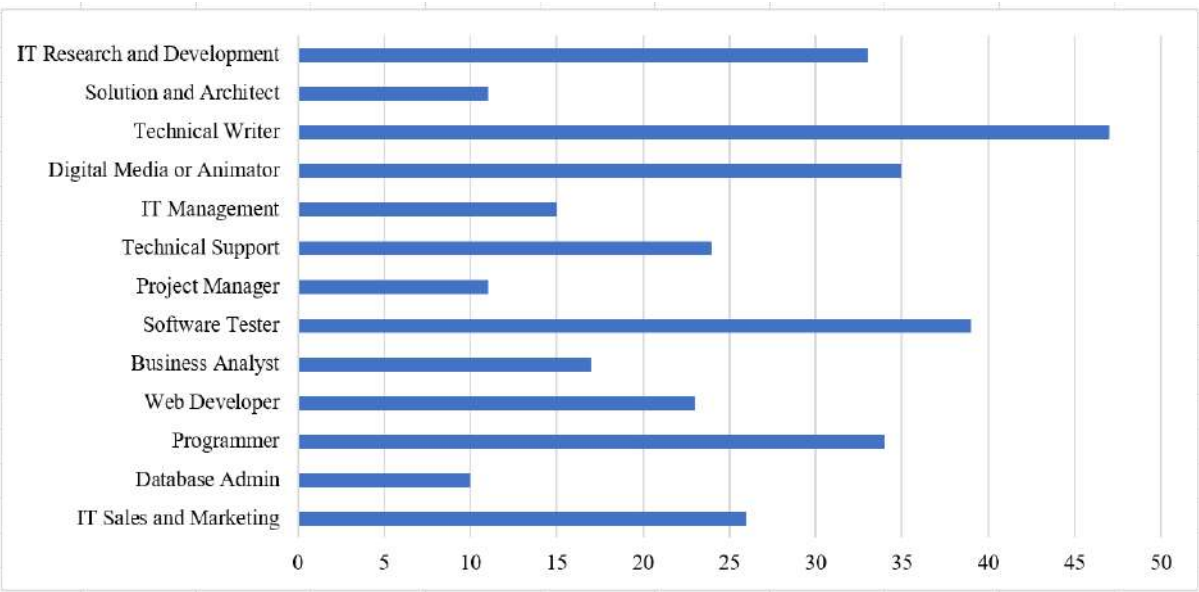

Figure 6.1: Trending jobs in global market

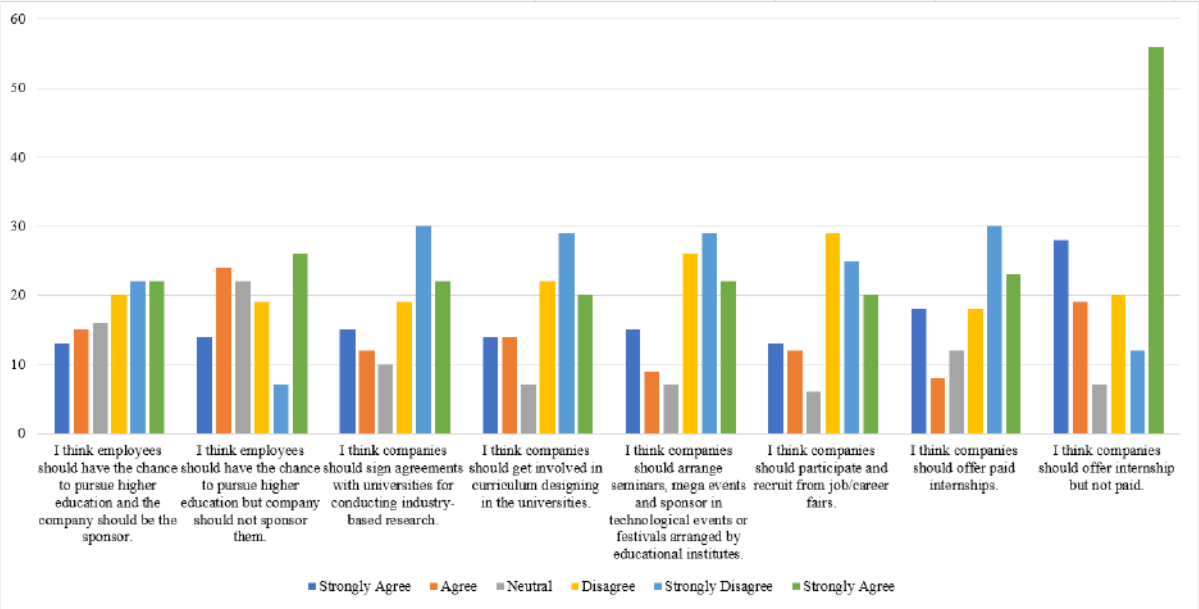

Figure 6.2: Statements regarding employment

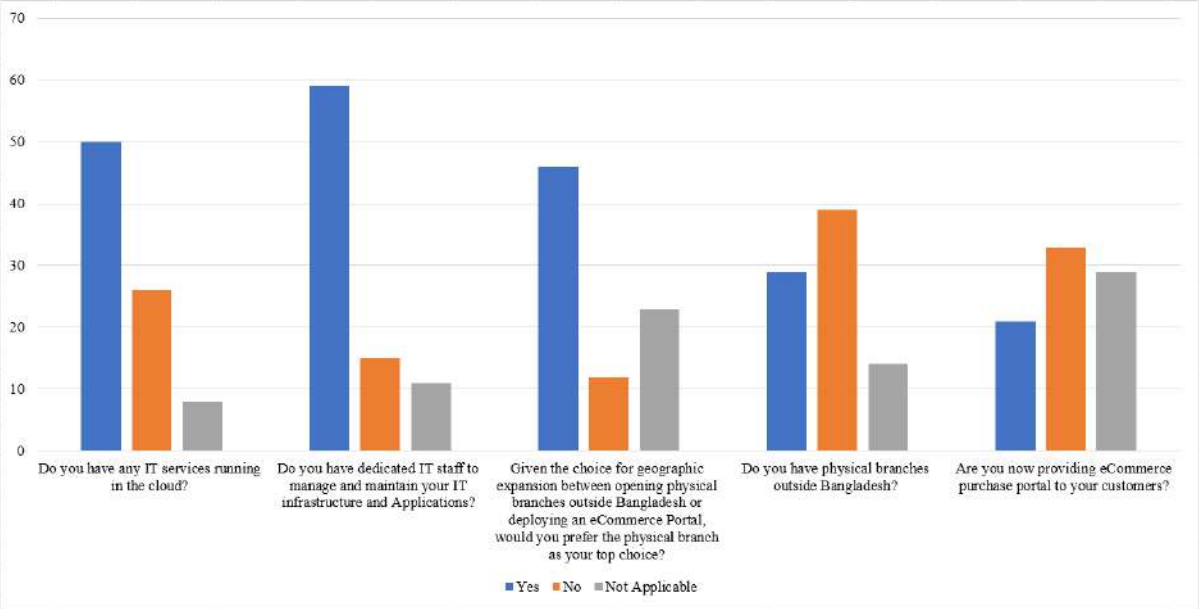

Figure 6.3: Statements regarding employer preferences

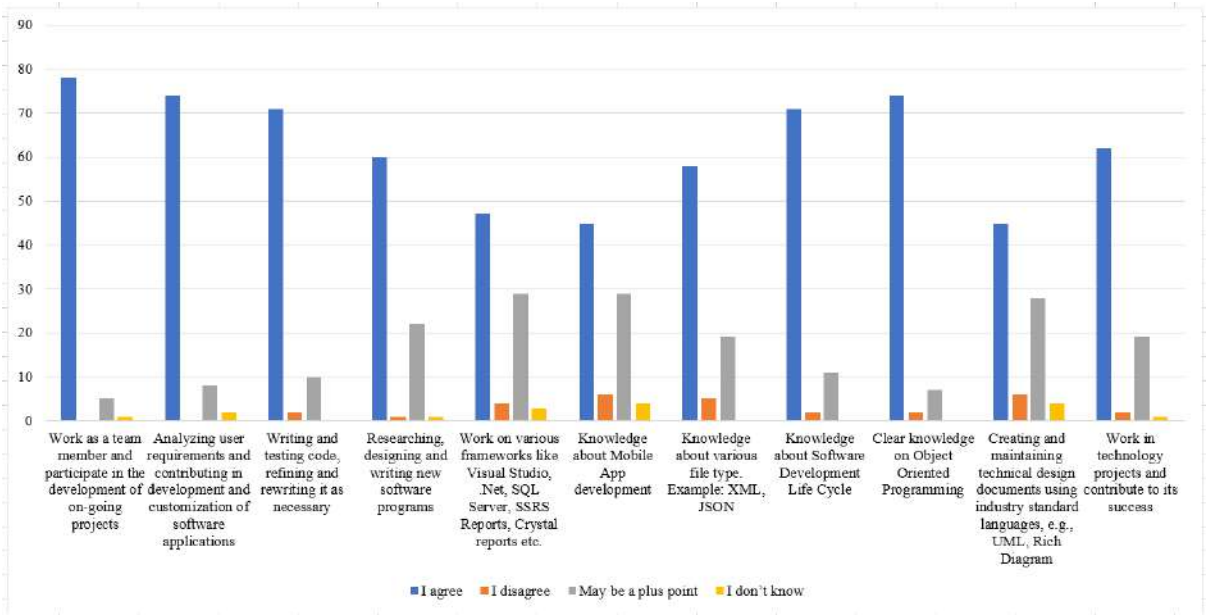

Figure 6.4: Survey of employer preferences for recruitment (Part-1)

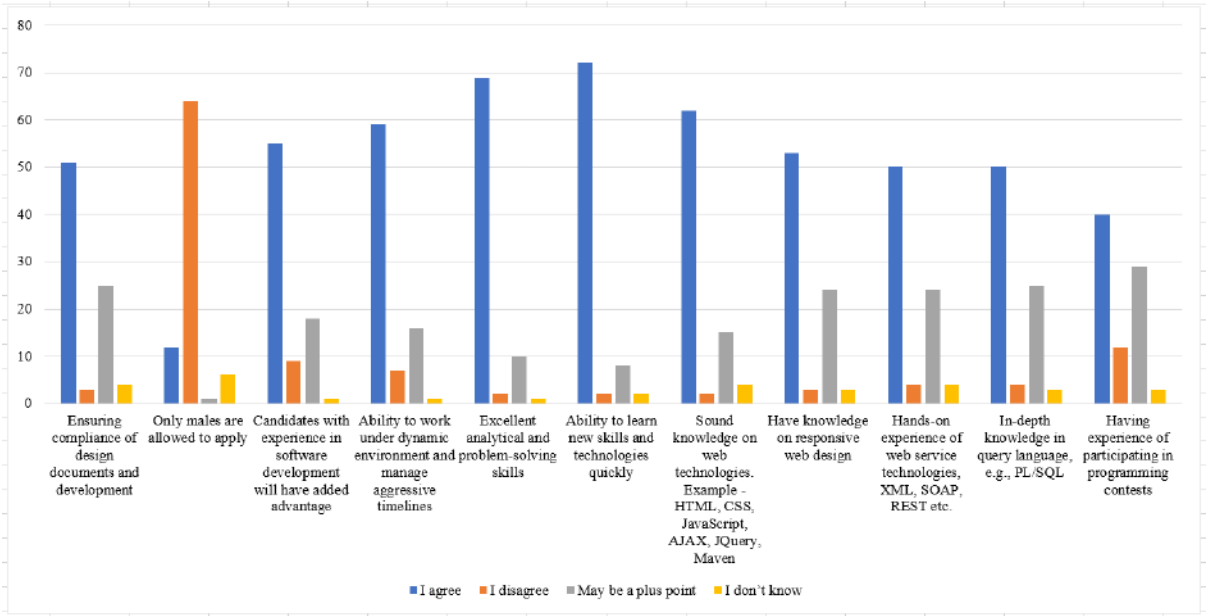

Figure 6.5: Survey of employer preferences for recruitment (Part-2)

We asked them the causes of the ICT problems. Here is the outcome:

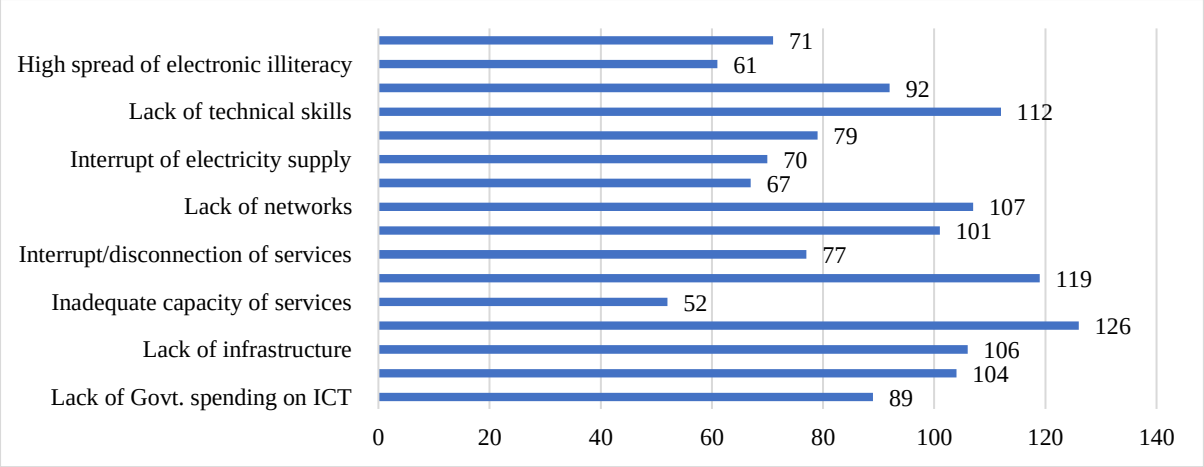

Figure 6.6: Causes of IT problems

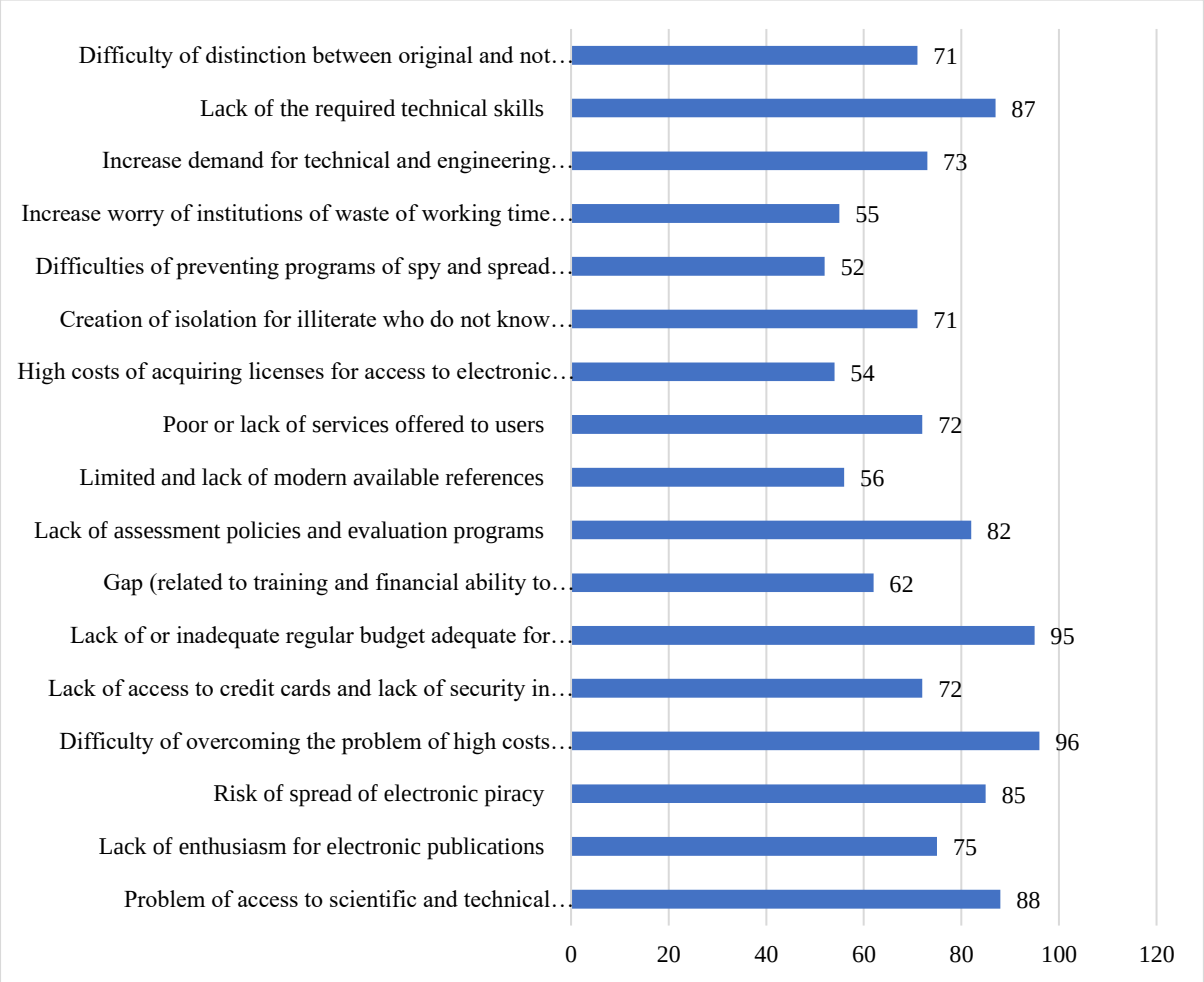

Figure 6.7: Detailed causes of IT problems

We asked the responders to mention which assessments are important in a course and here is the outcome:

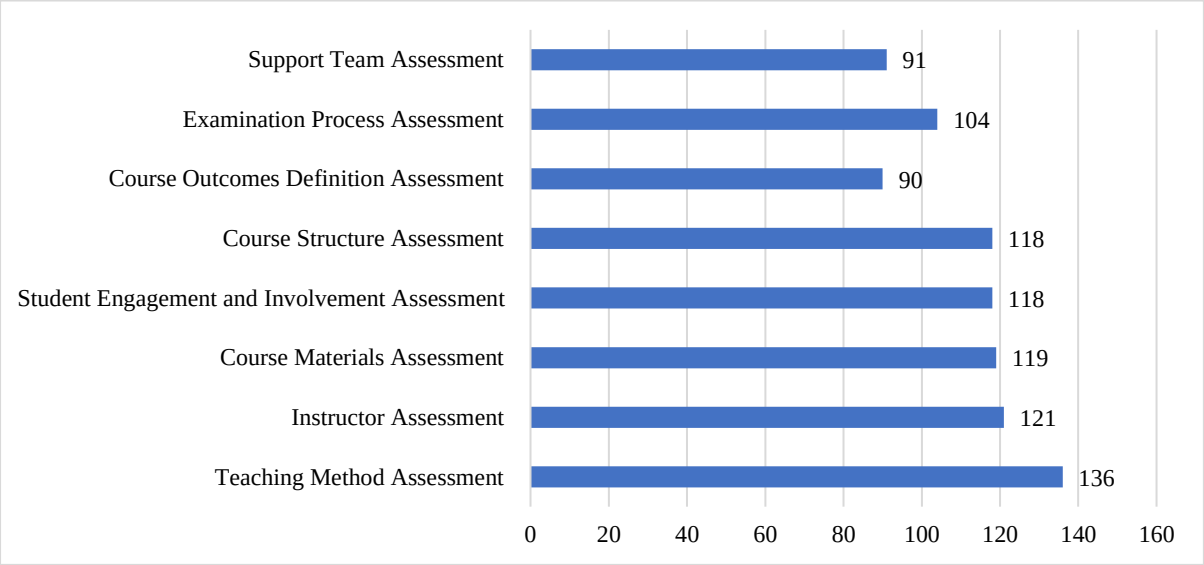

Figure 6.8: Importance of assessments as per the responders

6.3. Objective 2 – Propose a service/product that contributes to the field of training

To design feedback system, we have collected 600 samples. We presented 48 statements to the form submitters for deciding the rating of the course. The statements are:

1. Training goals and objectives were clearly stated before you started the course.
2. The course's title and description were easy to comprehend.
3. You felt confident enough before taking the course.
4. The course's sequence and flow were satisfactory.
5. You felt equally engaged in each course section.
6. There was a clear separation between the course's units.
7. You preferred more frequent assessments.
8. There were enough audio-visual contents throughout the course.
9. The quality of the content was consistent throughout the course.
10. There were enough variety in terms of course unit types.
11. The language was easy to understand.
12. The overall contents were highly engaging.
13. The reading materials was presented in an interesting way.
14. The course's content was too challenging for an average learner to understand.

15. The content was in-depth enough.
16. You liked the types of assessments used.
17. You notice any unnecessary repetitions in the content.
18. You, at some point, have to reread the content to understand it.
19. The course was easy to follow.
20. Sometimes you felt there are some lacking in the course in terms of contents or delivery.
21. The course felt too rushed.
22. The course felt too monotone.
23. The course felt too automated.
24. The course was not interactive enough.
25. The overall course delivery was satisfactory.
26. You had enough times to complete the assigned tasks, assignments and assessments.
27. The duration of the course was satisfactory.
28. All the units of the course had enough time allocated.
29. Some of the units felt rushed.
30. In the beginning, time has been spent unnecessarily.
31. The timeline of the course can be improved.
32. Your trainer showed empathy and helped you in tackling problems.
33. You felt that the trainer is an expert of the course.
34. The communication skill of the trainer was satisfactory.
35. The delivery skill of the trainer was satisfactory.
36. Your trainer responded to your queries in a timely manner.
37. You felt comfortable expressing your problems to your trainer.
38. You think your trainer was perfect for this course.
39. Earning a certificate can make you feel more driven towards a course.
40. You love when a course offer certification along with training.
41. If certified, you will share your certificate in social media (i.e., LinkedIn, Facebook etc.) and your personal website.
42. You believe that the certificate can help you get a job.
43. You will take similar course in the future if updates are added significantly.
44. So far, you're satisfied with the course outcomes.
45. You would recommend this course to others.
46. If asked, you will be able to summarize the goals and benefits of this course.
47. You think that the course materials can be improved for this course.

48. You think the learning experience can be improved.

The following figures shows the results of the survey based on frequency of answers for each of the statements.

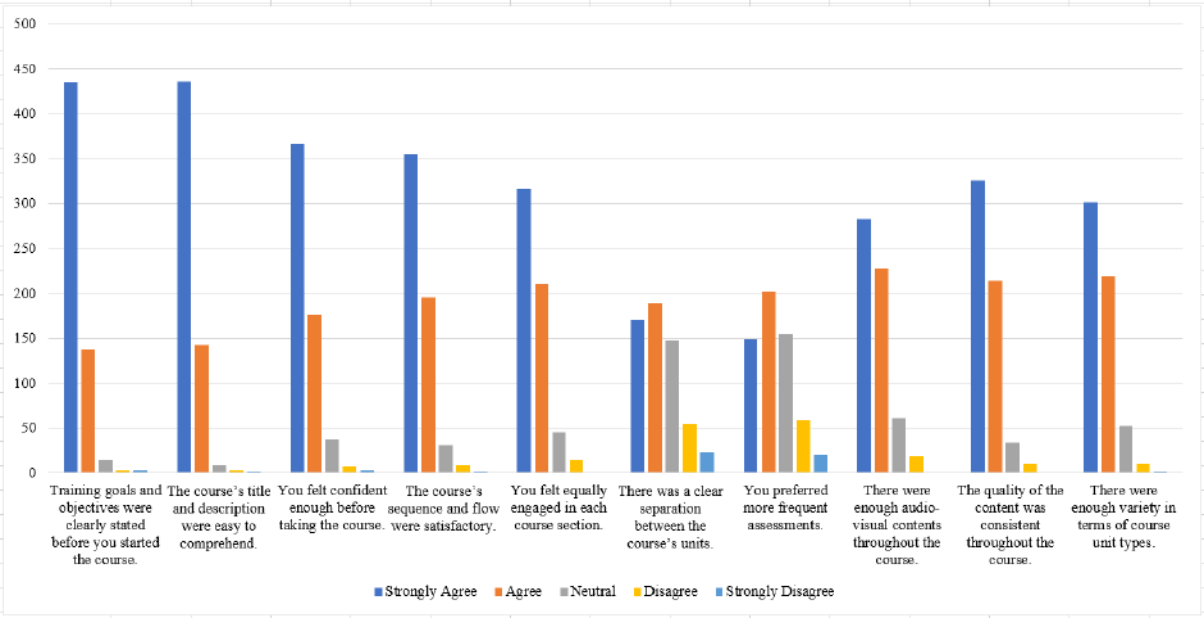

Figure 6.9: Frequency of answers for feedback statements (Part-1)

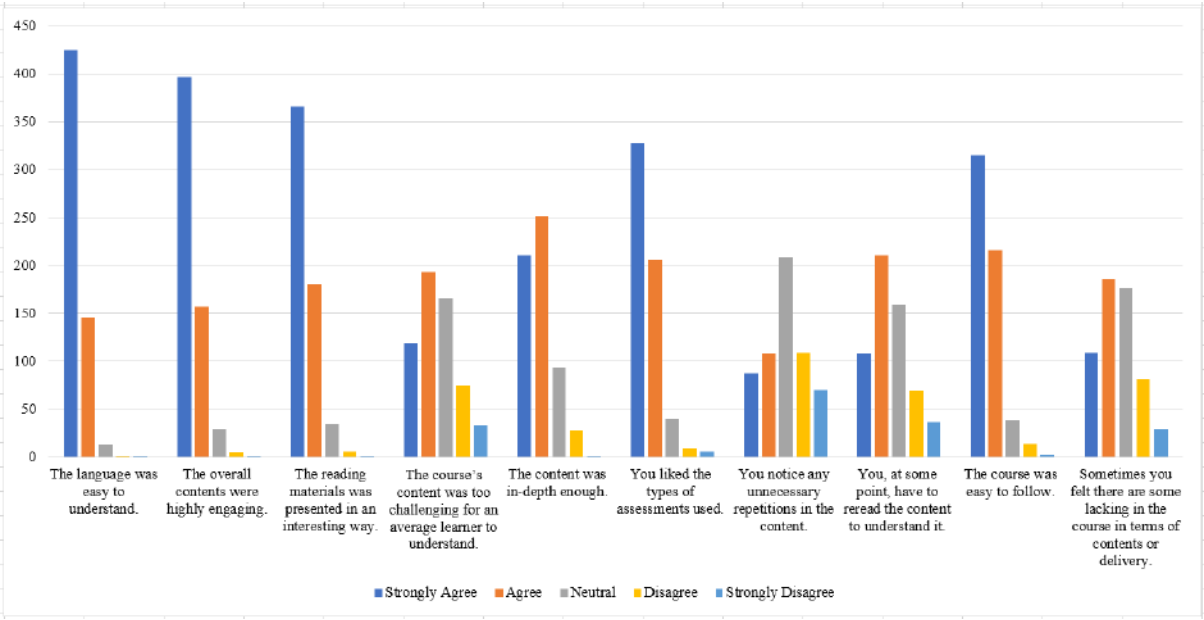

Figure 6.10: Frequency of answers for feedback statements (Part-2)

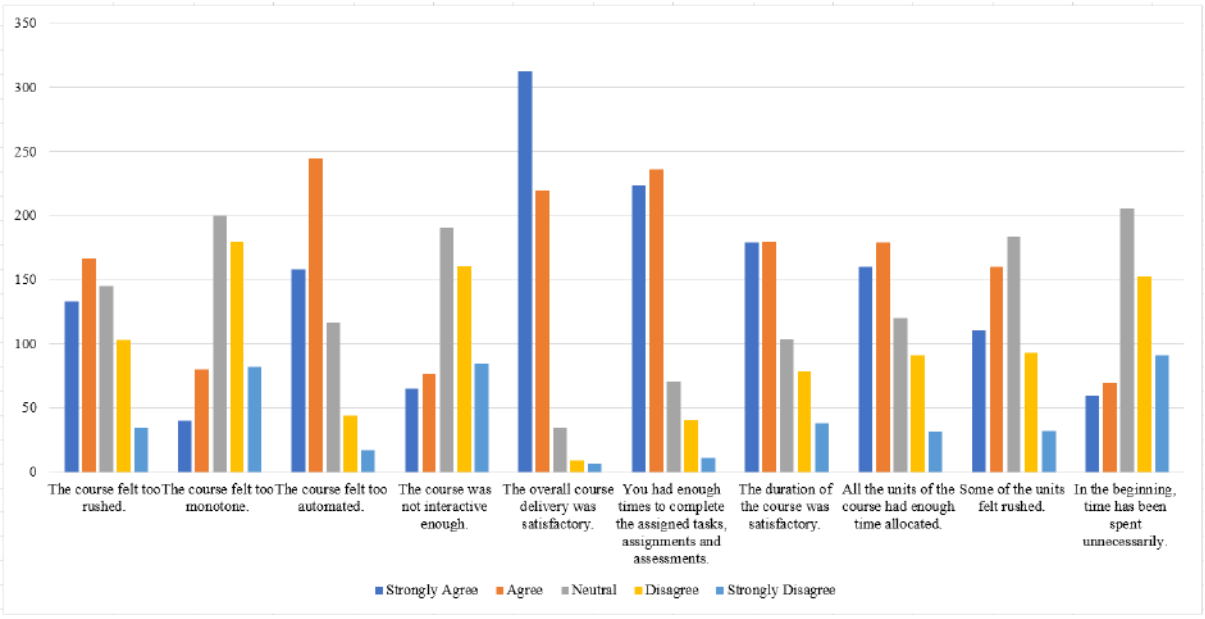

Figure 6.11: Frequency of answers for feedback statements (Part-3)

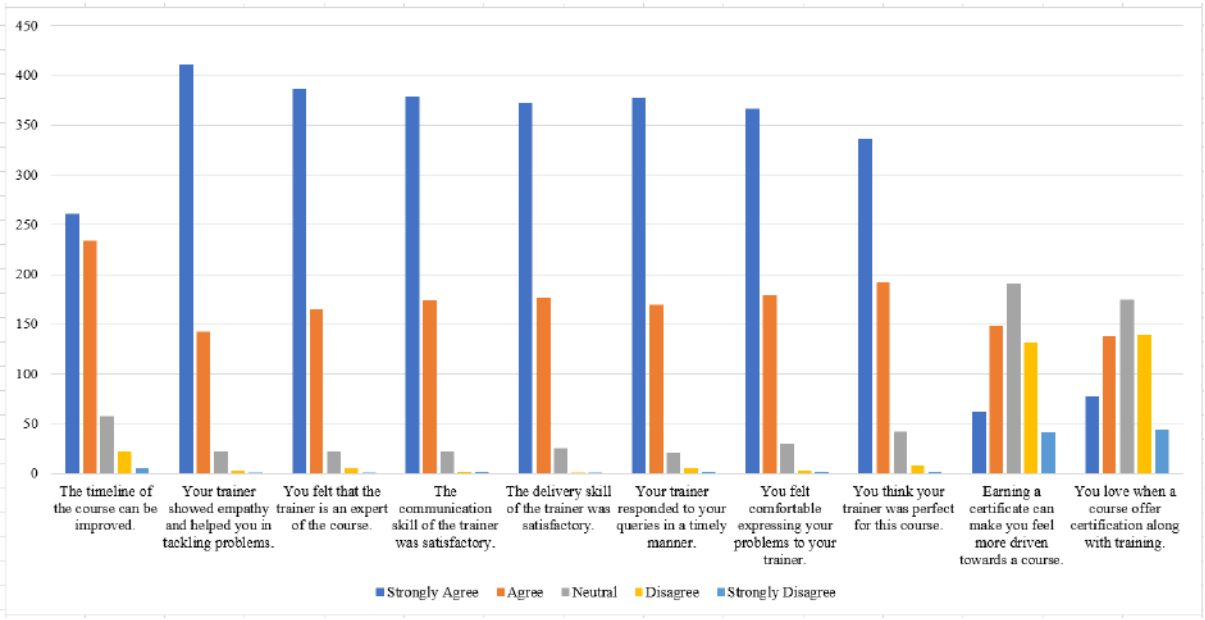

Figure 6.12: Frequency of answers for feedback statements (Part-4)

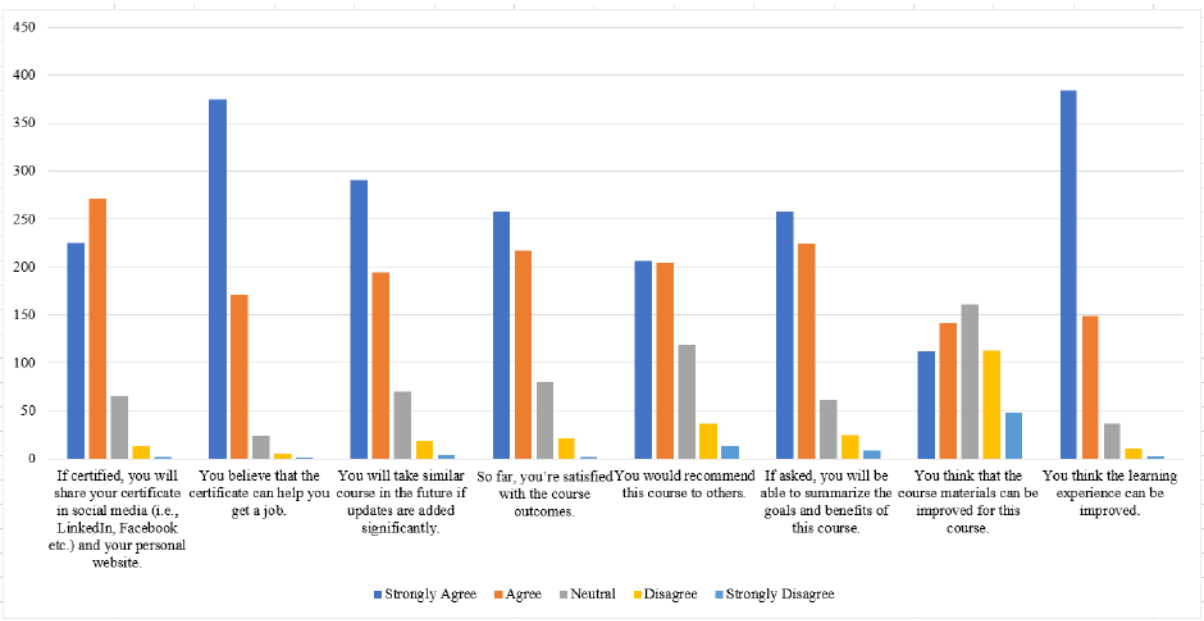

Figure 6.13: Frequency of answers for feedback statements (Part-5)

Based on the obtained data, machine learning models have been trained. The models predicted the importance of the features. Next, an algorithm has been designed to calculate the overall score for a course and based on the score the rating is calculated finally. The importance scores for the considered features are given below:

Table 6.1: Calculating weighted score for a course using feature importance score.

Criteria	Feature Importance Score	Full Score	Weighted Full Score	Sample Score	Weighted Sample Score
The course's title and description were easy to comprehend.	2	5	10	5	10
Training goals and objectives were clearly stated before you started the course.	1.95	5	9.75	4	7.8
The language was easy to understand.	1.9	5	9.5	5	9.5
Your trainer showed empathy and helped you in tackling problems.	1.85	5	9.25	4	7.4

The overall contents were highly engaging.	1.8	5	9	4	7.2
You felt that the trainer is an expert of the course.	1.75	5	8.75	4	7
You think the learning experience can be improved.	1.7	5	8.5	5	8.5
The communication skill of the trainer was satisfactory.	1.65	5	8.25	5	8.25
Your trainer responded to your queries in a timely manner.	1.6	5	8	5	8
You believe that the certificate can help you get a job.	1.55	5	7.75	5	7.75
The delivery skill of the trainer was satisfactory.	1.5	5	7.5	4	6
You felt comfortable expressing your problems to your trainer.	1.45	5	7.25	5	7.25
You felt confident enough before taking the course.	1.4	5	7	4	5.6
The reading materials was presented in an interesting way.	1.35	5	6.75	4	5.4
The course's sequence and flow were satisfactory.	1.3	5	6.5	4	5.2
You think your trainer was perfect for this course.	1.25	5	6.25	5	6.25
You liked the types of assessments used.	1.2	5	6	5	6
The quality of the content was consistent throughout the course.	1.15	5	5.75	5	5.75
You felt equally engaged in each course section.	1.1	5	5.5	5	5.5
The course was easy to follow.	1.05	5	5.25	4	4.2
The overall course delivery was satisfactory.	1	5	5	5	5

There were enough variety in terms of course unit types.	0.95	5	4.75	4	3.8
You will take similar course in the future if updates are added significantly.	0.945	5	4.725	4	3.78
There were enough audio-visual contents throughout the course.	0.94	5	4.7	4	3.76
The timeline of the course can be improved.	0.935	5	4.675	5	4.675
So far, you're satisfied with the course outcomes.	0.93	5	4.65	5	4.65
If asked, you will be able to summarize the goals and benefits of this course.	0.925	5	4.625	5	4.625
If certified, you will share your certificate in social media (i.e., LinkedIn, Facebook etc.) and your personal website.	0.92	5	4.6	5	4.6
You had enough times to complete the assigned tasks, assignments and assessments.	0.915	5	4.575	4	3.66
The content was in-depth enough.	0.91	5	4.55	5	4.55
You would recommend this course to others.	0.905	5	4.525	4	3.62
The duration of the course was satisfactory.	0.901	5	4.505	4	3.604
There was a clear separation between the course's units.	0.897	5	4.485	4	3.588
All the units of the course had enough time allocated.	0.893	5	4.465	5	4.465
The course felt too automated.	0.889	5	4.445	5	4.445
You preferred more frequent assessments.	0.885	5	4.425	5	4.425

The course felt too rushed.	0.881	5	4.405	5	4.405
The course's content was too challenging for an average learner to understand.	0.877	5	4.385	4	3.508
You think that the course materials can be improved for this course.	0.873	5	4.365	5	4.365
Some of the units felt rushed.	0.869	5	4.345	4	3.476
Sometimes you felt there are some lacking in the course in terms of contents or delivery.	0.865	5	4.325	4	3.46
You, at some point, have to reread the content to understand it.	0.861	5	4.305	4	3.444
You notice any unnecessary repetitions in the content.	0.8605	5	4.3025	5	4.3025
You love when a course offer certification along with training.	0.86	5	4.3	5	4.3
The course was not interactive enough.	0.8595	5	4.2975	5	4.2975
Earning a certificate can make you feel more driven towards a course.	0.859	5	4.295	4	3.436
In the beginning, time has been spent unnecessarily.	0.8585	5	4.2925	4	3.434
The course felt too monotone.	0.858	5	4.29	3	2.574
			278.1075		250.799

It can be seen that the total weighted score for the system is 278.1075. In the previous table, we have presented a sample test where we can see that the course has achieved 250.799 score out of 278.1075 which is equivalent to 90.18%. Therefore, now using this small module, the instructors will be able to generate the rating of the course very fast.

Moreover, an NLP based module have been designed which takes text input and generate the positivity or negativity of the text. Therefore, it can generate the status of a textual feedback – whether it is positive, negative or neutral. The following table showcases the output for different texts.

Table 6.2: Sample feedbacks about a ICT course and calculated verdict (positive, negative or neutral feedback?)

Sample Feedback	Verdict
I recently completed an ICT training course, and I must say it was an exceptional experience. The trainers were knowledgeable and approachable, making the learning process enjoyable. The course content was well-structured and covered a wide range of relevant topics. I feel confident in applying the skills I acquired to real-world scenarios. Highly recommended!	Positive
The ICT training course exceeded my expectations in every aspect. The instructors were highly skilled and passionate about their subject, which made the classes engaging and interactive. The course material was comprehensive, and the practical exercises helped solidify my understanding. The training equipped me with valuable skills that have opened up new career opportunities. I am grateful for the quality education provided.	Positive
I enrolled in an ICT training course, but I was disappointed with the overall experience. The course material lacked depth and failed to address advanced concepts. The trainers seemed unprepared and often struggled to answer our questions. The course also suffered from poor organization, with frequent schedule changes and lack of clear communication. I felt like I didn't gain the necessary skills and knowledge I was expecting from the training.	Negative

I had high hopes for the ICT training course, but unfortunately, it fell short of my expectations. The course content was outdated and didn't align with current industry practices. The trainers lacked enthusiasm, making the classes dull and uninspiring. Additionally, the course lacked practical hands-on exercises, which are crucial for skill development. I believe there is a need for significant improvements in the course structure and delivery.	Negative
The ICT training course provided a basic understanding of the subject matter. The trainers were knowledgeable, but the course lacked depth in certain areas. The content covered the fundamentals, but I feel there could have been more emphasis on practical applications. Overall, it was an average learning experience that gave me a foundation to build upon.	Neutral

6.4. Objective 3 – Impact of ICT on physical fitness and mental health of trainees

We have collected data for analyzing the importance of physical fitness and mental health for both NACTAR trainees and trainees from other organizations. Here first the results for NACTAR trainees have been presented.

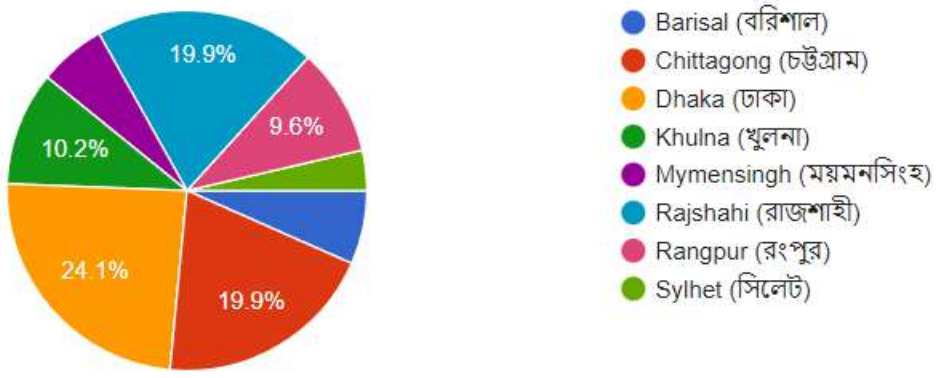

Figure 6.14: Division Distribution

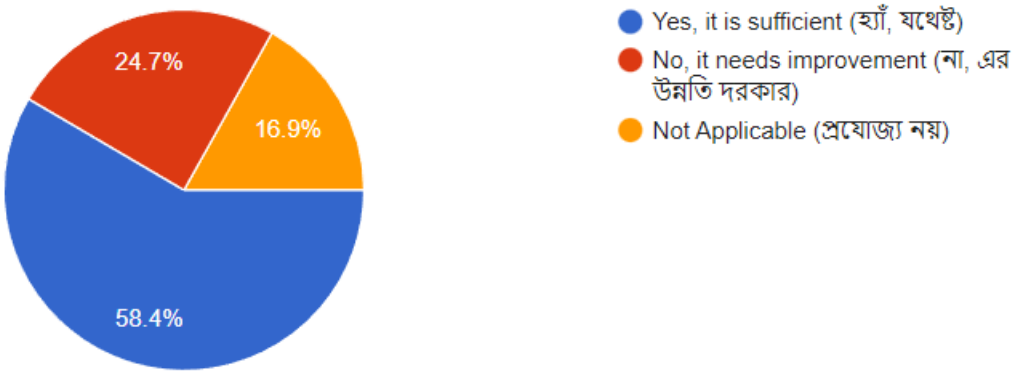

Figure 6.15: Do you feel the current training program provides enough guidance on warm-up and cool-down exercises?

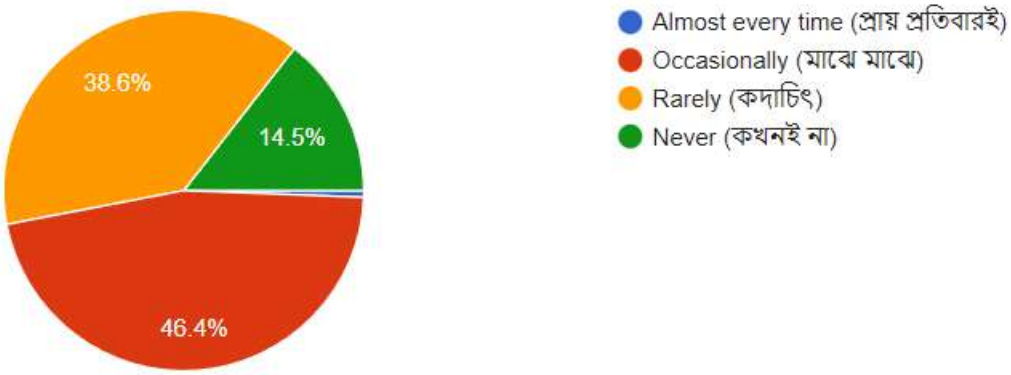

Figure 6.16: How often do you feel fatigued or drained during or after training sessions?

Figure 6.17: Have you noticed any changes in your physical stamina and endurance since starting the training program?

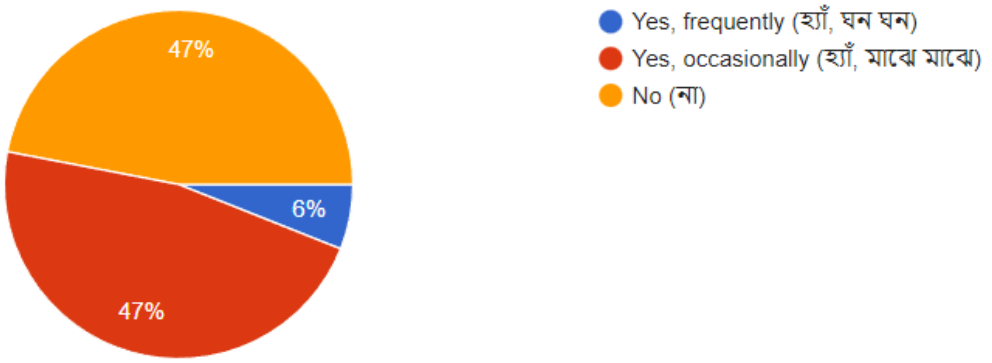

Figure 6.18: Have you noticed any muscle soreness or joint stiffness after training sessions?

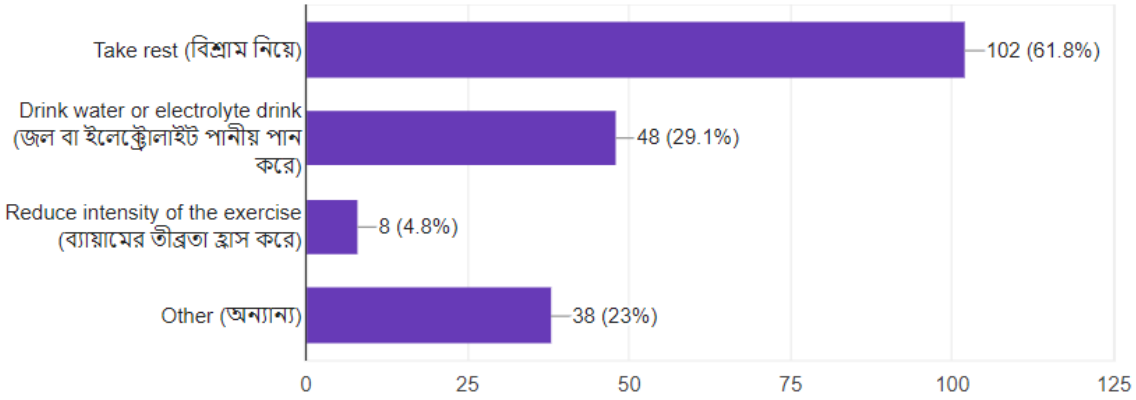

Figure 6.19: How do you manage physical exhaustion during the training program?

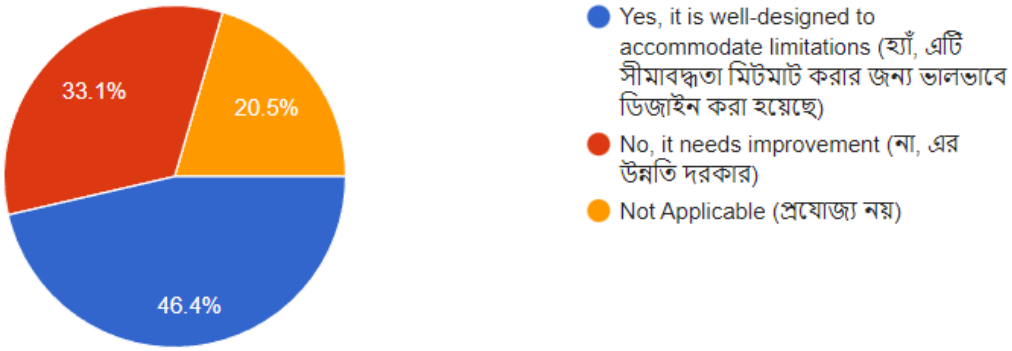

Figure 6.20: Do you feel the current training program takes into account the trainee's physical limitations, if any?

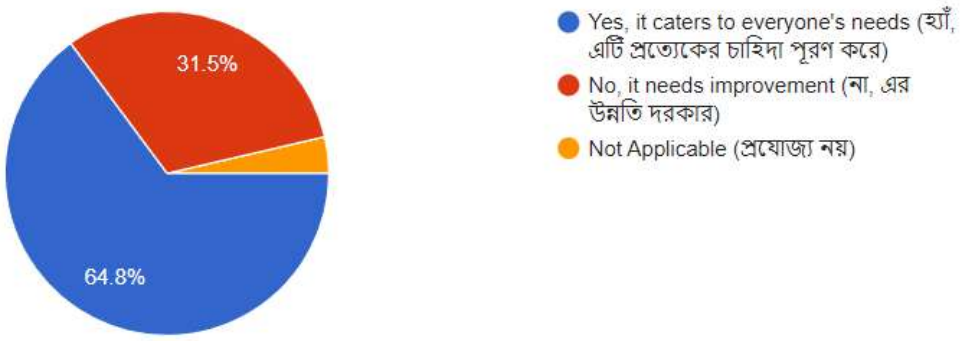

Figure 6.21: Do you feel the current training program is suitable for trainees of all fitness levels?

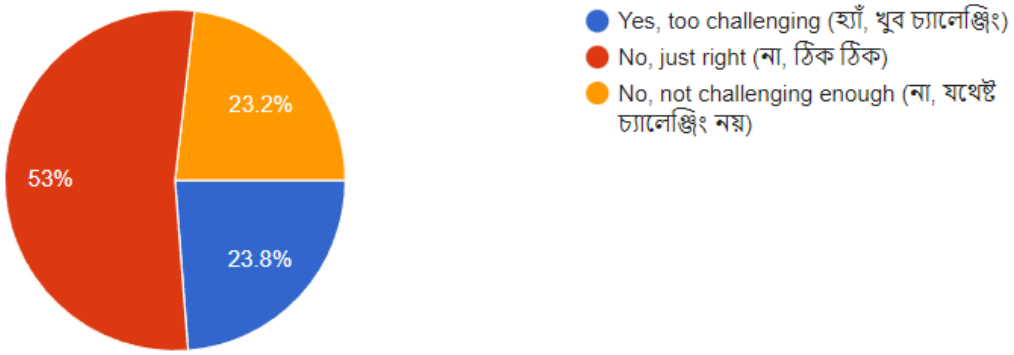

Figure 6.22: Do you feel the current training program is too strenuous or challenging for you?

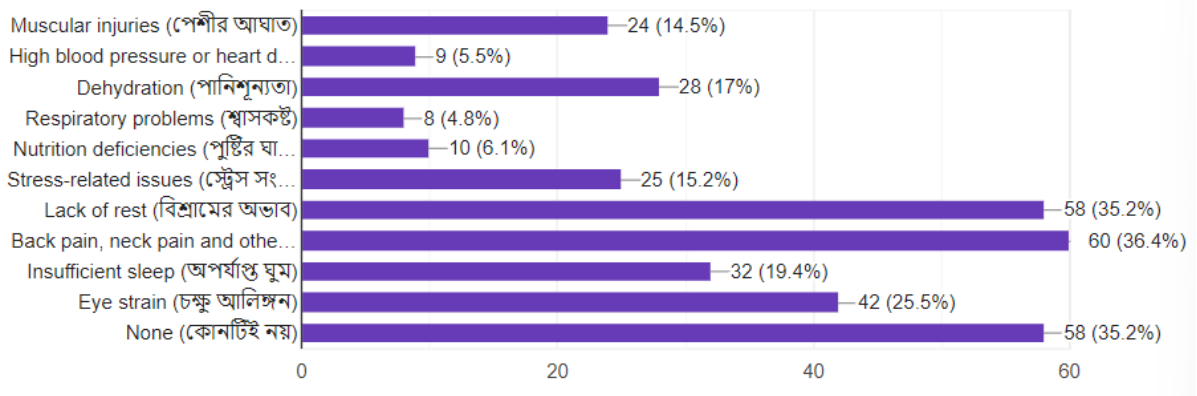

Figure 6.23: Tick the physical fitness issue that you think has been caused by the training program.

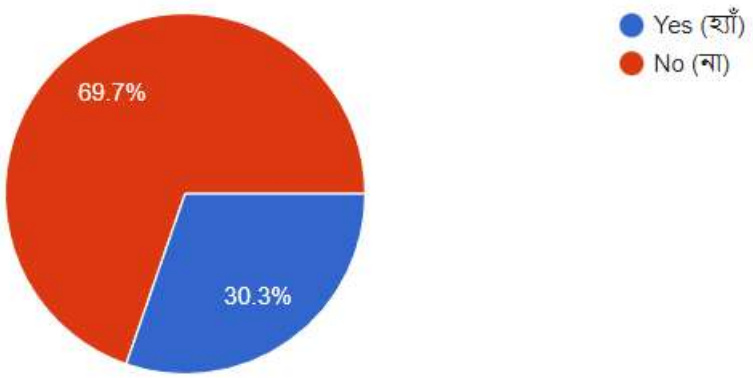

Figure 6.24: Have you experienced any stress or anxiety related to your technical training program?

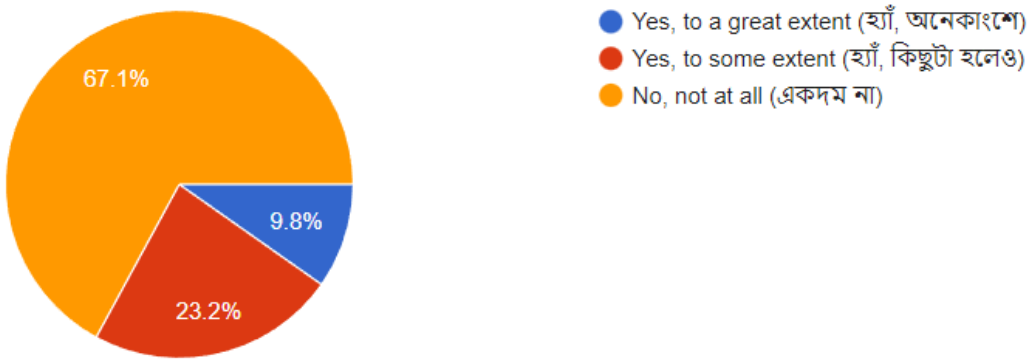

Figure 6.25: Do you feel your training program has negatively impacted your mental health?

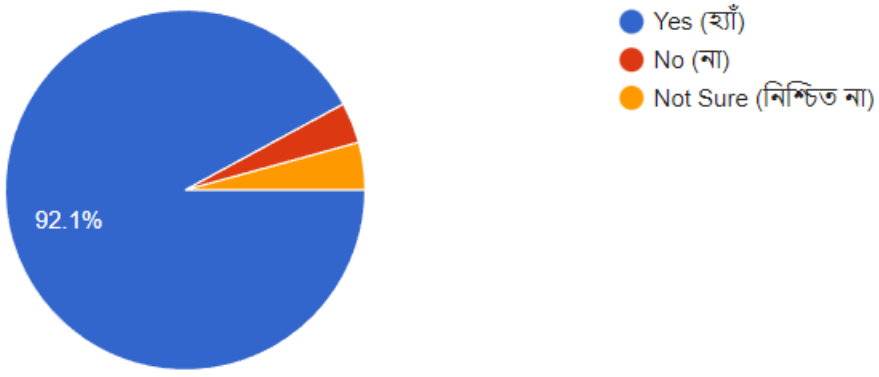

Figure 6.26: Do you feel that ICT training has improved your thinking capacity?

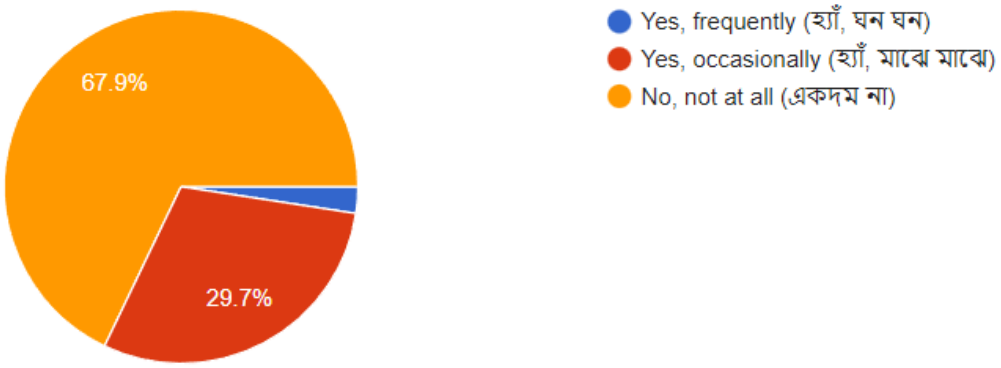

Figure 6.27: Have you felt overwhelmed by the workload and demands of the technical training program?

Figure 6.28: Have you noticed any changes in your mood or behavior since beginning the technical training program?

Figure 6.29: Do you feel that you have sufficient resources or support for addressing mental health concerns related to the training program?

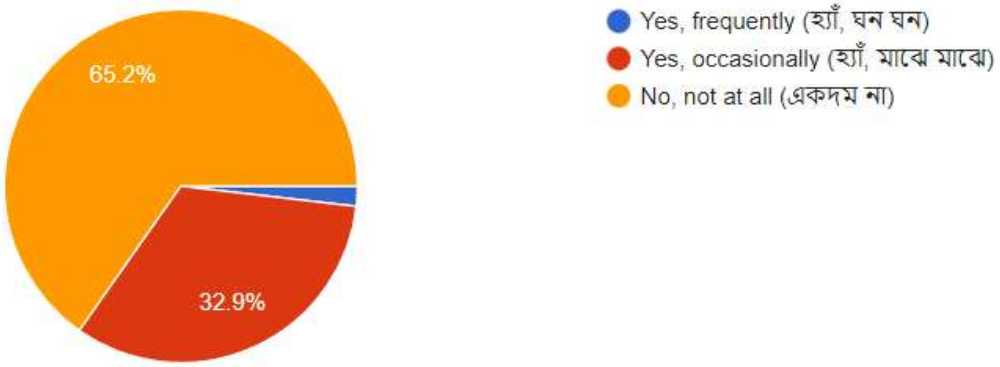

Figure 6.30: Have you ever felt isolated or unsupported during your technical training program?

Figure 6.31: Have you ever sought professional help or counseling for mental health concerns related to your technical training program?

Next, the outcomes for the trainees of other institutions have been presented.

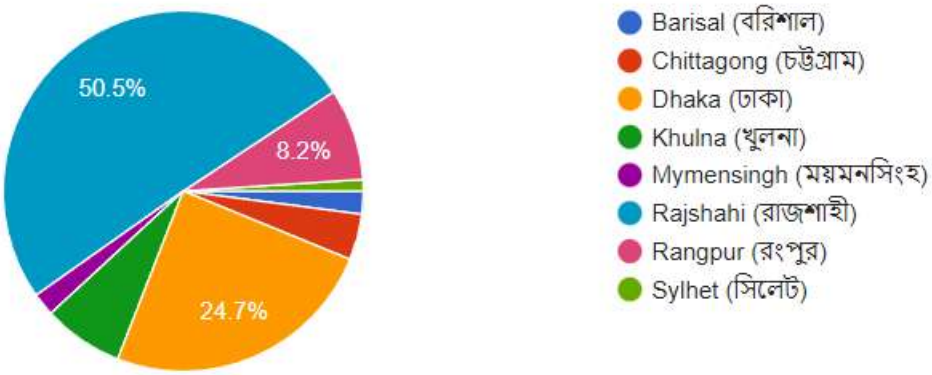

Figure 6.32: District Distribution

Figure 6.33: Do you feel the current training program provides enough guidance on warm-up and cool-down exercises?

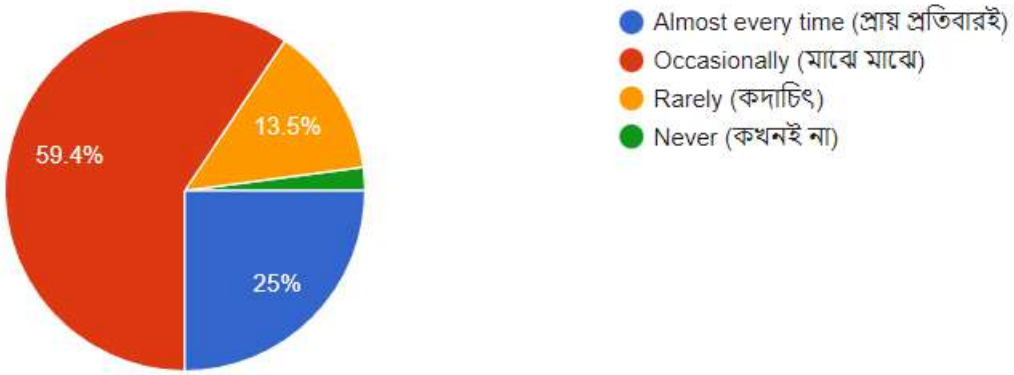

Figure 6.34: How often do you feel fatigued or drained during or after training sessions?

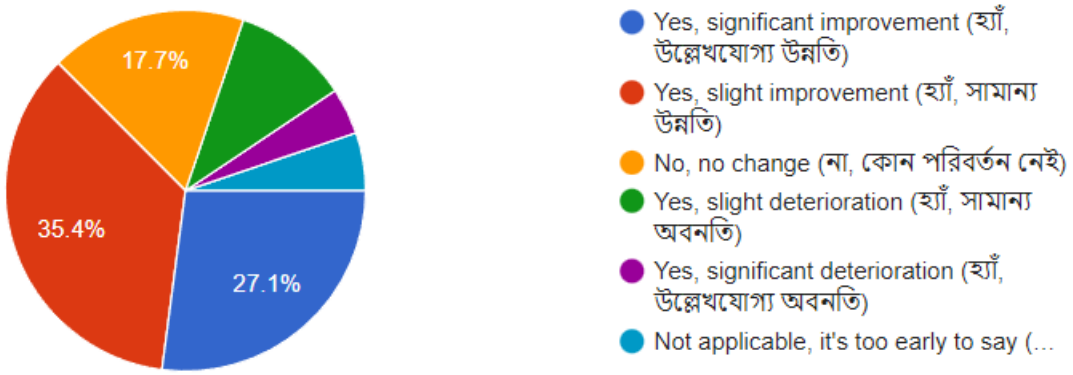

Figure 6.35: Have you noticed any changes in your physical stamina and endurance since starting the training program?

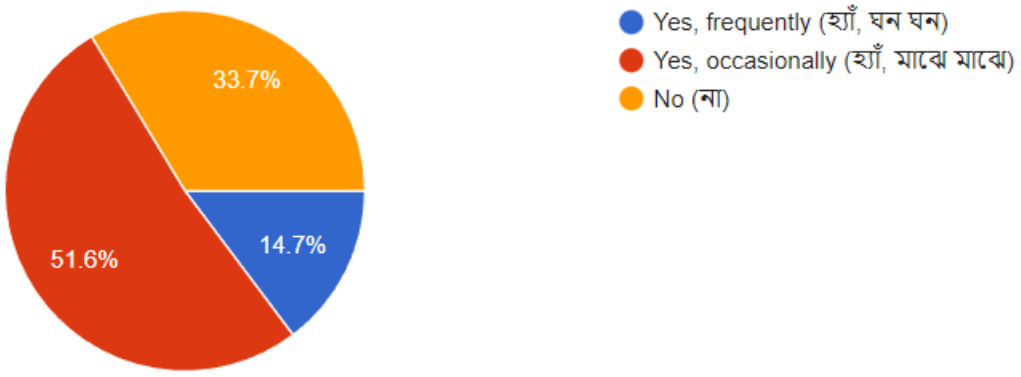

Figure 6.36: Have you noticed any muscle soreness or joint stiffness after training sessions?

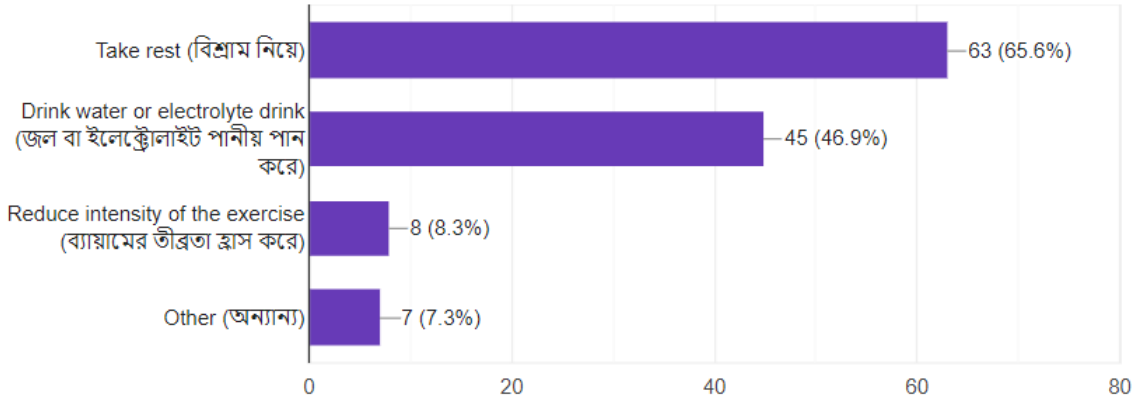

Figure 6.37: How do you manage physical exhaustion during the training program?

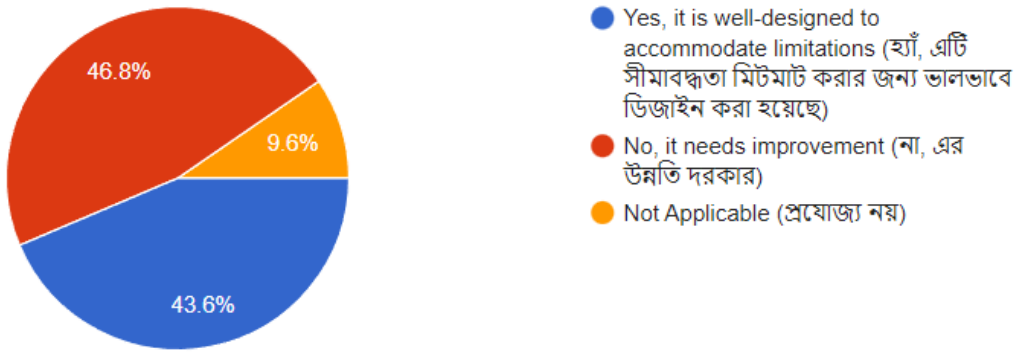

Figure 6.38: Do you feel the current training program takes into account the trainee's physical limitations, if any?

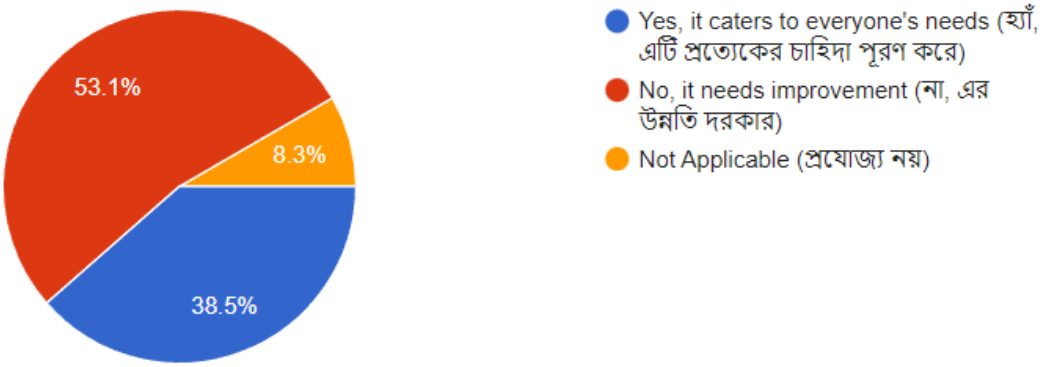

Figure 6.39: Do you feel the current training program is suitable for trainees of all fitness levels?

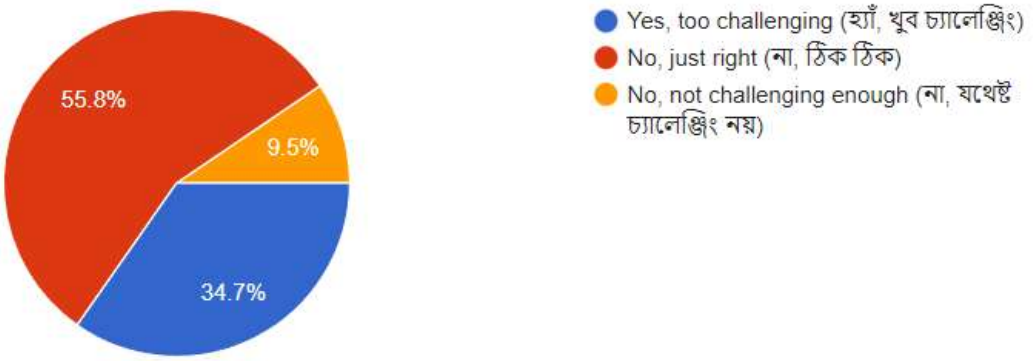

Figure 6.40: Do you feel the current training program is too strenuous or challenging for you?

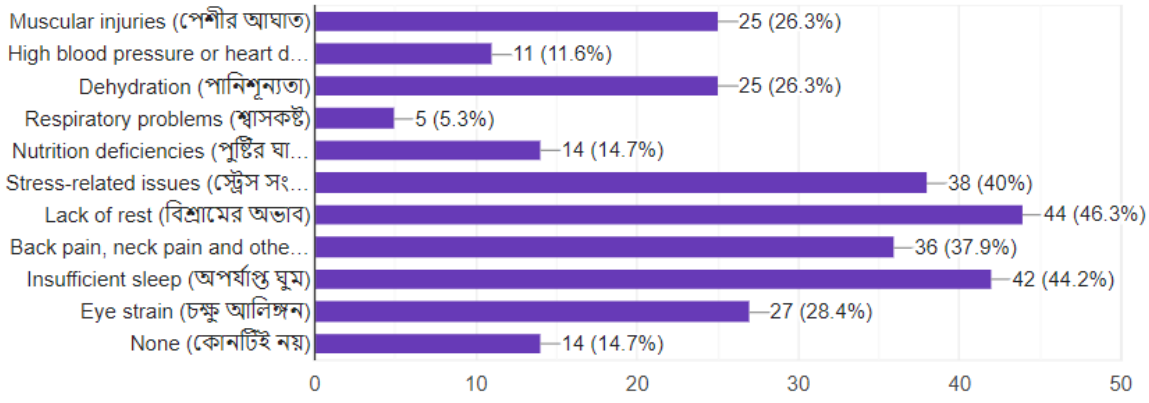

Figure 6.41: Tick the physical fitness issue that you think has been caused by the training program.

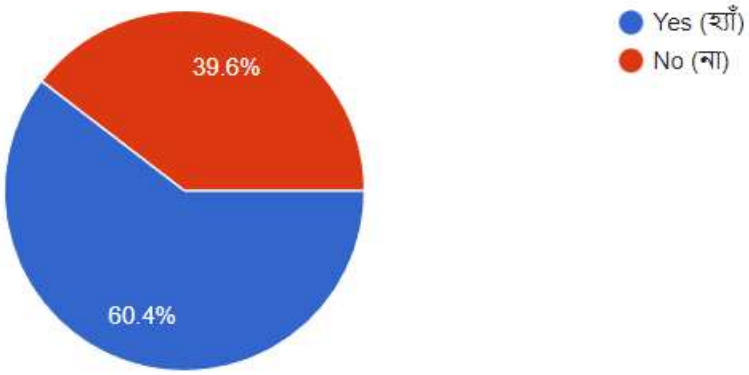

Figure 6.42: Have you experienced any stress or anxiety related to your technical training program?

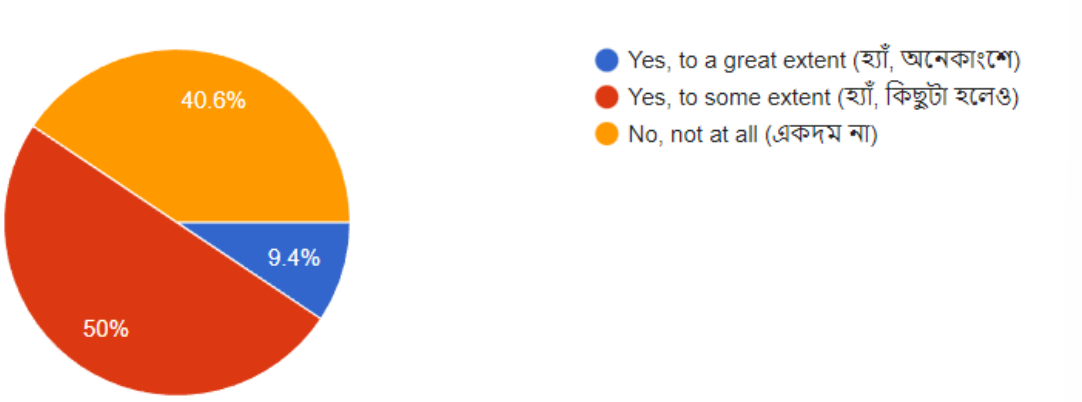

Figure 6.43: Do you feel your training program has negatively impacted your mental health?

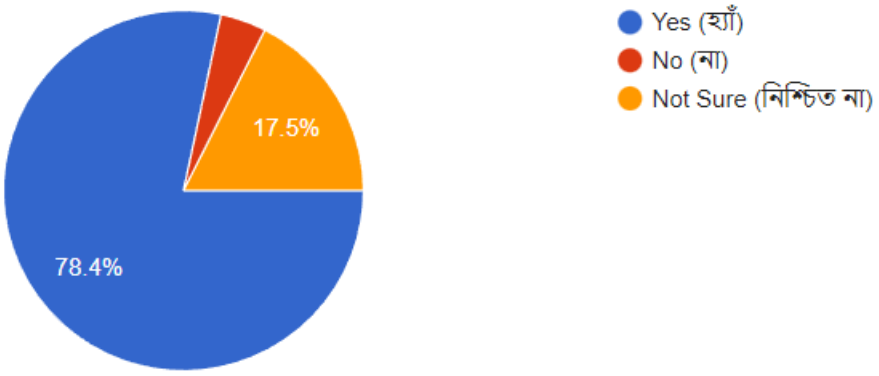

Figure 6.44: Do you feel that ICT training has improved your thinking capacity?

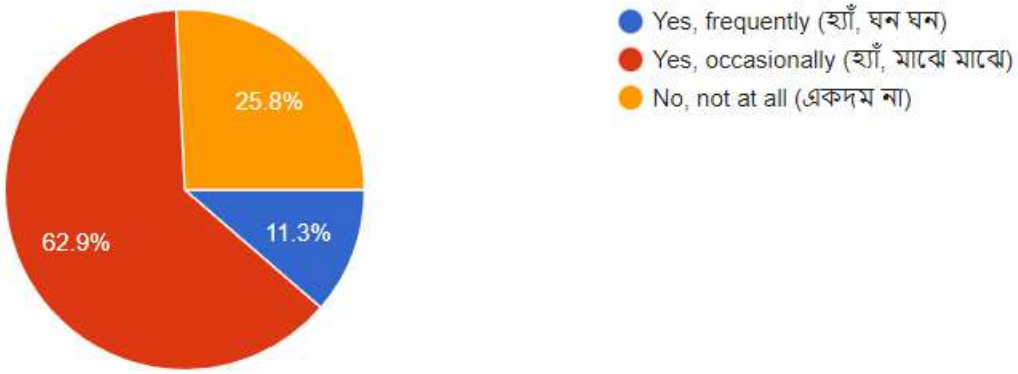

Figure 6.45: Have you felt overwhelmed by the workload and demands of the technical training program?

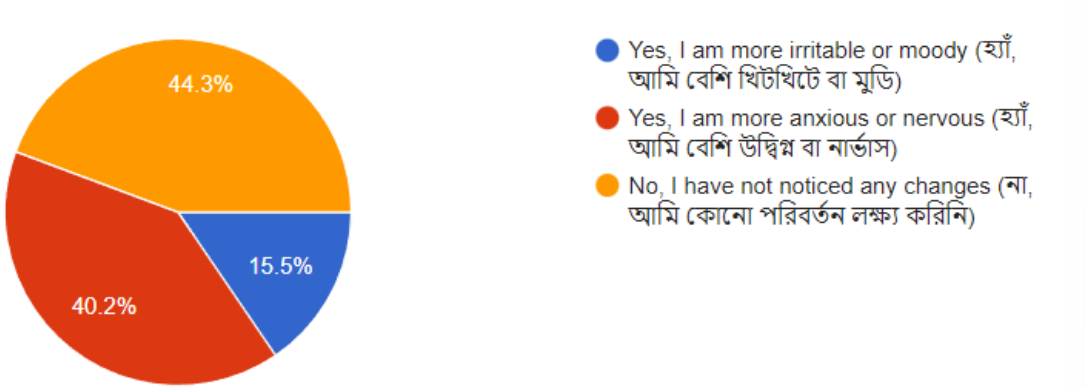

Figure 6.46: Have you noticed any changes in your mood or behavior since beginning the technical training program?

Figure 6.47: Do you feel that you have sufficient resources or support for addressing mental health concerns related to the training program?

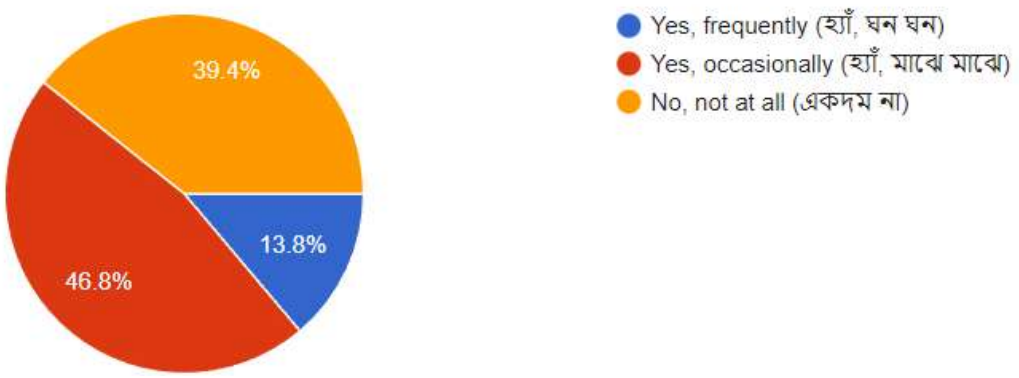

Figure 6.48: Have you ever felt isolated or unsupported during your technical training program?

Figure 6.49: Have you ever sought professional help or counseling for mental health concerns related to your technical training program?

6.5. Objective 4 – Solution of a problem related to Bengali language and Bangladesh

We asked the responders some questions related to language barrier. The survey was done for both NACTAR trainees and trainees of other institutions. First, the outcomes for the NACTAR trainees have been showcased.

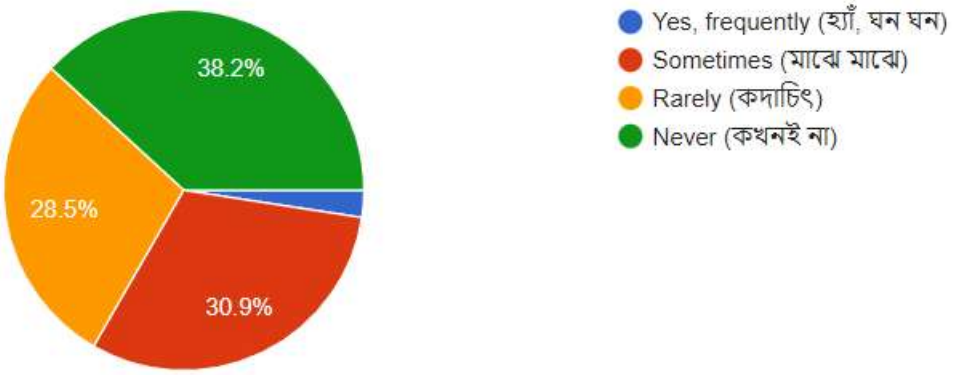

Figure 6.50: Do you face difficulties in understanding technical terms in English language?

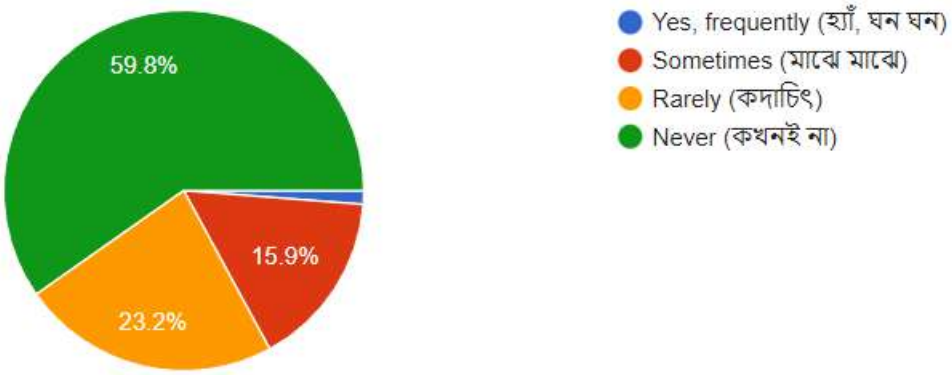

Figure 6.51: Have you faced any communication gap with your trainer because of the English language barrier?

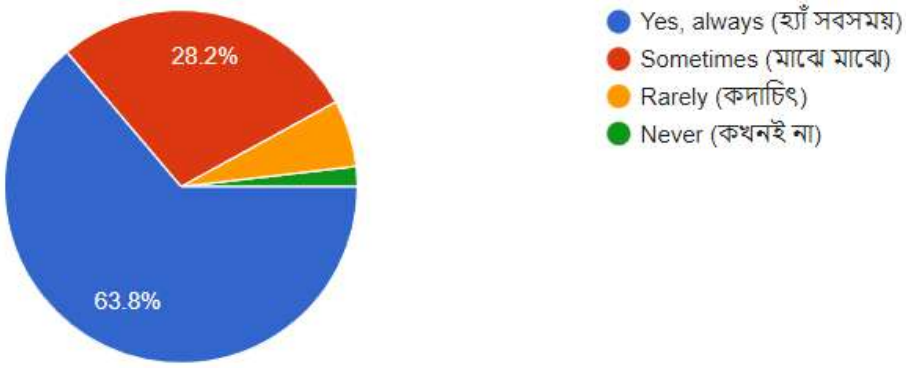

Figure 6.52: Do you feel confident in asking questions related to technical concepts in English language during the training sessions?

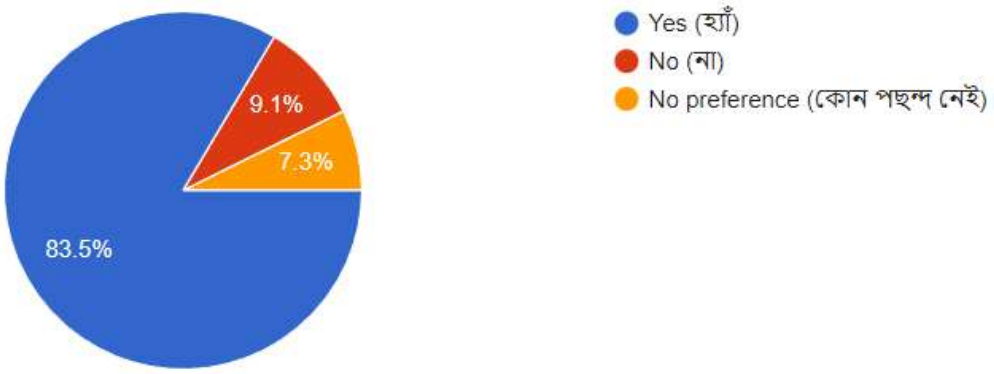

Figure 6.53: Do you think training materials should be provided in both Bengali and English languages?

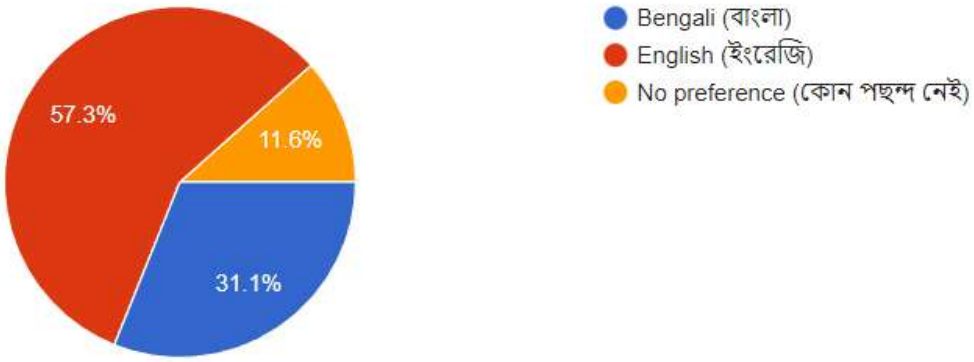

Figure 6.54: Do you prefer learning technical terms in Bengali or English language?

Next, the outcomes for the survey on trainees from other institutions have been presented.

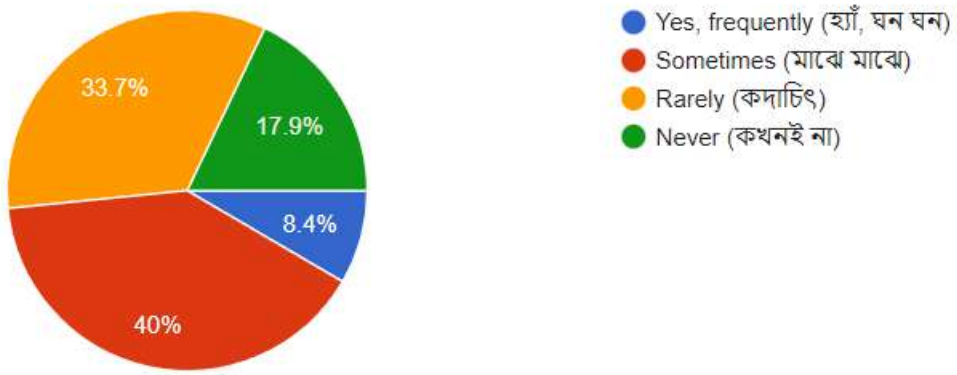

Figure 6.55: Do you face difficulties in understanding technical terms in English language?

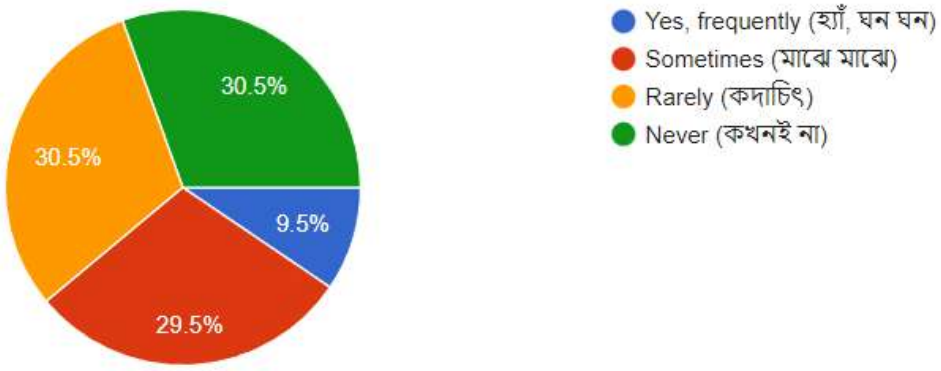

Figure 6.56: Have you faced any communication gap with your trainer because of the English language barrier?

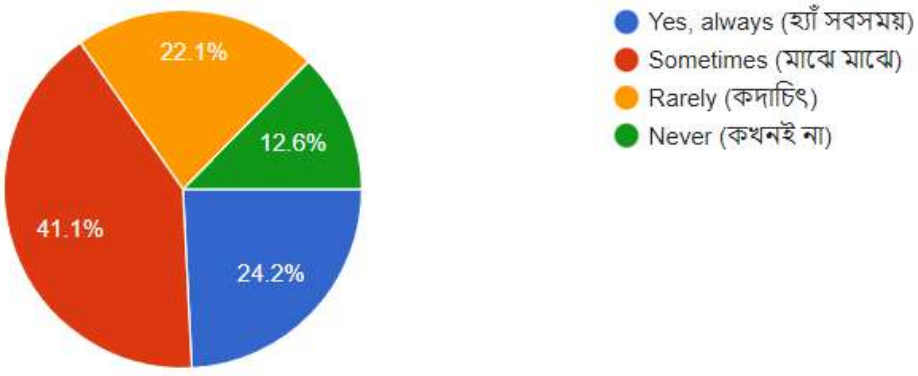

Figure 6.57: Do you feel confident in asking questions related to technical concepts in English language during the training sessions?

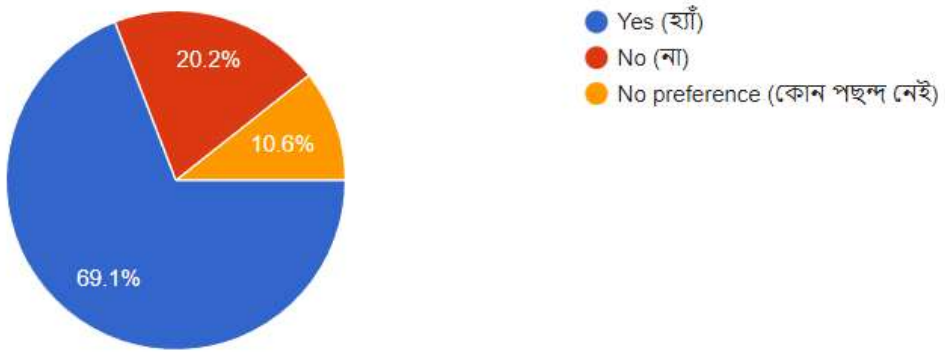

Figure 6.58: Do you think training materials should be provided in both Bengali and English languages?

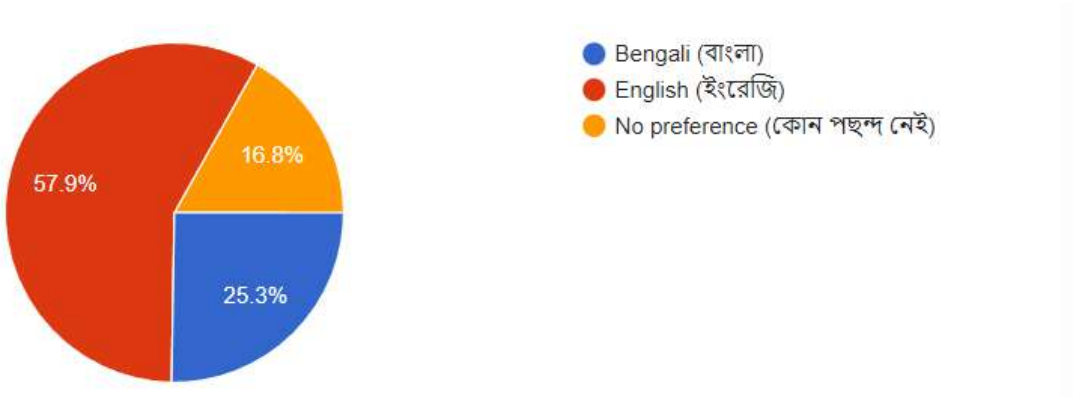

Figure 6.59: Do you prefer learning technical terms in Bengali or English language?

6.6. Objective 5 – Offering a useful service in everyday life

Here, we have introduced an outcome-based education system. In this system, the instructor will set some course outcomes. Each assessment will be connected to particular course outcome. Therefore, at the end of the course, instructor will be able to calculate the overall growth based on course outcomes. An example excel sheet is shared here:

https://docs.google.com/spreadsheets/d/1qitHImLqyVn8_ivM50HU7Y4gEhBucT77/edit?usp=sharing&ouid=106213424051111310369&rtpof=true&sd=true

6.7. Objective 6 – Innovative initiatives in domains of Machine Learning, Deep Learning, Data Mining, Natural Language Processing and Bio-engineering

We are suggesting the following recommendations:

1. The need of the domains of machine learning, deep learning, data mining, natural language processing and bio-engineering is prominent now. Therefore, courses related to such domains should be introduced.
2. Based on the data collected it can be seen that majority of the participants of NACTAR does not suffer from any physical or mental health issues due to training in comparison to other institutions – it's a very good news. However, to prevent any issues as mentioned by some participants, there should be some safety measures and exercise hours for the participants.
3. Mental health is becoming more and more important nowadays due to extreme stress and emotional manipulation in various layers. Therefore, initiative to integrate professional psychiatrist treatment should be introduced in NACTAR.
4. We have provided an excel sheet that can automatically calculate student's assessment. It will help NACTAR instructors to quickly calculate grades and monitor individual assessment easily.
5. We encourage all instructors to take feedback from the trainees and calculate the total score of the course as mentioned in the process.
6. Finally, the language barrier should be addressed. If some seminars and weekly spoken session among trainees can be arranged, it would be helpful.

6.6. Conclusion

In this chapter, we discussed about the collected datasets and showed all experimental results. Finally, we presented all the results and recommendations as well.

Chapter-7

Research Timeline and Budget

Introduction

Research Timeline

Budget

Work Breakdown Structure (WBS)

Conclusion

7.1. Introduction

In this chapter, we have discussed on the research timeline, budget and work breakdown structure with proper illustration.

7.2. Research Timeline

As per the research conditions of NACTAR, the research needs to be conducted within 45 days. To distribute the workload efficiently, the period of 45 days has been divided into 9 modules where each module has 5 days in it. Based on this calculation, the following Gantt chart has been prepared:

Sl.	Research Activities	Modules (5 days per one module)								
		1	2	3	4	5	6	7	8	9
1.	Monitor and Control all of the Project Activities									
2.	Seminar with Stockholders									
3.	Project Planning and Prepare Inception Report									
4.	Questionnaires Preparation for both Surveys and Interviews									
5.	Online and Offline Surveys									
6.	Conduct Interviews									
7.	Data Entry and Data Preprocessing									
8.	Data Analysis									
9.	Seminars with Stakeholders									
10.	Draft Report Writing									
11.	Final Report and Research Papers Preparation and Submission									

7.3. Budget

The budget of the research is given below: ***(Including all VAT and taxes)***

Sl.	Cost Criteria	Cost
1.	Honorarium of Principal Researcher	80,000/-
2.	Honorarium of Assistant Researcher	50,000/-

3.	Data Collection Cost (Surveys, Interviews)	30,000/-
4.	Data Entry and Data Analysis Cost	20,000/-
5.	Stationary Cost	10,000/-
6.	Documents/Material Collection Cost	20,000/-
7.	Draft Report Preparation and Printing Cost	15,000/-
8.	Seminar Cost	50,000/-
9.	Traveling Cost	20,000/-
10.	Miscellaneous	5,000/-
Total Cost		3,00,000/-
In word: Three Lac Taka Only		

7.4. Work Breakdown Structure (WBS)

Work Breakdown Structure (WBS) is a project management tool used to break down a large project into smaller and more manageable components. The purpose of WBS is to provide a clear and organized overview of the work required to complete a project successfully. It serves as a roadmap for the project team, breaking down the project into smaller tasks, and helping to ensure that all important tasks are accounted for and completed in a timely manner.

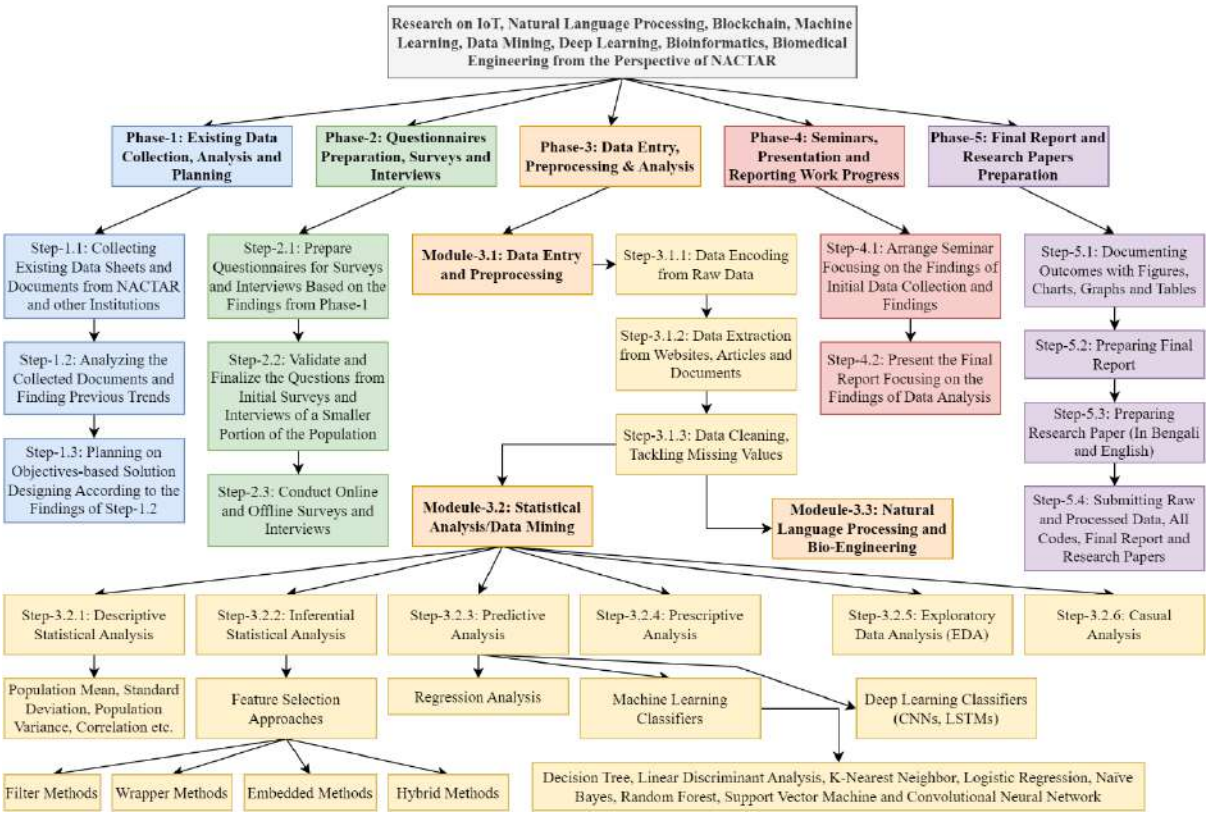

Figure 12: Work Breakdown Structure.

The WBS is typically organized in a hierarchical structure, starting with the main project goal at the top and breaking it down into smaller, more specific tasks at the lower levels. The WBS can be visualized as a tree, with each branch representing a different aspect of the project. By breaking down the project into smaller tasks, the WBS helps to identify dependencies and interrelationships between different parts of the project, making it easier to plan and manage the project effectively.

WBS is also a valuable tool for identifying potential risks and roadblocks, allowing project managers to anticipate and mitigate them before they occur. In addition, the WBS provides a clear understanding of the work required to complete a project and helps to ensure that everyone involved in the project is working towards the same goal. Figure 12 illustrates the work breakdown structure (WBS) of the proposed study.

7.5. Conclusion

In this chapter, we illustrated our planning through work breakdown structure and presented the financial information along with research timeline.

Chapter-8

Conclusion

Limitations of the Study

Conclusion and Future Works

8.1. Limitations of the Study

No research can be done without limitation. This research also has some drawbacks:

a) The dataset was formed based on the data collected from the participants. It should bear in mind that participants needed to recall their memories and answer the questionnaires on surveys and interviews. Thus, the answers to the questions are crucial and there's always a chance of getting some outliers that can affect the different sectors of data analysis.

b) The participants needed to be honest while answering the questions of surveys and interviews as the faulty answers will negatively impact the data analysis part. There are several methods to find out if an answer is faulty but there is always a 1% chance where a participant may convince the surveyor or interviewer with the faulty answer.

8.2. Conclusion and Future Works

To lead the 4th Industrial Revolution (4IR) and to achieve the Sustainable Development Goals (SDGs), integrating ICT in every section is important for an emerging country like Bangladesh. Such research projects like NACTAR's will facilitate to achieve the Vision 2041 definitely. In this research work, we will start by focusing on the 6 objectives, collect data based on the objectives and analyze the data to find fruitful outcomes by applying cutting-edge technologies such as machine learning, data mining, deep learning, feature engineering, natural language processing, bio-engineering and so on. We believe like our previous research; this research will have a high impact on the development of both NACTAR and Bangladesh.

References

[1] Al-Achi, A. (2019). The student's t-test: a brief description. *Research & Reviews: Journal of Hospital and Clinical Pharmacy*, *5*(1), 1.

[2] Albawi, S., Mohammed, T. A., & Al-Zawi, S. (2017, August). Understanding of a convolutional neural network. In *2017 International Conference on Engineering and Technology (ICET)* (pp. 1-6). Ieee.

[3] Assembly, G. (2015). Sustainable development goals. *SDGs Transform Our World, 2030*.

[4] Bangladesh Sangbad Sangstha(2013)Information technology to contribute 7.28 percent to GDP by 2021". *Bangladesh Sangbad Sangstha.*

[5] Bingham, C., Arbogast, B., Guillaume, G. C., Lee, J. K., &Halberg, F. (1982). Inferential statistical methods for estimating and comparing cosinor parameters. *Chronobiologia*.

[6] Bos, J. W., Lauter, K., &Naehrig, M. (2014). Private predictive analysis on encrypted medical data. *Journal of biomedical informatics*, *50*, 234-243.

[7] Carnoy, M. (2004). ICT in education: Possibilities and challenges. *Inaugural Lecture of the UOC, 2005*.

[8] Cuevas, A., Febrero, M., &Fraiman, R. (2004). An anova test for functional data. *Computational statistics & data analysis*, *47*(1), 111-122.

[9] El Aboudi, N., &Benhlima, L. (2016, September). Review on wrapper feature selection approaches. In *2016 International Conference on Engineering & MIS (ICEMIS)* (pp. 1-5). IEEE.

[10] Fagerland, M. W., & Sandvik, L. (2009). The wilcoxon–mann–whitney test under scrutiny. *Statistics in medicine*, *28*(10), 1487-1497.

[11] Fiet, J. O. (2007). A prescriptive analysis of search and discovery. *Journal of Management Studies*, *44*(4), 592-611.

[12] Freund, R. J., Wilson, W. J., & Sa, P. (2006). *Regression analysis*. Elsevier.

[13] Goasduff, L. (2012). Gartner Identifies Top 30 Countries for Offshore Services in 2010-2011.[Online]. Gartner.

[14] Hafner, A. W. (1998). *Descriptive statistical techniques for librarians*. ALA Editions, American Library Association, 155 North Wacker Dr., Chicago, IL 60606-1719 (ALA members: $49.50; nonmembers: $55).

[15] Heise, D. R. (1975). *Causal analysis*. John Wiley & Sons.

[16] IMF. (2019). Real GDP growth: annual percent change.

[17] Izenman, A. J. (2013). Linear discriminant analysis. In *Modern multivariate statistical techniques* (pp. 237-280). Springer, New York, NY.

[18] Karim, H. N. (2010). Bangladesh IT industry going global. *The Daily Star*, *6*.

[19] Lin, K. C., & Wei, Y. C. (2011, July). Online interactive game-based learning in high school history education: impact on educational effectiveness and student motivation. In *2011 Fourth International Conference on Ubi-Media Computing* (pp. 265-268). IEEE.

[20] Marquardt, D. W., &Snee, R. D. (1975). Ridge regression in practice. *The American Statistician*, *29*(1), 3-20.

[21] McHugh, M. L. (2013). The chi-square test of independence. *Biochemia medica*, *23*(2), 143-149.

[22] Myles, A. J., Feudale, R. N., Liu, Y., Woody, N. A., & Brown, S. D. (2004). An introduction to decision tree modeling. *Journal of Chemometrics: A Journal of the Chemometrics Society*, *18*(6), 275-285.

[23] National Education Policy. (2010). Link: https://moedu.gov.bd/site/page/318a22d2-b400-48a7-8222-303ab11cc205/National-Education-Policy-2010-

[24] Noble, W. S. (2006). What is a support vector machine?. *Nature biotechnology*, *24*(12), 1565-1567.

[25] Norris, P. (2001). *Digital divide: Civic engagement, information poverty, and the Internet worldwide*. Cambridge university press.

[26] Peterson, L. E. (2009). K-nearest neighbor. *Scholarpedia*, *4*(2), 1883.

[27] Radovic, M., Ghalwash, M., Filipovic, N., &Obradovic, Z. (2017). Minimum redundancy maximum relevance feature selection approach for temporal gene expression data. *BMC bioinformatics*, *18*(1), 1-14.

[28] Ranstam, J., & Cook, J. A. (2018). LASSO regression. *Journal of British Surgery*, *105*(10), 1348-1348.

[29] Riaz, A., & Rahman, M. S. (Eds.). (2016). *Routledge Handbook of Contemporary Bangladesh*. Routledge.

[30] Rigatti, S. J. (2017). Random forest. *Journal of Insurance Medicine*, *47*(1), 31-39.

[31] Sedgwick, P. (2012). Pearson's correlation coefficient. *Bmj*, *345*.

[32] Sedgwick, P. (2014). Spearman's rank correlation coefficient. *Bmj*, *349*.

[33] Semenov, A., &Resta, P. (2002). Information and communication technologies in teacher education. A planning guide. *UNESCO, Paris*, *235*.

[34] Latifee, & Hossain, Enamul Hafiz, Md. Sajib (14 March 2018). "ICT industry thriving, needs reform". *The Financial Express*.

[35] Tukey, J. W. (1977). *Exploratory data analysis* (Vol. 2, pp. 131-160).

[36] Upton, G. J. (1992). Fisher's exact test. *Journal of the Royal Statistical Society: Series A (Statistics in Society)*, *155*(3), 395-402.

[37] Vargha, A., & Delaney, H. D. (1998). The Kruskal-Wallis test and stochastic homogeneity. *Journal of Educational and behavioral Statistics*, *23*(2), 170-192.

[38] Webb, G. I., Keogh, E., & Miikkulainen, R. (2010). Naïve Bayes. *Encyclopedia of machine learning*, *15*, 713-714.

[39] Wright, R. E. (1995). Logistic regression.

আইসিটি সম্পৃক্ত অনলাইন বা অফলাইন কোর্স সংক্রান্ত সমীক্ষা ২০২৩

Targeted Objectives (টার্গেটেড উদ্দেশ্য):
Objective-3: Impact of ICT on physical fitness and mental health of trainees
(**উদ্দেশ্য-৩:** প্রশিক্ষণার্থীদের শারীরিক সুস্থতা ও মানসিক স্বাস্থ্যের উপর আইসিটির প্রভাব)
Objective-4: Solution of a problem related to Bengali language and Bangladesh
(**উদ্দেশ্য-৪:** বাংলা ভাষা ও বাংলাদেশ সম্পর্কিত সমস্যার সমাধান)

You can fill this form in either Bangla or English. However, English is preferred. (আপনি এই ফর্মটি বাংলা বা ইংরেজিতে পূরণ করতে পারেন। তবে ইংরেজিকে অগ্রাধিকার দেওয়া হচ্ছে।)

Each response will take about 5/6 minutes max to complete. So, please take 5/6 minutes in hand before starting to fill this form. (প্রতিটি রেসপন্স সম্পূর্ণ করতে সর্বোচ্চ ৫/৬ মিনিট সময় লাগবে। সুতরাং, এই ফর্মটি পূরণ করার আগে অনুগ্রহ করে ৫/৬ মিনিট হাতে রাখুন।)

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* Indicates required question

Personal Information (ব্যক্তিগত তথ্য)

Your Name (আপনার নাম) *

Your answer

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This will be kept confidential and will only be used to contact you if needed. (এটি গোপন রাখা হবে এবং প্রয়োজন হলে শুধুমাত্র আপনার সাথে যোগাযোগ করতে ব্যবহার করা হবে।)

Your answer

Your Division (আপনার বিভাগ) *

Choose

Your Institution / Company / Industry / Enterprise (আপনার প্রতিষ্ঠান / কোম্পানি / শিল্প / এন্টারপ্রাইজ) *

If you're a student, write: Student (আপনি যদি একজন ছাত্র হন তবে লিখুন: Student)

Your answer

Name of the Training Program (ট্রেনিং প্রোগ্রামটির নাম)

Your answer

Questions Related to Physical Fitness (শারীরিক সুস্থতা সম্পর্কিত প্রশ্ন)

Do you feel the current training program provides enough guidance on warm-up and cool-down exercises? (আপনি কি মনে করেন যে বর্তমান প্রশিক্ষণ প্রোগ্রামটি ওয়ার্ম-আপ এবং কুল-ডাউন ব্যায়ামের জন্য যথেষ্ট নির্দেশনা প্রদান করে?)

Warm-up exercise: What exercise to do before starting a training session? (ওয়ার্ম-আপ ব্যায়াম: ট্রেনিং সেশন শুরু করার আগে কী ব্যায়াম করতে হবে?)
Cool-down exercise: What exercise to do after a training session? (কুল-ডাউন ব্যায়াম: ট্রেনিং সেশনের পরে কী ব্যায়াম করবেন?)

- ◯ Yes, it is sufficient (হ্যাঁ, যথেষ্ট)
- ◯ No, it needs improvement (না, এর উন্নতি দরকার)
- ◯ Not Applicable (প্রযোজ্য নয়)

How often do you feel fatigued or drained during or after training sessions? (ট্রেনিং সেশনের সময় বা পরে আপনি কত ঘন ঘন ক্লান্ত বা ড্রেন বোধ করেন?)

- ◯ Almost every time (প্রায় প্রতিবারই)

- ○ Occasionally (মাঝে মাঝে)
- ○ Rarely (কদাচিৎ)
- ○ Never (কখনই না)

Have you noticed any changes in your physical stamina and endurance since starting the training program? (প্রশিক্ষণ কার্যক্রম শুরু করার পর থেকে আপনি কি আপনার শারীরিক স্থিতিশীলতা এবং সহনশীলতার কোনো পরিবর্তন লক্ষ্য করেছেন?)

- ○ Yes, significant improvement (হ্যাঁ, উল্লেখযোগ্য উন্নতি)
- ○ Yes, slight improvement (হ্যাঁ, সামান্য উন্নতি)
- ○ No, no change (না, কোন পরিবর্তন নেই)
- ○ Yes, slight deterioration (হ্যাঁ, সামান্য অবনতি)
- ○ Yes, significant deterioration (হ্যাঁ, উল্লেখযোগ্য অবনতি)
- ○ Not applicable, it's too early to say (প্রযোজ্য নয়, এটা বলা খুব তাড়াতাড়ি)

Have you noticed any muscle soreness or joint stiffness after training sessions? (আপনি কি প্রশিক্ষণ সেশনের পরে কোন পেশী ব্যথা বা জয়েন্টের শক্ততা লক্ষ্য করেছেন?)

- ○ Yes, frequently (হ্যাঁ, ঘন ঘন)
- ○ Yes, occasionally (হ্যাঁ, মাঝে মাঝে)
- ○ No (না)

How do you manage physical exhaustion during the training program? (প্রশিক্ষণ কর্মসূচির সময় আপনি কীভাবে শারীরিক ক্লান্তি দূর করেন?)

- ☐ Take rest (বিশ্রাম নিয়ে)
- ☐ Drink water or electrolyte drink (জল বা ইলেক্ট্রোলাইট পানীয় পান করে)
- ☐ Reduce intensity of the exercise (ব্যায়ামের তীব্রতা হ্রাস করে)
- ☐ Other (অন্যান্য)

Other (অন্যান্য)

Do you feel the current training program takes into account the trainee's physical limitations, if any? (আপনি কি মনে করেন যে বর্তমান প্রশিক্ষণ কর্মসূচি প্রশিক্ষণার্থীর শারীরিক সীমাবদ্ধতা বিবেচনা করে, যদি থাকে?)

- Yes, it is well-designed to accommodate limitations (হ্যাঁ, এটি সীমাবদ্ধতা মিটমাট করার জন্য ভালভাবে ডিজাইন করা হয়েছে)
- No, it needs improvement (না, এর উন্নতি দরকার)
- Not Applicable (প্রযোজ্য নয়)

Do you feel the current training program is suitable for trainees of all fitness levels? (আপনি কি বর্তমান প্রশিক্ষণ কর্মসূচী সমস্ত ফিটনেস স্তরের প্রশিক্ষণার্থীদের জন্য উপযুক্ত বলে মনে করেন?)

- Yes, it caters to everyone's needs (হ্যাঁ, এটি প্রত্যেকের চাহিদা পূরণ করে)
- No, it needs improvement (না, এর উন্নতি দরকার)
- Not Applicable (প্রযোজ্য নয়)

Do you feel the current training program is too strenuous or challenging for you? (আপনি কি বর্তমান প্রশিক্ষণ প্রোগ্রামটি আপনার জন্য খুব কঠিন বা চ্যালেঞ্জিং মনে করেন?)

- Yes, too challenging (হ্যাঁ, খুব চ্যালেঞ্জিং)
- No, just right (না, ঠিক ঠিক)
- No, not challenging enough (না, যথেষ্ট চ্যালেঞ্জিং নয়)

Tick the physical fitness issue that you think has been caused by the training program. (সেই সকল শারীরিক ফিটনেস সমস্যাগুলিতে টিক দিন যা আপনি মনে করেন প্রশিক্ষণ প্রোগ্রামের কারণে হয়েছে।)

- [ ] Muscular injuries (পেশীর আঘাত)
- [ ] High blood pressure or heart disease (উচ্চ রক্তচাপ বা হৃদরোগ)
- [ ] Dehydration (পানিশূন্যতা)
- [ ] Respiratory problems (শ্বাসকষ্ট)
- [ ] Nutrition deficiencies (পুষ্টির ঘাটতি)
- [ ] Stress-related issues (স্ট্রেস সংক্রান্ত সমস্যা)
- [ ] Lack of rest (বিশ্রামের অভাব)
- [ ] Back pain, neck pain and others (পিঠে ব্যথা, ঘাড় ব্যথা এবং অন্যান্য)
- [ ] Insufficient sleep (অপর্যাপ্ত ঘুম)
- [ ] Eye strain (চক্ষু আলিঙ্গন)
- [ ] None (কোনটিই নয়)

Questions Related to Mental Health (মানসিক স্বাস্থ্য সম্পর্কিত প্রশ্ন)

Have you experienced any stress or anxiety related to your technical training program? (আপনি কি আপনার প্রযুক্তিগত প্রশিক্ষণ প্রোগ্রামের সাথে সম্পর্কিত কোন চাপ বা উদ্বেগ অনুভব করেছেন?)

- ◯ Yes (হ্যাঁ)
- ◯ No (না)

Do you feel your training program has negatively impacted your mental health? (আপনি কি মনে করেন যে আপনার প্রশিক্ষণ প্রোগ্রাম আপনার মানসিক স্বাস্থ্যকে নেতিবাচকভাবে প্রভাবিত করেছে?)

- ◯ Yes, to a great extent (হ্যাঁ, অনেকাংশে)
- ◯ Yes, to some extent (হ্যাঁ, কিছুটা হলেও)
- ◯ No, not at all (একদম না)

Do you feel that ICT training has improved your thinking capacity? (আপনি কি মনে করেন যে আইসিটি প্রশিক্ষণ আপনার চিন্তা করার ক্ষমতা উন্নত করেছে?)

- ◯ Yes (হ্যাঁ)
- ◯ No (না)
- ◯ Not Sure (নিশ্চিত না)

Have you felt overwhelmed by the workload and demands of the technical training program? (আপনি কি কাজের চাপ এবং প্রযুক্তিগত প্রশিক্ষণ প্রোগ্রামের চাহিদার দ্বারা বিরক্তি বোধ করেছেন?)

- ◯ Yes, frequently (হ্যাঁ, ঘন ঘন)
- ◯ Yes, occasionally (হ্যাঁ, মাঝে মাঝে)
- ◯ No, not at all (একদম না)

Have you noticed any changes in your mood or behavior since beginning the technical training program? (প্রযুক্তিগত প্রশিক্ষণ কার্যক্রম শুরু করার পর থেকে আপনি কি আপনার মেজাজ বা আচরণে কোনো পরিবর্তন লক্ষ্য করেছেন?)

- ◯ Yes, I am more irritable or moody (হ্যাঁ, আমি বেশি খিটখিটে বা মুডি)
- ◯ Yes, I am more anxious or nervous (হ্যাঁ, আমি বেশি উদ্বিগ্ন বা নার্ভাস)
- ◯ No, I have not noticed any changes (না, আমি কোনো পরিবর্তন লক্ষ্য করিনি)

Do you feel that you have sufficient resources or support for addressing mental health concerns related to the training program? (আপনি কি মনে করেন যে প্রশিক্ষণ প্রোগ্রামের সাথে সম্পর্কিত মানসিক স্বাস্থ্য সংক্রান্ত উদ্বেগগুলি সমাধান করার জন্য আপনার কাছে যথেষ্ট সংস্থান বা সমর্থন রয়েছে?)

- ◯ Yes, I have been provided with ample resources and support (হ্যাঁ, আমাকে যথেষ্ট সম্পদ এবং সহায়তা প্রদান করা হয়েছে)
- ◯ No, I have not been provided with sufficient resources or support (না, আমাকে পর্যাপ্ত সম্পদ বা সহায়তা দেওয়া হয়নি)

Have you ever felt isolated or unsupported during your technical training program? (আপনি কি কখনও আপনার প্রযুক্তিগত প্রশিক্ষণ প্রোগ্রামের সময় বিচ্ছিন্ন বা অবহেলিত অনুভব করেছেন?)

- ◯ Yes, frequently (হ্যাঁ, ঘন ঘন)
- ◯ Yes, occasionally (হ্যাঁ, মাঝে মাঝে)
- ◯ No, not at all (একদম না)

Have you ever sought professional help or counseling for mental health concerns related to your technical training program? (আপনি কি কখনও আপনার প্রযুক্তিগত প্রশিক্ষণ প্রোগ্রামের সাথে সম্পর্কিত মানসিক স্বাস্থ্য উদ্বেগের জন্য পেশাদার সাহায্য বা পরামর্শ চেয়েছেন?)

- ◯ Yes, I have sought professional help or counseling (হ্যাঁ, আমি পেশাদার সাহায্য বা কাউন্সেলিং চেয়েছি)
- ◯ No, I have not sought professional help or counseling (না, আমি পেশাদার সাহায্য বা কাউন্সেলিং চাইনি)

Questions Related to Language Barriers Problems (ভাষাগত পার্থক্যের কারণে সৃষ্ট সমস্যা-সংক্রান্ত প্রশ্ন)

Do you face difficulties in understanding technical terms in English language? (আপনি ইংরেজি ভাষায় প্রযুক্তিগত পদ বুঝতে অসুবিধা সম্মুখীন?)

- ◯ Yes, frequently (হ্যাঁ, ঘন ঘন)
- ◯ Sometimes (মাঝে মাঝে)
- ◯ Rarely (কদাচিৎ)
- ◯ Never (কখনই না)

Have you faced any communication gap with your trainer because of the English language barrier? (ইংরেজি ভাষার বাধার কারণে আপনি কি আপনার প্রশিক্ষকের সাথে যোগাযোগের সমস্যার সম্মুখীন হয়েছেন?)

- ◯ Yes, frequently (হ্যাঁ, ঘন ঘন)
- ◯ Sometimes (মাঝে মাঝে)
- ◯ Rarely (কদাচিৎ)
- ◯ Never (কখনই না)

Do you feel confident in asking questions related to technical concepts in English language during the training sessions? (আপনি কি প্রশিক্ষণের সময় ইংরেজি ভাষায় প্রযুক্তিগত ধারণা সম্পর্কিত প্রশ্ন জিজ্ঞাসা করতে আত্মবিশ্বাসী বোধ করেন?)

- ◯ Yes, always (হ্যাঁ সবসময়)
- ◯ Sometimes (মাঝে মাঝে)
- ◯ Rarely (কদাচিৎ)
- ◯ Never (কখনই না)

Do you think training materials should be provided in both Bengali and English languages? (আপনি কি মনে করেন বাংলা ও ইংরেজি উভয় ভাষায়ই প্রশিক্ষণের উপকরণ সরবরাহ করা উচিত?)

- ◯ Yes (হ্যাঁ)
- ◯ No (না)
- ◯ No preference (কোন পছন্দ নেই)

Do you prefer learning technical terms in Bengali or English language? (আপনি কি বাংলা বা ইংরেজি ভাষায় প্রযুক্তিগত পদ শিখতে পছন্দ করেন?)

- ◯ Bengali (বাংলা)

- ○ English (ইংরেজি)
- ○ No preference (কোন পছন্দ নেই)

Questions Related to Course Assessment (কোর্স মূল্যায়ন সম্পর্কিত প্রশ্ন)

Rate the different aspects of course in a scale of 1-5 (১-৫ স্কেলে বিভিন্ন দিক রেট করুন)

	1 (এক)	2 (দুই)	3 (তিন)	4 (চার)	5 (পাঁচ)
Pre-training Preparation (প্রাক-প্রশিক্ষণ প্রস্তুতি)	○	○	○	○	○
Course Structure (কোর্সের কাঠামো)	○	○	○	○	○
Course Contents (কোর্সের বিষয়বস্তু)	○	○	○	○	○
Delivery Quality (ডেলিভারি গুণমান)	○	○	○	○	○
Duration (সময়কাল)	○	○	○	○	○
Trainer (প্রশিক্ষক)	○	○	○	○	○
Support Team (সাপোর্ট টিম)	○	○	○	○	○
Environment (পরিবেশ)	○	○	○	○	○
Accessibility of Information (তথ্যের অ্যাক্সেসযোগ্যতা)	○	○	○	○	○

Usage of Games (গেমের ব্যবহার)	○	○	○	○	○
Expected Outcomes (প্রত্যাশিত ফলাফল)	○	○	○	○	○
Learning Experience (শেখার অভিজ্ঞতা)	○	○	○	○	○
Overall Rating (সামগ্রিক রেটিং)	○	○	○	○	○

Give your feedback regarding the course. Please write in English. Your feedback will only be used for research purposes. (কোর্স সম্পর্কে আপনার মতামত দিন। অনুগ্রহ-পূর্বক ইংরেজিতে লিখুন। আপনার মতামত শুধুমাত্র গবেষণা উদ্দেশ্যে ব্যবহার করা হবে.)

Your answer

Submit

Clear form

Never submit passwords through Google Forms.

Section 1 of 4

আইসিটি ভিত্তিক শ্রম বাজারের উপর সমীক্ষা ২০২৩

Targeted Objectives (টার্গেটেড উদ্দেশ্য):
Objective-1: Design research plan by analyzing global trends in research fields aligned with NACTAR
(**উদ্দেশ্য-1:** NACTAR-এর সাথে সংযুক্ত গবেষণা ক্ষেত্রে বিশ্বব্যাপী প্রবণতা বিশ্লেষণ করে গবেষণা পরিকল্পনা ডিজাইন)

You can fill this form in either Bangla or English. However, English is preferred. (আপনি এই ফর্মটি বাংলা বা ইংরেজিতে পূরণ করতে পারেন। তবে ইংরেজিকে অগ্রাধিকার দেওয়া হচ্ছে।)

Each response will take about 5-10 minutes max to complete. So, please take 5-10 minutes in hand before starting to fill this form. (প্রতিটি রেসপন্স সম্পূর্ণ করতে সর্বোচ্চ ৫-১০ মিনিট সময় লাগবে। সুতরাং, এই ফর্মটি পূরণ করার আগে অনুগ্রহ করে ৫-১০ মিনিট হাতে রাখুন।)

Your Name (আপনার নাম) *

Short answer text

Your Email (আপনার ই-মেইল)

This will be kept confidential and will only be used to contact you if needed. (এটি গোপন রাখা হবে এবং প্রয়োজন হলে শুধুমাত্র আপনার সাথে যোগাযোগ করতে ব্যবহার করা হবে।)

Short answer text

Your Phone Number (আপনার ফোন নম্বর)

This will be kept confidential and will only be used to contact you if needed. This field is optional. (এটি গোপন রাখা হবে এবং প্রয়োজন হলে শুধুমাত্র আপনার সাথে যোগাযোগ করতে ব্যবহার করা হবে। এটি ঐচ্ছিক।)

Short answer text

Your Division (আপনার বিভাগ) *

1. Barisal (বরিশাল)
2. Chittagong (চট্টগ্রাম)
3. Dhaka (ঢাকা)
4. Khulna (খুলনা)
5. Mymensingh (ময়মনসিংহ)
6. Rajshahi (রাজশাহী)

7. Rangpur (রংপুর)

8. Sylhet (সিলেট)

What is the name of your company or Institution? (আপনার কোম্পানি বা প্রতিষ্ঠানের নাম কি?)

Short answer text

Your Designation (আপনার উপাধি)

If you're a student, type: Student (আপনি যদি শিক্ষার্থী হয়ে থাকেন, লিখুনঃ Student)

Short answer text

Your Age (আপনার বয়স)

Example: 26

Short answer text

Your Highest Educational Qualification (আপনার সর্বোচ্চ শিক্ষাগত যোগ্যতা)

1. JSC or equivalent (জেসসি বা সমমান)
2. SSC or equivalent (এসএসসি বা সমমান)
3. HSC or equivalent (এইচএসসি বা সমমান)
4. B.Sc. or equivalent (বিএসসি বা সমমান)
5. M.Sc. or equivalent (এমএসসি বা সমমান)
6. Ph.D. or equivalent (পিএইচডি বা সমমান
7. Post-Doc. or equivalent (পোস্ট ডক্টরেট বা সমমান)

Your First Job Year (আপনার প্রথম চাকরির বছর)

Example: 2010

Short answer text

Your Monthly Income In Taka (টাকায় আপনার মাসিক আয়)

This field is optional and confidential. This will only be used for the purpose of predicting trends in ICT market. (এই ক্ষেত্রটি ঐচ্ছিক এবং গোপনীয়। এটি শুধুমাত্র আইসিটি বাজারের প্রবণতা পূর্বাভাসের উদ্দেশ্যে ব্যবহার করা হবে।)

Short answer text

Your Gender (আপনার লিঙ্গ)

1. Male (পুরুষ)
2. Female (মহিলা)
3. Others (অন্যান্য)

After section 1 Continue to next section

Section 2 of 4

সাবমডিউল-১/৩: আইসিটি ব্যবহারের প্যাটার্ন এবং গুরুত্ব

Description (optional)

How much do you know about the following technologies? (নিচের প্রযুক্তিগুলি সম্পর্কে আপনার জ্ঞান কিরূপ?)

	Excellent (চমৎ...	Very Good (খুব ...	Good (ভাল)	Weak (দুর্বল)	No previous kn...
Mobile Phone (...	○	○	○	○	○
Computer (ক...	○	○	○	○	○
Internet (ইন্টার...	○	○	○	○	○
Fixed Telephon...	○	○	○	○	○

What is the source of your Internet Connection? (আপনার ইন্টারনেট সংযোগের উৎস কি?)

- [ ] BTCL Broadband (BTCL ব্রডব্যান্ড)
- [ ] Other Broadband (অন্যান্য ব্রডব্যান্ড)
- [ ] Grameenphone (গ্রামীণফোন)
- [ ] Banglalink (বাংলালিংক)
- [ ] Teletalk (টেলিটক)
- [ ] Airtel (এয়ারটেল)
- [ ] Robi (রবি)
- [ ] Other...

How often do you use Mobile Phone in the common places? (সাধারণ জায়গায় আপনি কত ঘন ঘন

মোবাইল কোন ব্যবহার করেন?)

	Often (প্রায়ই)	Sometimes (কখনও কখ...	Not at all (মোটেই না)
Home (হোম)	○	○	○
Office (অফিস)	○	○	○
Internet Café/Telecomm...	○	○	○
Other Places (অন্যান্য স্থা...	○	○	○

How often do you use Computer in the common places? (সাধারণ জায়গায় আপনি কত ঘন ঘন কম্পিউটার ব্যবহার করেন?)

	Often (প্রায়ই)	Sometimes (কখনও কখ...	Not at all (মোটেই না)
Home (হোম)	○	○	○
Office (অফিস)	○	○	○
Internet Café/Telecomm...	○	○	○
Other Places (অন্যান্য স্থা...	○	○	○

How often do you use Internet in the common places? (সাধারণ জায়গায় আপনি কত ঘন ঘন ইন্টারনেট ব্যবহার করেন?)

	Often (প্রায়ই)	Sometimes (কখনও কখ...	Not at all (মোটেই না)
Home (হোম)	○	○	○
Office (অফিস)	○	○	○
Internet Café/Telecomm...	○	○	○
Other Places (অন্যান্য স্থা...	○	○	○

After section 2 Continue to next section

Section 3 of 4

সাবমডিউল-২/৩: আইসিটি ব্যবহারের ব্যয়

Description (optional)

Please give an assessment of your personal trend for the use of ICT over the past 4 years. (অনুগ্রহ করে গত 4 বছরে আইসিটি ব্যবহারের জন্য আপনার ব্যক্তিগত প্রবণতার একটি মূল্যায়ন দিন।)

	Increase (বেড়েছে)	Decrease (কমেছে)	Constant (পরিবর্তন হয় ...

Mobile Phone Usage (...			
Computer Usage (কম্পি...			
Internet Usage (ইন্টারনে...			
Fixed Telephone Usage (...			

How much money do you spend on Computer, Mobile Phone and Internet per month? (আপনি প্রতি মাসে কম্পিউটার, মোবাইল ফোন এবং ইন্টারনেটে কত টাকা খরচ করেন?)

Example: 3000

Short answer text

How many hours do you spend on Computer, Mobile Phone and Internet per week? (আপনি প্রতি সপ্তাহে কম্পিউটার, মোবাইল ফোন এবং ইন্টারনেটে কত ঘন্টা সময় ব্যয় করেন?)

Short answer text

Please give your opinion if the cost of the following technologies should increase, decrease or be constant. (অনুগ্রহ করে আপনার মতামত দিন, নিম্নলিখিত প্রযুক্তিগুলির খরচ বৃদ্ধি, হ্রাস বা ধ্রুবক হওয়া সম্পর্কে।)

	Cost should increase (খ...	Cost should decrease (...	Cost should be constan...
Mobile Phone (মোবাইল ...			
Computer (কম্পিউটার)			
Internet (ইন্টারনেট)			
Fixed Telephone (টেলি...			

After section 3 Continue to next section

Section 4 of 4

সাবমডিউল-৩/৩ঃ আইসিটির সুযোগ-সুবিধা ও সমস্যা নীরিক্ষণ

Description (optional)

What are the main problems of ICT in the context of Bangladesh? (বাংলাদেশের প্রেক্ষাপটে আইসিটির মূল সমস্যাগুলি কি কি?)

- [ ] Lack of Govt. spending on ICT (আইসিটিতে সরকারি ব্যয়ের অভাব)
- [ ] Lack of adequate investment (পর্যাপ্ত বিনিয়োগের অভাব)

- [ ] Lack of adequate investment (পর্যাপ্ত বিনিয়োগের অভাব)
- [ ] Lack of infrastructure (অবকাঠামোর অভাব)
- [ ] Lack of Research & Development (গবেষণা ও উন্নয়নের অভাব)
- [ ] Inadequate capacity of services (পরিষেবার অপর্যাপ্ত ক্ষমতা)
- [ ] Slow speed of the services (সেবার মন্থর গতি)
- [ ] Interrupt/disconnection of services (পরিষেবার বিঘ্ন/সংযোগ বিচ্ছিন্ন)
- [ ] High costs of offering services (সেবা প্রদানের উচ্চ খরচ)
- [ ] Lack of networks (নেটওয়ার্কের অভাব)
- [ ] Uncertainty related to investment in ICT (আইসিটিতে বিনিয়োগ সংক্রান্ত অনিশ্চয়তা)
- [ ] Interrupt of electricity supply (বিদ্যুৎ সরবরাহ বিঘ্নিত)
- [ ] Low quality/efficiency of the services (পরিষেবার নিম্ন গুণমান/দক্ষতা)
- [ ] Lack of technical skills (প্রযুক্তিগত দক্ষতার অভাব)
- [ ] Lack of awareness of the importance of ICT in the new economy (নতুন অর্থনীতিতে আইসিটির গুরুত্ব সম্প...
- [ ] High spread of electronic illiteracy (ইলেকট্রনিক নিরক্ষরতার উচ্চ বিস্তার)
- [ ] High spread of poverty (দারিদ্র্যের উচ্চ বিস্তার)
- [ ] Other...

Assess how much Internet is important for following fields. (নিম্নলিখিত ক্ষেত্রেগুলির জন্য ইন্টারনেট কতটা গুরুত্বপূর্ণ তা মূল্যায়ন করুন।)

	Unimportant (গুরু...	Slightly Important ...	Moderately Import...	Extremely Importa...
For Studying (অধ্য...	○	○	○	○
For researching (গ...	○	○	○	○
For network and c...	○	○	○	○
For finding a job (...	○	○	○	○
For participation in...	○	○	○	○
For social and wor...	○	○	○	○
For encouraging a...	○	○	○	○

Which of the following problems are evident in internet usage? (ইন্টারনেট ব্যবহারের ক্ষেত্রে নিচের কোন সমস্যাগুলি প্রকট?)

- [ ] Problem of access to scientific and technical information for creation and transfer of knowledge (জ্ঞান সৃ...

- [ ] Lack of enthusiasm for electronic publications (ইলেকট্রনিক প্রকাশনার জন্য উৎসাহের অভাব)
- [ ] Risk of spread of electronic piracy (ইলেকট্রনিক পাইরেসি ছড়িয়ে পড়ার ঝুঁকি)
- [ ] Difficulty of overcoming the problem of high costs paid for using information (তথ্য ব্যবহারের জন্য প্রদত্ত উ...
- [ ] Lack of access to credit cards and lack of security in their use (ক্রেডিট কার্ড অ্যাক্সেসের অভাব এবং তাদের ...
- [ ] Lack of or inadequate regular budget adequate for universities libraries to pay for access to scientific, tec...
- [ ] Gap (related to training and financial ability to communicate) between those who own and those who do ...
- [ ] Lack of assessment policies and evaluation programs (মূল্যায়ন নীতি ও মূল্যায়ন কর্মসূচির অভাব)
- [ ] Limited and lack of modern available references (সীমিত এবং আধুনিক উপলব্ধ রেফারেন্সের অভাব)
- [ ] Poor or lack of services offered to users (ব্যবহারকারীদের দেওয়া পরিষেবার অভাব)
- [ ] High costs of acquiring licenses for access to electronic libraries for individuals and institutions (ব্যক্তি এ...
- [ ] Creation of isolation for illiterate who do not know how to use the internet (নিরক্ষরদের জন্য বিচ্ছিন্নতা সৃষ্টি ...
- [ ] Difficulties of preventing programs of spy and spread of viruses (গুপ্তচর কর্মসূচি এবং ভাইরাসের বিস্তার প্র...
- [ ] Increase worry of institutions of waste of working time of their workers on internet, personal e-mail and u...
- [ ] Increase demand for technical and engineering education related to ICT (আইসিটি সম্পর্কিত কারিগরি ও প্র...
- [ ] Lack of the required technical skills (প্রয়োজনীয় প্রযুক্তিগত দক্ষতার অভাব)
- [ ] Difficulty of distinction between original and not original documents and risk for users to use wrong unrel...
- [ ] Other...

If you participate in a training course, which parts of the course you think should be assessed? (আপনি যদি একটি প্রশিক্ষণ কোর্সে অংশগ্রহণ করেন, তাহলে কোর্সের কোন অংশগুলি মূল্যায়ন করা উচিত বলে আপনি মনে করেন?)

- [ ] Teaching Method Assessment (শিক্ষণ পদ্ধতি মূল্যায়ন)
- [ ] Instructor Assessment (প্রশিক্ষক মূল্যায়ন)
- [ ] Course Materials Assessment (কোর্স উপকরণ মূল্যায়ন)
- [ ] Student Engagement and Involvement Assessment (শিক্ষার্থীদের সম্পৃক্ততা মূল্যায়ন)
- [ ] Course Structure Assessment (কোর্স স্ট্রাকচার মূল্যায়ন)
- [ ] Course Outcomes Definition Assessment (কোর্স ফলাফল সংজ্ঞা মূল্যায়ন)
- [ ] Examination Process Assessment (পরীক্ষার প্রক্রিয়া মূল্যায়ন)
- [ ] Support Team Assessment (সমর্থন টিম মূল্যায়ন)

Curriculum Vitae of Principal Researcher
(Prof. Md. Rabiul Islam, Ph.D.)

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E-mail : rabiul_cse@cse.ruet.ac.bd

Objectives

To prove me as a quick learner and highly energetic person to face any challenge for the development of research and teaching-learning environment in education and IT industry.

Employment Record

Full Time Effective Teaching Experience:

Name of Post	Organization	Job Description	Period		Total length
			From	To	
Professor (Grade-2)	Dept. of Computer Science & Engineering, Rajshahi University of Engineering & Technology, Bangladesh.	Teaching	30 June 2019	Till to date	-
Professor (Grade-3)	Dept. of Computer Science & Engineering, Rajshahi University of Engineering & Technology, Bangladesh.	Teaching	30 June 2015	29 June 2019	04 Year
Associate Professor	Dept. of Computer Science & Engineering, Rajshahi University of Engineering & Technology, Bangladesh.	Teaching	02 June 2013	29 June 2015	02 Year 0 Months and 27 Days
Assistant Professor	Dept. of Computer Science & Engineering, Rajshahi University of Engineering &Technology, Bangladesh.	Teaching	25 August 2008	01 June 2013	04 Year 09 Months and 07 Days
Lecturer	Dept. of Computer Science &	Teaching	09 Nov.	24 Aug.	03 Years 09

	Engineering, Rajshahi University of Engineering & Technology, Bangladesh.		2004	2008	Months and 15 Days

Part Time Teaching Experience:

Name of Post	Organization	Job Description	Period		Total length
			From	To	
Professor	Dept. of Computer science & Engineering, Bangladesh Army University of Engineering & Technology (BAUET), Nator, Bangladesh Dept. of Computer Science and Engineering, Daffodil International University (DIU), Dhaka, Bangladesh. Dept. of Computer Science and Engineering, Varendra University, Rajshahi, Bangladesh. Dept. of Computer Science and Engineering, North Bengal International University (NBIU), Rajshahi, Bangladesh.	Teaching (Working with the mentioned Universities with various academic activities of different times)	June 2015	Till to Date	-
Associate Professor	IT courses, Bangladesh Police Academy, Sardah, Rajshahi, Bangladesh.	Teaching	July 2012	Till to Date	
Assistant Professor	Dept. of Computer Science & Engineering, University of Information Technology and Sciences (UITS), Rajshahi, Bangladesh.	Teaching	January 2009	June 2011	-
Assistant Professor	Dept. of Business Administration, Northern University Bangladesh (NUB), Rajshahi, Bangladesh.	Teaching	July 2009	Dec. 2009	-
Assistant Professor	Dept. of Computer Science & Engineering, Ahsanullah University of Science & Technology (AUST), Rajshahi, Bangladesh.	Teaching	January 2007	Dec. 2010	-
Lecturer	Dept. of Law, Northern University Bangladesh (NUB), Rajshahi, Bangladesh.	Teaching	January 2005	Dec. 2006	-

Research Papers

(**Please see the additional sheet (From 42 to 57) for detail:** Paper in (A) Journals = 66, (B) Conference Proceedings = 52, (C) Workshop = 01 and (D) Books = 05; Total = 124)

Research Interests

Artificial Intelligence, Machine Learning, System Development, Software Design, Cyber Security Biomedical Engineering, Biometric Security and Pattern Recognition.

Special Training Received

1.	CISCO Certified Network Associate (CCNA) instructor training (Four semester long course) from Bangladesh University of Engineering and Technology (BUET), Bangladesh at 2009.
2.	Information Technology Engineers Examination (ITEE) Training of Trainers (TOT) from 08 March 2014 to 13 March 2014, organized by Information Technology Promotion Agency (IPA), Japan through Bangladesh IT-engineers Examination Center, Ministry of Information and Communication Technology.
3.	Refresher Training Course on Information Technology Engineers Examination (ITEE) from 08 August 2015 to 09 August 2015, organized by Information Technology Promotion Agency (IPA), Japan through Bangladesh IT-engineers Examination Center, Ministry of Information and Communication Technology.
4.	CISCO CCNA Security (CCNAS) instructor training from American International University Bangladesh (AIUB) at 2015.
5.	Outcome Based Education (OBE) training at Institute of Engineers (IEB) organized by Board of Accreditation for Engineering and Technical Education (BAETE), 2019.
6.	CISCO APIC-EMinstructor training of Network Programmability with Python from American International University Bangladesh (AIUB) at 2020.

List of Working Projects

1.	*Project Title:* "Feature Fusion Based Audio-Only Person Identification System using Genetic Algorithm" *Allowed Amount:* 200000 BDT (Two lac taka) *Sponsored By:* University Grand Commission (UGC), Bangladesh in 2010-2011 financial year.
2.	*Project Title:* "Improvement of Noise Robust Speaker Recognition System using GA-HMM based Hybrid Techniques" *Allowed Amount:* 100000 BDT (One lac taka) *Sponsored By:* University Grand Commission (UGC), Bangladesh in 2009-2010 financial year.
3.	*Project Title:* "Evolutionary Approach of Multimodal Biometric Authentication System Using Hybrid Techniques"

	Allowed Amount: 100000 BDT (One lac taka) *Sponsored By:* University Grand Commission (UGC), Bangladesh in 2008-2009 financial year.

Important Administrative Activities

1.	**Legal Main Contract (LMC), CISCO Network Academy at Rajshahi University of Engineering & Technology, Bangladesh from 08 May, 2012 to 07 May, 2013, from 15 April, 2015 to 14 April, 2016 and from 06 June, 2020 to 05 June, 2021.**
2.	**Head, Department of Electronics & Telecommunication Engineering (ETE), at Rajshahi University of Engineering & Technology (RUET) from 27 September, 2015 to 01 July, 2017.**
3.	**Head, Department of Computer Science & Engineering (CSE), at Rajshahi University of Engineering & Technology (RUET) from 02 July, 2017 to 01 July, 2019.**
4.	**Chairman of SA Committee, Institutional Quality Control Cell (IQAC) for the Dept. of Computer Science & Engineering at Rajshahi University of Engineering & Technology (RUET) from September, 2017 to September, 2018.**

Other Administrative Activities

1.	Acted as a Member of Academic Council of Rajshahi University of Engineering & Technology, Bangladesh from 02 June 2013 to till date.
2.	Acted as a Member of Disciplinary Committee of Rajshahi University of Engineering & Technology, Bangladesh from 27 September 2015 to 01 July, 2020.
3.	Acted as a Member of Committee of Advance Study and Research (CASR) of Rajshahi University of Engineering & Technology, Bangladesh from 02 July 2017 to 01 July, 2019.
4.	Acted as a Member of Central Library Management Committee at Rajshahi University of Engineering & Technology, Bangladesh.
5.	Acted as Member for the Result Processing Committee of B.Sc. Admission Test 2011,2016, 2017 and 2018 of Rajshahi University of Engineering & Technology, Bangladesh.
6.	Acted as Member for the Technical (Online Registration) Committee of B.Sc. Admission Test 2012, 2013, 2014, 2015 and 2019 of Rajshahi University of Engineering & Technology, Bangladesh.
7.	Acted as Member for the Wi-Fi Security Management Committee of Rajshahi University of Engineering & Technology, Bangladesh.
8.	Acted as Member Secretary for the Registration and Information Publishing Sub-committee of 4th Convocation 2013 of Rajshahi University of Engineering & Technology, Bangladesh.
9.	Acted as Member of the RegistrationSub-committee of 5th Convocation 2019 of Rajshahi University of Engineering & Technology, Bangladesh.
10.	Acted as Member for Employees Job Rules Up gradation Committee of Rajshahi University of

	Engineering & Technology, Bangladesh.
11.	In-charge of Seminar Library of the Department of Computer Science & Engineering at Rajshahi University of Engineering & Technology, Bangladesh from 15 February, 2007 to 30 June, 2017.
12.	Chairman of Preparing the Ordinance of CISCO Networking Academy, Rajshahi University of Engineering & Technology, Bangladesh, 2014.
13.	Member, PABX Management and Development Committee of Rajshahi University of Engineering & Technology, 2015.
14.	Executive Member of RUET Computer Center Direction, Website and Internet Management Committee from 04 May, 2015 to 30 June, 2017.
15.	Member of Higher Education Evaluation Committee of Rajshahi University of Engineering & Technology, Bangladesh from 06 June, 2015 to 30 June, 2020.
16.	Member of Board of Governance of Institute of Information and Communication Technology (IICT) at Rajshahi University of Engineering & Technology, Bangladesh from 25 April, 2018 to till date.
17.	Member of Board of Governance of National Training Academy for Computer Training and Research (NACTAR), Bangladesh from 2019 to till date.

Additional Administrative Activities

1.	Acted as a Member of the Specification committee of TSCOTEC to establish the IT Forensic Laboratory at Bangladesh Police Academy, Sardah, 2011.
2.	Acted as a member to establish the Laboratory of Cyber Crime at Bangladesh Police Academy, Sardah, 2012.
3.	Acted as a Member to measure the performance of work station of IT branch of Forensic Laboratory at Bangladesh Police Academy, Sardah, 2013.
4.	Acted as a Member of the TSP, Evaluation Committee of TSCOTEC 2014 for the Modernization of Bangladesh Police Academy (Revised) at Bangladesh Police Academy, Sardah.
5.	Acted as a member for the establishment of IT Centre at Bangladesh Police Academy, Sardah, 2018.
6.	Member of IoT Lab specification committee, Bangabandhu Sheikh Mujib Hi-Tech Park *in* Rajshahi under the supervision of *Bangladesh Hi-Tech* Park Authority (BHTPA) at 2018.

Additional Academic Activities

1.	Acted as an Instructor of Local Academy, CISCO Network Academy Program, Rajshahi University of Engineering & Technology, Bangladesh from April, 2009 to till now.
2.	Acted as Member of Undergraduate and Postgraduate Academic Ordinance, Rajshahi University of Engineering & Technology, Bangladesh.
3.	Acted as Coordinator of CSE Fest 2012, Organized by the Dept. of Computer Science & Engineering, Rajshahi University of Engineering & Technology, Bangladesh.

4.	Acted as a Chairman for the Post Graduate Syllabus Committee of the Department of Computer Science & Engineering at Rajshahi University of Engineering & Technology, Bangladesh.
5.	Member of Subeditorial Committee, Journal of Engineering and Applied Science (JEAS), Organized by Rajshahi University of Engineering & Technology, Bangladesh.
6.	Acted as Technical Secretary of International Conference on Electrical, Computer and Telecommunication Engineering 2012 (ICECTE 2012), organized by Rajshahi University of Engineering & Technology, Bangladesh.
7.	Member of the Academic Council at Rajshahi University of Engineeing& Technology, Bangladesh.
8.	Member of the Dean's Committee, Faculty of Electrical & Electronic Engineering at Rajshahi University of Engineering & Technology, Bangladesh.
9.	Course Coordinator, Post Graduate (M.Sc. and Ph.D.) program of the Department of Computer Science & Engineering, Rajshahi University of Engineering & Technology, Bangladesh from 02 November, 2013 to 11 October, 2015.
10.	Conduct three days workshop for the certification of Fundamentals of Engineers (FE), Information Technology Engineers Examination (ITEE) at University of Rajshahi, October, 2014.
11.	Chairman of Proposal writing Committee for the "Development of Infrastructure Facilities of the Institute of Information & Communication Technology (IICT)" and "Development of Infrastructure Facilities of the Electronic & Computer Engineering (ECE)" under the faculty of Electrical and Computer Engineering at Rajshahi University of Engineering & Technology.
12.	Acted as a Member for the Graduate Syllabus Committee of the Department of Electrical &Computer Engineering at Rajshahi University of Engineering & Technology, Bangladesh.
13.	Chairman of Technical Program Committee of National Collegiate Programming Contest (NCPC 2105), Organized by the Dept. of Computer Science & Engineering, Rajshahi University of Engineering & Technology, Bangladesh.
14.	Member, Organization Committee of the International Conference on Electrical & Electronic Engineering (ICAEE 2015), Organized by the Dept. of Electrical & Electronic Engineering at Rajshahi University of Engineering & Technology, Bangladesh.
15.	External Member for the Undergraduate and Post Graduate Syllabus Committee of the Department of Computer Science & Engineering at University of Rajshahi (RU), Bangladesh from 2017 to till date.
16.	Member of Lecturer and Assistant Professor Selection Committee of the Dept. of Computer Science & Engineering (CSE) and Dept. of Electronics & Telecommunication Engineering (ETE) at Rajshahi University of Engineering & Technology (RUET).
17.	Member of Lecturer Selection Committee of the Dept. of Computer Science & Engineering (CSE) of Varendra University (VU), North Bengal International University (NBIU) and Pundra University of Science & Technology (PUST) at Bangladesh.
18.	External Peer Reviewer (Subject Matter Expert) for Self Assessment activities and Self Assessment Report of the Faculty of Computer Science and Engineering at Hajee Mohammad

	Danesh Science and Technology University,Bangladesh, 2018.
19.	Acted as Co-Chair of International Conference on Electrical, Computer and Telecommunication Engineering 2019 (ICECTE 2019), organized by Rajshahi University of Engineering & Technology, Bangladesh.
20.	Conduct a Software Management Training Program at Bangladesh Police Academy, Sardah, Bangladesh from 21 March, 2021 to 31 March, 2021.

Other Academic Activities

1.	Develop a concept paper under the title of **"Establishment of IT Center at Bangladesh Police Academy to fulfill the Vision 2021 in Digital Bangladesh"** as per declaration of the joint statement issued during the visit of the Honorable Prime Minister Dr. Manmohan Singh's, referenced by the High Commission of India in Dhaka, Note Verbale No. DAC/Pol/103/1/2012 (III) dated on 11 April, 2012.
2.	Acted as Invited Guest Speaker for the courses of "Bioinformatics" and "Computer Forensics" at Bangladesh Police Academy, Sardah in 2013 and 2014 respectively.
3.	Acted as Invited Guest Speaker for the IT Training courses of ASP level at Bangladesh Police Academy, Sardah from 2019 to 2020.

Expert Member of Ph.D./M.Phil Degree Awarding Committee

Sl. No.	Thesis Topic	Degree	Awarded Date
1.	Person Identification using Gait Biometric with Challenging Clothing and Speed Cofactors	Ph.D.	February, 2021
2.	Machine Learning and Bioinformatics Models to Identify the Genetic Link of Neurological Diseases Associated with the Causal Risk Factors	M.Phill	June, 2021

M.Sc. Degree Awarded

Sl. No.	Thesis Topic	Awarded Date
1.	Face Recognition System using Bayesian Fusion Method	July, 20127
2.	Epileptic Seizure Detection and Classification using Support Vector Machine from Scalp EEG Signal	May, 2019
3.	Efficient Subspace Detection using a Statistical Information Measure for Hyperspectral Image	May, 2019
4.	Masked Face Recognition using Convolutional Neural Network	January, 2020
5.	Iris-Pupil Thickness based Biometric Approach for Determining Age Group using Data Mining Technique	October, 2020
6.	Classification of Twitter Data using Machine Learning Approach	October, 2020

7.	Privacy Preserving in Serial Data Publishing	November, 2021
8.	Deep Convolutional Neural Network Based Medical Image Processing	December, 2021

Certifications

1.	Instructor Trainer of CISCO Certified Network Associate (CCNA)
2.	Master Trainer on Information Technology Engineers Examination (ITEE)
3.	Instructor Trainer of CISCO CCNA Security (CCNAS)
4.	Instructor Training of Network Programmability with CISCO APIC-EM

Professional Awards

1.	Instructor Excellence Award: **Advanced level instructor** excellence and lasting contribution to the CISCO Networking Academy program at 2016
2.	Instructor Years of Service: **10 years active participation and service** in the CISCO Networking Academy program at 2018
3	Instructor Excellence Award: **Advanced level instructor** excellence and lasting contribution to the CISCO Networking Academy program at 2018

Online Certifications Courses

1.	Cloud Computing Basics, Skillsoft courses from Association of Computing Machinery (ACM).
2.	Enterprise Data and Cloud Interaction, Skillsoft courses from Association of Computing Machinery (ACM).
3.	**Agile with Atalassian Jira** which is authorized by Atlassian and offered through Coursera at .2020

Participation of Workshop and Seminar

1.	Workshop on Prospects andProblems of Mobile and Land Phones in Bangladesh, Independent University, Bangladesh, 08 December, 2005, Dhaka, Bangladesh.
2.	Workshop on Algorithms and Computation 2012, Bangladesh University of Engineering and Technology, 15-17 February, 2012.
3.	Workshop on Wireless Network and Communication (WNC), Department of Computer Science & Engineering, Bangladesh University of Engineering and Technology, 16 March 2013, Dhaka, Bangladesh.
4.	Proposal Writing Workshop of 2nd Round AFI HEQEP, 2011 and 3rd Round AFI HEQEP, 2014 at Rajshahi University.
5.	Attended of the CISCO Network Academy Instructor Conference of May, 2014 and August, 2015 at American International University Bangladesh.

6.	Participate as a session chair of ICECTE 2012, ICCIE 2015, IC4ME2 2016, ICECTE 2016, ICEEE 2017, IC4ME2 2018, ICECTE 2019.
7.	Workshop of Institutional Quality Control Cell (IQAC) at Rajshahi University of Engineering & Technology (RUET), 2019 and 2020.

Professional Membership and Reviewers

1.	Member, Institution of Engineers Bangladesh (IEB). *(Member No.: M-21546).*
2.	Professional Membership, Association of Computing Machinery (ACM). *(Member No.: M-5510719).*
3.	Membership of IEEE. *(Member No.: 94286929).*
4.	Acted as a reviewer of the journal of IJCA, IJCSI, IJCSIS, Journal of Computing, IJDM (World Scientific journal), IET Image Processing, IEE Access and IET Biometrics.
5.	Acted as a reviewer of the conference of ICECTE 2012, EICT 2013, ICMEIE 2015, ICEEE 2015, ICCIE 2015, IC4ME2 2016, ICECTE 2016, IC4ME2 2018, BIM 2021.

References

Name :	Prof. Dr. Md. Rafiqul Islam Sheikh	*Name :*	Prof. Dr. Md. Fayzur Rahman
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Name: **Prof. Md. Rabiul Islam, Ph.D.**

Date: 20.12.2021

Additional sheet (Pages from 42 to 57) for List of Published Research Papers:

Please see below for detail: Papers in (A) Journals = 66, (B) Conference Proceedings = 52, (C) Workshop = 01 and (D) Books = 05; Total = 124)

A: Journals

1. A. S. M Sohail, B. Mondal, ***Md. Rabiul Islam*** and M. A. Motallib, "**An Approach to Improve the Recognition Efficiency of Face Recognition Techniques by Increasing Sustainability to Rotation and Noise**",*Computer Science and Engineering Research Journal*, Chittagong University of Engineering &Technology, Bangladesh, Volume 2, pp. 18-24, 2004, ISSN: 1990-4010.
2. ***Md. Rabiul Islam*** and Md. Shahid Uz Zaman, "**Improvement of Existing Real Time Human Iris Recognition System Introducing Sustainability of Rotation and Noise Distortion**", *Journal of Computer Science*, IBAIS University Bangladesh, Volume 1, Number 2, pp. 25-30, December 2007, ISSN: 1994-6244.
3. ***Md. Rabiul Islam***, Md. Shahid Uz Zaman, and Md. Ruhul Amin, "**Genetically Optimized HMM for Speaker Identification**", *International Journal of Engineering and Technology (IJET)*, G–ScienceImplementation & Publication, Volume 5, Issue 1, pp. 188-192, March 2008, ISSN: 1812-7711 (Print version), 1816-1383 (CD Version).
4. ***Md. Rabiul Islam***, Md. Fayzur Rahman and M. Abdul Goffar Khan,"**An Approach to Implement the Multicast Multi-Constrained Routing based on Genetic Algorithm**",*Bangladesh Research Publications (BRP) Journal*, Volume 1, Issue 1, pp. 101-112, April-June 2008, ISSN: 1998-2003.
5. M. Abdul Goffar Khan, ***Md. Rabiul Islam*** and Md. Fayzur Rahman, "**Personal Computer based Precision Industrial Temperature Monitor and Control Scheme**", *Bangladesh Research Publications (BRP) Journal*, Volume 1, Issue 1, pp. 61-73, April-June 2008, ISSN: 1998-2003.
6. ***Md. Rabiul Islam***, Md. Fayzur Rahman and Md. Shahid Uz Zaman, "**Speaker Identification based on Artificial Neural Network, Genetic Algorithm and Discrete Hidden Markov Model**", *International Journal of Engineering and Technology (IJET)*, G–ScienceImplementation & Publication, Volume 5, Issue 2, pp. 275-280, June 2008, ISSN: 1812-7711 (Print version), 1816-1383 (CD Version).
7. ***Md. Rabiul Islam***, M. Abdul Goffar Khanand Md. Fayzur Rahman, "**Multi-**

Variable and Multi-Level Industrial Process Control using Fuzzy Logic Controller",*Bangladesh Research Publications (BRP) Journal*, Volume 1, Issue 2, pp. 144-155, July-August 2008, ISSN: 1998-2003.

8. M. Abdul Goffar Khan, ***Md. Rabiul Islam*** *and* Md. Fayzur Rahman, "**Computer Aided Advanced Industrial Motor Protection Scheme**", *Southeast University Journal of Science & Engineering (SEUJSE)*, Volume 2, Number 2, pp. 56-63, December 2008, ISSN: 1999-1630.

9. ***Md. Rabiul Islam*** *and* Md. Fayzur Rahman, "**Codebook Design Method for Noise Robust Speaker Identification based on Genetic Algorithm**", International Journal of Computer Science and Information Security (IJCSIS), Volume 4, Number 1, pp. 131-135, August 2009, ISSN 1947 5500.

10. ***Md. Rabiul Islam*** *and* Md. Fayzur Rahman, "**Improvement of Text Dependent Speaker Identification System using Neuro-Genetic Hybrid Algorithm in Office Environmental Conditions**", International Journal of Computer Science Issues (IJCSI), Volume 1, pp. 42-47, August 2009, ISSN: 1694-0814 (Print version), 1694-0784 (Online Version).

11. ***Md. Rabiul Islam*** and Md. Fayzur Rahman, "**Rotation Independent Face Recognition using Neuri-Genetic Hybrid System**", Journal of Computing, Volume 2, Issue 7, pp. 6-11, July 2010, ISSN: 2151-9617.

12. ***Md. Rabiul Islam*** and Md. Fayzur Rahman, "**Noise Robust Speaker Identification using PCA based Genetic Algorithm**", *International Journal of Computer Applications (IJCA)*, Volume 4, Number 12, pp.27-31, August 2010, ISSN: 0975-8887.

13. ***Md. Rabiul Islam*** and Md. Fayzur Rahman, "**Likelihood Ratio Based Score Fusion for Audio-Visual Speaker Identification in Challenging Environment**", *International Journal of Computer Applications (IJCA)*, Volume 6, Number 7, pp. 6-11, September 2010, ISSN: 0975-8887.

14. ***Md. Rabiul Islam*** and Md. Fayzur Rahman, "**Hybrid Feature and Decision Fusion based Audio-Visual Speaker Identification in Challenging Environment**", *International Journal of Computer Applications (IJCA)*, Volume 9, Number 5, pp. 9-15, November 2010, ISSN: 0975-8887.

15. ***Md. Rabiul Islam*** and Md. Fayzur Rahman, "**Performance Comparison among Various Speech Parameterization Techniques for Speaker Identification**", *International Journal of Systems Simulation*, Volume 4, Number 2, pp. 73-78, July-December 2010, ISSN: 0975-2080.

16. ***Md. Rabiul Islam*** and Md. Fayzur Rahman, "**Text Dependent Speaker**

Identification System using Discrete HMM in Noise", *International Journal of Computer Applications (IJCA)*, Volume 21, Number 3, pp. 7-13, May 2011, ISSN: 0975-8887.

17. ***Md. Rabiul Islam,*** Md. Fayzur Rahman and Muhammad Abdul Goffar Khan, "**Improvement of the Text Dependent Speaker Identification System using Discrete HMM with Cepstral based Features**", *Daffodil International University Journal of Science and Technology*, Volume 6, Issue 2, pp. 14-21, July 2011.

18. ***Md. Rabiul Islam*** and Md. Fayzur Rahman, "**Feature and Decision Fusion based Facial Recognition in Challenging Environment"**, *International Journal of Computer Applications (IJCA)*, Special Issue on Artificial Intelligence Techniques - Novel Approaches & Practical Applications, pp. 30-35, 2011, ISSN: 0975-8887.

19. Muhammad Abdul Goffar Khan and ***Md. Rabiul Islam***, "**Simulation to Estimate the Potential and Electric Field for Different Sphere-Sphere Electrodes under High Voltage",** *Journal of Engineering and Applied Science (JEAS),* Vol. 2, No. 1, pp. 18-23, June 2012, ISSN: 1999-530X.

20. ***Md. Rabiul Islam***, RizoanToufiq and Md. Abdus Sobhan, "**Appearance and Shape Based Face Recognition Using Backpropagation Learning Neural Network Algorithm with Different Lighting Variations"**,*Science Journal of Circuits, Systems and Signal Processing,*Vol. 2, No. 4, pp. 93-99, 2013, ISSN: 2326-9065 (Print), 2326-9073 (Online), doi: 10.11648/j.cssp.20130204.11.

21. ***Md. Rabiul Islam***,**"An Approach of Likelihood Ratio Score Fusion for Appearance and Shape based Face Recognition",***Journal of Computer Technology & Applications,* Vol. 4, No. 3, pp. 1-8, 2013, ISSN: 2229-6964.

22. ***Md. Rabiul Islam*** and Md. Abdus Sobhan, **"Audio-Only Speaker Identification using Principal Component Analysis based Back-Propagation Learning Neural Network in Noisy Environment",** Current Trends in Signal Processing, Volume 3, Issue 3, pp. 1-10, 2013, ISSN: 2277–6176.

23. ***Md. Rabiul Islam***, **"Iris Recognition System Using Principal Component Analysis based Back-Propagation Learning Neural Networks",** Current Trends in Information Technology, Volume 3, Issue 3, pp. 5-11, 2013, ISSN: 2249-4707.

24. ***Md. Rabiul Islam*** and Md. Abdus Sobhan, **"BPN Based Likelihood Ratio Score Fusion for Audio-Visual Speaker Identification in Response to Noise,"** ISRN Artificial Intelligence, Volume 2014, Article ID 737814, 13

pages, 2014, doi:10.1155/2014/737814.

25. *Md. Rabiul Islam,* **"Performance Comparison between Back-Propagation Learning and Kohonen Self-Organizing Neural Networks Algorithm in Terms of Pattern Recognition,"** Journal of Image Processing & Pattern Recognition Progress, Volume 1, Issue 1, pp. 7-14, 2014, ISSN:

26. *Md. Rabiul Islam* and Md. Abdus Sobhan, **"Feature Fusion Based Audio-Visual Speaker Identification Using Hidden Markov Model under Different Lighting Variations,"** Applied Computational Intelligence and Soft Computing, Volume 2014, Article ID 831830, 7 pages, 2014, doi:10.1155/2014/831830.

27. RizoanToufiq and*Md. Rabiul Islam*, **"Performance Analysis of Fusion Classifier of Face Recognition System based on ANN and GA",** Current Trends in Information Technology, Volume 4, Issue 1, pp. 4-13, 2014, ISSN: 2249-4707.

28. *Md. Rabiul Islam* and RizoanToufiq, **"Multi-Layer Perceptron Neural Network Based Person Identification Using Appearance Based Facial Feature",** Current Trends in Signal Processing, Volume 4, Issue 1, pp. 26-34, 2014, ISSN: 2277–6176.

29. *Md. Rabiul Islam* and RizoanToufiq, **"Discrete Hidden Markov Model based Face Recognition System Introducing Sustainability of Uneven Lighting Distortion",** Trends in Electrical Engineering, Volume 4, Issue 1, pp. 9-16, 2014, ISSN: 2249-4774.

30. RizoanToufiq, Md. Shamiul Haque Chowdhury and *Md. Rabiul Islam*, **"Face Detection and Recognition System Using Back-Propagation Neural Network Classifier",** Journal of Artificial Intelligence Research & Advances, Volume 1, Issue 1, pp. 21-26, 2014.

31. ***Md. Rabiul Islam,***RizoanToufiq and Fayzur Rahman, **"Face Recognition System based on Classifier Local Accuracy Measurements by Multiple Classifier Selection Method",***Journal of the Bangladesh Electronic Society*, Volume 13, Issue 1-2, pp.89-99, 2013, ISSN: ISSN 1816-1510

32. *Md. Rabiul Islam,* **"Feature and Score Fusion Based Multiple Classifier Selection for Iris Recognition,"** Computational Intelligence and Neuroscience, vol. 2014, Article ID 380585, 11 pages, 2014. doi:10.1155/2014/380585.

33. ***Md. Rabiul Islam,***Md. Mostafizur Rahman andRizoanToufiq, **"An Approach to Develop Secure Ear Biometric System",** Journal of Network Security, Volume 2, Issue 1, 2014, ISSN: 2321-8517.

34. Ujjal Suttra Dhar, ***Md. Rabiul Islam***andRizoanToufiq, **"Face Recognition using LDA based Support Vector Machine"**, Journal of Computer Technology & Applications, Volume 5, Issue 2, pp. 1-7, 2014, ISSN: 2229-6964 (online), ISSN: 2347-7229 (print).

35. Md. AhnafTahmid Shakil and ***Md. Rabiul Islam***, **"An Efficient Modification to Playfair Cipher"**, ULAB Journal of Science and Engineering, Volume 5, Issue 1, pp. 26-30, Nov. 2014, ISSN: 2079-4398.

36. SamsJarin, Shah Mohazzem Hossain and ***Md. Rabiul Islam***, **"Introducing Image Steganography in Bangla Language Communication",***International Journal of Computer Applications (IJCA),* Volume 110, No. 8, January 2015, ISSN: 0975 – 8887.

37. ***Md. Rabiul Islam***, "**Retina Recognition System using PCA-based Discrete Hidden Markov Model",***Journal of Network Security,* Volume 3, Issue 1, pp. 28-32, 2015, ISSN: 2321-8517.

38. ***Md. Rabiul Islam*, "Face Recognition using Genetic Algorithm with Self-Organizing Mapping based Dimensionality Reduction Technique",** *Journal of Multimedia Technology & Recent Advancements,* Volume 2, Issue 1, pp. 22-26, 2015, ISSN: 2349-9028.

39. RizoanToufiq, Rawshon Raha, ***Md. Rabiul Islam, "Hand Geometry based Person Identification System usingSupport Vector Machine", Current Trends in Signal Processing,*** Volume 5, Issue 1, pp. 26-33, 2015, ISSN: 2277-6176(online), ISSN: 2321-4252(print).

40. RizoanToufiq, ***Md. Rabiul Islam,*****"A Literature Survey of Hand Geometry-based Verification System",***Current Trends in Information Technology,*Volume 5, Issue 1, pp. 35-42, 2015, ISSN: 2249-4707(online), ISSN: 2348-7895(print).

41. Barshon Sen, ***Md. Rabiul Islam,*****"Iris and Retina Recognition based Multimodal Person Identification System",***Current Trends in Information Technology,*Volume 5, Issue 1, pp. 22-28, 2015, ISSN: 2249-4707(online), ISSN: 2348-7895(print).

42. Golam Kibria, ***Md. Rabiul Islam***, **"Automated Diagnosis of Skin Diseases Using Gray Level Co-occurrence Matrix with Back-Propagation Neural Network Algorithm",***Research and Reviews: Journal of Computational Biology,*Volume 4, Issue 1, pp. 22-27, 2015, ISSN: 2319-3433(online), ISSN: 2349-3720(print).

43. ***Md. Rabiul Islam,*****"Back-Propagation Neural Network Based Speaker**

Identification Under Noise Distortion",*Trends in Electrical Engineering,* Volume 5, Issue 2, pp. 1-6, 2015, ISSN: 2249-4774(online), ISSN: 2321-4260(print).

44. ***Md. Rabiul Islam,*** **"Decision Fusion based Pair of Iris Recognition using Back-Propagation Learning Neural Network Algorithm",** J*ournal of Computer Technology & Applications,* Volume 6, Issue 2, pp. 1-6, 2015, ISSN: 2229-6964(online), ISSN: 2347-7229(print).

45. ***Md. Rabiul Islam,***RizoanToufiq and Md. Fayzur Rahman, **"Genetic Algorithm Based Face Recognition System using Principal Component Analysis"**, *Journal of Electrical Engineering, The Institution of Engineers, Bangladesh (IEB),* Vol. EE 40, No. I & II, pp. 14-20, June & December, 2014.

46. ***Md. Rabiul Islam,*** Md. Fayzur Rahman and M. Abdul Goffar Khan, **"Appearance based Facial Recognition System using DHMM with Linear Discriminant Analysis"**, Daffodil International University Journal of Science and Technology, Vol. 10, Issue 1-2, pp. 51-56, July 2015, ISSN: 1818-5878.

47. ***Md. Rabiul Islam***and Md. Fayzur Rahman, **"Feature Fusion Based Iris and Retina Recognition System Using Kohonon Self-Organizing Mapping Neural Network Algorithm"**, *Trends in Electrical Engineering,*Volume 5, Issue 2, pp. 22-26, 2015, ISSN: 2249-4774(online), ISSN: 2321-4260(print).

48. ***Md. Rabiul Islam*** and Md. Fayzur Rahman,**"Self Organization Mapping based Noise Robust Speaker Identification using Linear Discriminant Analysis",** ULAB Journal of Science and Engineering, Vol. 6, No.1, pp. 2-7, November 2015, ISSN: 2079-4398.

49. ***Md. Rabiul Islam*** and Md. Fayzur Rahman"**Pair of Retina Recognition System using Hopfield Neural Network Algorithm",***Journal of Image Processing & Pattern Recognition Progress*, Volume 2, Issue 2, pp. 41-45, 2015, ISSN: 2394-1995(online).

50. Md. Altaf Hoshain and ***Md. Rabiul Islam,*** **"An Approach to Translate English Voice to Bangla Text for Android Environment",***Journal of Mobile Computing, Communications & Mobile Networks,* Volume 2, Issue 2, pp. 23-28, 2015, ISSN: 2349-901X (online).

51. ***Md. Rabiul Islam*** and Md. Fayzur Rahman,**"An Approachof Multi-modal Biometric Iris and Speech based Person Recognition System with Decision Fusion Technique",** *Journal of Multimedia Technology & Recent Advancements*, Volume 2, Issue 2, pp. 5-10, 2015, ISSN: 2349-9028(online).

52. S. M. Sadrul Islam Asif, RizoanToufiq, ***Md. Rabiul Islam,*** **"Analysis and Optimization of the Naïve Bayes Classifiers Using Cancer Datasets",***Research & Reviews: Journal of Computational Biology***,** Volume 4, Issue 2, pp. 8-12, 2015, ISSN: 2319-3433(online), ISSN: 2349-3720(print).

53. ***Md. Rabiul Islam*** and Md. Fayzur Rahman, **"Speaker Identification using Hopfield Neural Network based Classifier"**, *Journal of Network Security*, Volume 3, Issue 2, pp. 32-35, 2015, ISSN: 2321-8517.

54. ***Md. Rabiul Islam,*** **"Retina Recognition System Using WaveletBased Neural Network Algorithm"**, *Journal of Current Trends in Signal Processing*, Volume 5, Issue 2, pp. 35-39, 2015, ISSN: 2277-6176(online), ISSN: 2321-4252(print).

55. ***Md. Rabiul Islam,*** Md. Fayzur Rahman,**"Multi-Modal Iris and Retina Recognition System using Discrete Hidden Markov Model based Score Fusion Technique",***Current Trends in Information Technology,* Volume 5, Issue 2, pp. 7-12, 2015, ISSN: 2249-4707(online), ISSN: 2348-7895(print).

56. A. K. M. NuhilMehdy and ***Md. Rabiul Islam,*** **"Remote Hardware Control by Web Application",***Journal of Instrumentation Technology & Innovations,*Volume 5, Issue 2, pp. 25-30, 2015, ISSN: 2249-4731(online), ISSN: 2347-7261(print).

57. Abu Sayeed, Abhijeet Saha, ***Md. Rabiul Islam,*** **"Gait Based Person Identification Using Kohonen Self-Organizing Mapping Technique",***Current Trends in Information Technology,*Volume 5, Issue 2, pp. 1-6, 2015, ISSN: 2249-4707(online), ISSN: 2348-7895(print).

58. ***Md. Rabiul Islam***and Md. Abdus Sobhan,**"Face and Iris based Multi-Modal Person Identification using Likelihood Ratio Score Fusion Approach",***Journal of Computer Technology & Applications,*Volume 6, Number 3, pp. 60-67, November 2015, ISSN: 2347-7229.

59. ***Md. Rabiul Islam,*** Md. Abdus Sobhan and Md. Fayzur Rahman, **"Adaptive Fusion for Audio-Visual Speaker Identification using Self-organizing Mapping based Neural Network Algorithm",***Accepted for the publication of Journal of Bangladesh Electronics Society,* Volume 15, Number 1-2, June-December 2015, ISSN: 1816-1510.

60. Md. Nahiduzzaman Rose and ***Md. Rabiul Islam*****, "Human Segregation for Access Control Based on Histogram of Oriented Gradients and Frame Difference Method",** *Computer Science and Engineering Research Journal,* Volume 11, 2018 ISSN: 1990-4010.

61. Abu Sayeed , Md. Ali Hossain and ***Md. Rabiul Islam***, **"A Comparative Analysis on the Task of Classification for Remote Sensing Hyperspectral Data"**, *Journal of Engineering and Applied Science*, Volume 3 No. 1, 2019.

62. Md. Ali Hossain, SubirSarker and ***Md. Rabiul Islam***, **"Optimized Subspace Selection based on Dominant Band Detection from Hyperspectral Images"**, Journal of Engineering and Applied Science, Volume 3 No. 1, 2019.

63. ***Md. Rabiul Islam***, Md. Rajwanul Haque and Md. Minhaz Kadir, **"Tri-Band Double U-Slots Micro-Strip Patch Antenna for Wireless Application"**, *Bangladesh Electronics Society*, Volume 18, Number 1-2, 2018, ISSN: 1816-1510.

64. Sania Zahan, ***Md. Rabiul Islam*** and Md. Khademul Islam Molla, **"A Comparative Study on Classifier Performance for Epileptic Seizure Detection"**, Bangladesh Computer Society *Journal of Computer and Information Technology,* Vol. 01, Issue 01, June 2019.

65. Nakib Aman Turzo, **Md. Rabiul Islam, "Convolutional Neural Network Based Age Classification Using CASIA Iris Dataset",** Bangladesh Computer Society Journal of Computer and Information Technology, Vol.02, September 2020, pp.61-70**,** ISSN 2664-4592(print), 2664-4606(online).

66. Mahit Kumar Paul, **Md. Rabiul Islam,** A.H.M. Sarowar Sattar,**"An efficient perturbation approach for multivariate data in sensitive and reliable data mining"**, Elsevier Journal of Information Security and Applications, Volume 62, November 2021, 102954, **https://doi.org/10.1016/j.jisa.2021.102954**

B: Conference Proceedings

1. ***Md. Rabiul Islam*** and Kaushik Roy, "**An Approach To Implement the Real Time Eye Recognition System Using Artificial Neural Network**",*3rd International Conference on Electrical, Electronics and Computer Engineering (ICEECE-2003)*, pp. 96-101, Stamford University, December 22-24, 2003, Dhaka, Bangladesh**,** ISBN: 984-31-1528-7.

2. Abu Sayeed Md. Sohail, Kaushik Roy, ***Md. Rabiul Islam*** and A.H.M. SarowarSatter,"**Real Time Iris Scanning Using Neural Networks: An Efficient Way To Eye Recognition System**",*2nd International Conference on Computer Science and Its Applications (ICCSA-2004)*, pp. 3-8, National University, US Education Service, San Diego, California, June 28-30, 2004, USA, ISBN: 0-9742448-1-3.

3. Kaushik Roy, Abu Sayeed Md. Sohail, ***Md. Rabiul Islam*** and A.H.M. SarowarSatter, "**Image Processing Techniques for Real Time Eye Recognition**",*2nd International Conference on Computer Science and Its Applications (ICCSA-2004)*, pp. 9-13, National University, US Education Service, San Diego, California, June 28-30, 2004, USA, ISBN: 0-9742448-1-3.

4. Abu Sayeed Md. Sohail, ***Md. Rabiul Islam*** and Kaushik Roy, "**Real Time Face Recognition Using Artificial Neural Networks: A Secure Personnel Identification System**", *3rd International Conference on Electrical & Computer Engineering (ICECE-2004)*, pp. 120-123, Bangladesh University of Engineering & Technology (BUET), December 28-30, 2004, Dhaka, Bangladesh, ISBN: 984-32-1804-4.

5. ***Md. Rabiul Islam***, Abu Sayeed Md. Sohail, Md. Waselul Haque Sadid and M AMottalib, "**Bangla Speech Recognition using Three Layer Back-propagation Neural Network**", *National Conference on Computer Processing of Bangla (NCCPB-2005)*, Independent University Bangladesh (IUB), pp. 148-153, 18 February, 2005, Dhaka, Bangladesh**,** ISBN: 984-32-1983-2.

6. Abu Sayeed Md. Sohail, ***Md. Rabiul Islam***, Boshir Ahmed and M AMottalib, "**Improvement in Existing Offline Bangla Character Recognition Techniques Introducing Sustainability to Rotation and Noise**",*National Conference on Computer Processing of Bangla (NCCPB-2005)*, Independent University Bangladesh (IUB), pp. 163-170, 18 February, Dhaka, 2005, Bangladesh**,** ISBN: 984-32-1983-2.

7. Abu Sayeed Md. Sohail, Md.Mahbubur Rahman Chowdhury, ***Md. Rabiul Islam***, Nazrul Islam Mondaland M A Mottalib, "**Development of A Web Based Bangla SQL Interface Implementing Keyboard Parsing Technique**", *National Conference on Computer Processing of Bangla (NCCPB-2005)*, Independent University Bangladesh (IUB), pp. 126-132, 18 February, 2005, Dhaka, Bangladesh**,** ISBN: 984-32-1983-2.

8. ***Md. Rabiul Islam*** and Md. Waselul Haque Sadid, "**Improvement of the Real Time Eye Recognition System using Neuro-Genetic Hybrid Algorithm**", *8th International Conference on Computer and Information Technology (ICCIT 2005)*, Islamic University of Technology (IUT), pp. 667-672, December 28-30, 2005, Gazipur, Bangladesh, ISBN: 984-32-2873-1.

9. Md. Waselul Haque Sadid**,** ***Md. Rabiul Islam*** and S. M. Kamrul Hasan,"**A New Strategy for Solving Multiple-Choice Multiple-Dimension Knapsack Problem in PRAM Model**",*3rdAsian Applied Computing Conference (AACC 2005) - Innovative Applications of Information Technology for Developing World*, World Scientific e-proceedings, pp. 63-67, 10-12 December, 2005, Kathmandu, Nepal, ISBN-13 978-1-86094-827-5.

10. Md. Waselul Haque Sadid, Mirza Nazrul Alam, Md. Al Mamun, A.H.M. Sarwar Sattar, Mir Md. Jahangir Kabir and***Md. Rabiul Islam***,"**A New Heuristic Algorithm for Multi-Dimension Multiple-Choice Knapsack**

Problem in Distributed System",*3rd Asian Applied Computing Conference (AACC 2005) - Innovative Applications of Information Technology for Developing World*, World Scientific e-proceedings, pp. 50-52, 10-12 December, 2005, Kathmandu, Nepal, ISBN-13 978-1-86094-827-5.

11. Md. Nazrul Islam Mondal, Md. Sadique Sarwar, Boshir Ahmed, and ***Md. Rabiul Islam***, "**The Fastest New Algorithm for Large Number Multiplication by Taking Eight Digits at a Time**", *4th International Conference on Electrical Engineering (ICEE) and 2nd Annual Paper Meet (APM)*, pp. 143-146, Electrical Engineering Division, The Institute of Engineers, Bangladesh, Ramna, Dhaka, Bangladesh.

12. Md. Zakir Hossain, ***Md. Rabiul Islam***, Md. Nazrul Islam Mondal, Md. Waselul Haque Sadid and Md. Shamsul Alam, "**Real Time Audio Video Conferencing with Bangla Interface**", *International Conference on Computer Processing of Bangla (ICCPB 2006)*, Independent University, Bangladesh(IUB), pp. 185-191, 17 February, Dhaka, Bangladesh, ISBN: 984-32-3005-1.

13. Md. Nazrul Islam Mondal, A.A.M. Mahmudul Haque, Md. Sadique Sarwar and ***Md. Rabiul Islam***, "**A Hybrid Implementation of Machine Translation from English to Bengali using the optimal 17 bits Information Code**", *International Conference on Computer Processing of Bangla (ICCPB 2006)*, Independent University, Bangladesh(IUB), pp. 99-105, 17 February, Dhaka, Bangladesh, ISBN: 984-32-3005-1.

14. ***Md. Rabiul Islam*** and M. Abdus Sobhan, "**Improving the Convergence of Backpropagation Learning Neural Networks Based Bangla Speaker Identification System for Various Weight Update Frequencies, Momentum Term and Error Rate**", *International Conference on Computer Processing of Bangla (ICCPB 2006)*, Independent University, Bangladesh(IUB), pp. 27-34, 17 February, Dhaka, Bangladesh, ISBN: 984-32-3005-1.

15. Md. MusfequsSalehin, ***Md. Rabiul Islam*** and M. M. Manjurul Islam, "**An Efficient Approach to Develop an Artificial Intelligent Robot Based on Real Time Task Specifications Using Genetic Programming**",*9th International Conference on Computer and Information Technology (ICCIT 2006)*,Independent University, Bangladesh (IUB), December 21-23, 2006, Dhaka, Bangladesh, ISBN: 984-32-3828-1.

16. Md. Al Mehedi Hasan, Md. Mamun Ar Rashid, Md. Ayub Hossain, ***Md. Rabiul Islam***, Md. Omar Faruqe, "**Performance Analysis of ROWA**

Protocol for Controlling Replica in Data Replication",*International Conference on Electronics, Computer and Communication (ICECC 2008)*, pp. 770-773, University of Rajshahi, June 27-29, 2008, Rajshahi, Bangladesh, ISBN: 984-300-002131-3.

17. ***Md. Rabiul Islam***, Md. Al Mehedi Hasan, Md. Shahid Uz Zaman and Md. Fayzur Rahman "**Performance Comparison between Artificial Neural Network and Genetic Algorithm in terms of Character Recognition System**",*International Conference on Electronics, Computer and Communication (ICECC 2008)*, pp. 578-581, University of Rajshahi, June 27-29, 2008, Rajshahi, Bangladesh, ISBN: 984-300-002131-3.

18. ***Md. Rabiul Islam***, Md. Al Mehedi Hasan, Md. Shahid Uz Zaman and Md. Fayzur Rahman "**Comparison between Iris and Retina Recognition Using Neural Networks: Measurement of Best Technique for Eye Recognition in Biometrics**",*International Conference on Electronics, Computer and Communication (ICECC 2008)*, pp. 360-363, University of Rajshahi, June 27-29, 2008, Rajshahi, Bangladesh, ISBN: 984-300-002131-3.

19. ***Md. Rabiul Islam***, Md. Al Mehedi Hasan and Md. Fayzur Rahman"**Developing Expert Mobile Payment System**",*International Conference on Electronics, Computer and Communication (ICECC 2008)*, pp. 582-585, University of Rajshahi, June 27-29, 2008, Rajshahi, Bangladesh, ISBN: 984-300-002131-3.

20. ***Md. Rabiul Islam***, M. A. Goffar Khan and M. F. Rahman, "**Microprocessor based Temperature Monitoring and Control System using Fuzzy Logic Controller**", *5th International Conference on Electrical and Computer Engineering (ICECE 2008)*, pp. 878-882, IEEE Explorer, 20-22 December, 2008, Dhaka, Bangladesh, ISBN: 978-1-4244-2015-5.

21. ***Md. Rabiul Islam***, Md. Fayzur Rahman, Md. Ruhul Amin and Md. Shahid Uz Zaman, "**Codebook Design Method for Speaker Identification based on Genetic Algorithm**", *11th International Conference on Computer and Information Technology (ICCIT 2008),* IEEE Explorer , pp. 116-120, 25-27 December, 2008, Khulna, Bangladesh, ISBN: 978-1-4244-2136-7.

22. Muhammad Abdul Goffar Khan, ***Md. Rabiul Islam*** and Md. Fayzur Rahman, "**Microprocessor based Online Multiple Data Acquisition and Control Scheme**", *National Conference on Communication and Information Security (NCCIS 2009)*, pp. 59-62, 14 February, 2009, Daffodil International University, Dhaka, Bangladesh.

23. ***Md. Rabiul Islam,*** Md. Fayzur Rahman and Muhammad Abdul

GoffarKhan, "**Improvement of Speech Enhancement Techniques for Robust Speaker Identification in Noise**", *12th International Conference on Computer and Information Technology (ICCIT 2009)*, pp. 255-260, *IEEE Explorer*, pp. 21-23 December, 2009, Dhaka, Bangladesh, ISBN: 978-1-4244-6283-4.

24. M A G Khan, ***Md. Rabiul Islam*** and Md. Akramul Alim, "**Design and Implementation of Non-uniform Segment for Improved Bangla Numeral Display**", Conference on Electronics and Telecommunication, *Bangladesh Electronics Society*, pp. 21-25, June 02-03, 2010, Atomic Energy Centre, Dhaka, Bangladesh.

25. ***Md. Rabiul Islam,*** Md. Fayzur Rahman and M. Abdus Sobhan, "**Genetically Optimized HMM for Robust Speaker Identification in Noise**", *International Conference on Advances in Electrical Engineering (ICAEE 2011)*, Independent University, Bangladesh (IUB), pp. 258-263, December 19-20, 2011, Dhaka, Bangladesh, ISBN: 978-984-33-4342-0.

26. RizoanToufiq, ***Md. Rabiul Islam***and M. Abdus Sobhan, "**PCA based Gradient Decent Variable Learning Rate BPN Algorithms in terms of Face Recognition**",*International Conference on Electrical, Computer and Telecommunication Engineering (ICECTE 2012),* pp. 408-411, 01-02 December, 2012, Bangladesh, ISBN: 978-984-33-5879-0.

27. RizoanToufiq, ***Md. Rabiul Islam***,M. Abdus Sobhan and Md. Fayzur Rahman, "**Face Recognition using Self-Organizing Mapping Technique**",*International Conference on Electrical, Computer and Telecommunication Engineering (ICECTE 2012),* pp. 419-422, 01-02 December, 2012, Bangladesh, ISBN: 978-984-33-5879-0.

28. Tasnuva Haque,***Md. Rabiul Islam***and RizoanToufiq,"**Human Facial Expression Detection using Genetic Algorithm**",*International Conference on Electrical, Computer and Telecommunication Engineering (ICECTE 2012),* pp. 458- 461, 01-02 December, 2012, Bangladesh, ISBN: 978-984-33-5879-0.

29. Muhammad Abdul Goffar Khan, ***Md Rabiul Islam*** and Sarim Khan, "**Design and Implementation of a PC Based Single Channel Online Data Logger using USB Port**",*International Conference on Electrical, Computer and Telecommunication Engineering (ICECTE 2012),* pp. 499-501, 01-02 December, 2012, Bangladesh, ISBN: 978-984-33-5879-0.

30. ***Md. Rabiul Islam***, RizoanToufiq, Md. Nahid Hasan and M. Abdul Goffar Khan, "**Microcontroller Operated Intelligent Vehicle using Artificial Neural Networks**", *International Conference on Electrical, Computer and*

Telecommunication Engineering (ICECTE 2012), pp. 515-518, 01-02 December, 2012, Bangladesh, ISBN: 978-984-33-5879-0.

31. ***Md. Rabiul Islam***, RizoanToufiq, and Md. Fayzur Rahman, "**Appearance and Shape Based Facial Recognition System using PCA and HMM**", *7th International Conference on Electrical and Computer Engineering (ICECE 2012),* pp. 1-4, 20-22 December, 2012, Dhaka, Bangladesh.

32. Muhammad Abdul Goffar Khan, ***Md. Rabiul Islam*** and RizoanToufiq, "**Characterization of Symmetrical Electrode System to Estimate the Degree of Uniformity under Symmetrically and Asymmetrically Applied High Voltage**", *7th International Conference on Electrical and Computer Engineering (ICECE 2012),* pp. 319-322, 20-22 December, 2012, Dhaka, Bangladesh.

33. RizoanToufiq and***Md. Rabiul Islam***, "**Improvement of Face Recognition System Using Multiple Classifier Fusion**",International Conference on Engineering Research, Innovation and Education (ICERIE 2013), pp. 341-346, 11-13 January, Sylhet, Bangladesh.

34. ***Md. Rabiul Islam***and RizoanToufiq, "**Face Recognition Approach Based on Genetic Algorithm**",International Conference on Engineering Research, Innovation and Education (ICERIE 2013), pp. 347-352, 11-13 January, Sylhet, Bangladesh.

35. RizoanToufiq and ***Md. Rabiul Islam***, **"Face Recognition System using PCA-ANN Technique with Feature Fusion Method",** 1st International Conference on Electrical Engineering and Information & Communication Technology (ICEEICT 2014), 10-14 April, 2014, Dhaka, Bangladesh, ISBN: 978-1-4799-4821-5.

36. SagorChandroBakchy, ***Md. Rabiul Islam*** and Abu Sayeed, "**Human Identification on the Basis of Gait Analysis Using Kohonen Self-Organizing Mapping Technique**", 2nd International Conference on Electrical, Computer & Telecommunication Engineering (ICECTE), 8-10 December 2016, Rajshahi-6204, Bangladesh, IEEE Xplore Digital Library, DOI:10.1109/ICECTE.2016.7879561.

37. RizoanToufiq and ***Md. Rabiul Isalm***, "**Face Recognition System Using Soft-output Classifier Fusion Method**", 2nd International Conference on Electrical, Computer & Telecommunication Engineering (ICECTE), 8-10 December 2016, Rajshahi-6204, Bangladesh, IEEE Xplore Digital Library, DOI:10.1109/ICECTE.2016.7879582.

38. Md. Hasibur Rahman and ***Md. Rabiul Islam***, "Predict Student's Academic Performance and Evaluate the Impact of Different Attributes on the Performance Using Data Mining Techniques", 2nd International Conference on Electrical & Electronic Engineering (ICEEE), 27-28 December 2017, RUET, Rajshahi, Bangladesh, IEEE Xplore Digital Library.

39. Hasan Sarker, Md. Oli-Uz-Zaman, Imtiaz Hasan Chowdhury, S. A. H. Chowdhury and ***Md. Rabiul Islam***, **"Node Estimation Approach of Underwater Communication Networks Using Cross-correlation for Direct and Multi-path Propagation",** 1st International Conference on Robotics, Electrical and Signal Processing Techniques (ICREST), 10-12 January, 2019, Dhaka, Bangladesh, IEEE Xplore Digital Library.

40. Md. Sabbir Ejaz, ***Md. Rabiul Islam***, Md Sifatullah and Ananya Sarker, **"Implementation of Principal Component Analysis on Masked and Non-masked Face Recognition",** 1st International Conference on Advances in Science, Engineering and Robotics Technology (ICASERT 2019), 3-5 May, 2019, Dhaka, Bangladesh, , IEEE Xplore Digital Library.

41. Abu Sayeed, Md. Ali Hossain and **Md. Rabiul Islam, "Feature Selection and Comparative Analysis of the Supervised Learning Model for Hyperspectral Image Classification"**, 1st International Conference on Advances in Science, Engineering and Robotics Technology (ICASERT 2019), 3-5 May, 2019, Dhaka, Bangladesh, IEEE Xplore Digital Library.

42. Sania Zahan and **Md. Rabiul Islam, "Epileptic Seizure Detection and Classification using Support Vector Machine from Scalp EEG Signal"**, 1st International Conference on Advances in Science, Engineering and Robotics Technology (ICASERT 2019), 3-5 May, 2019, Dhaka, Bangladesh, IEEE Xplore Digital Library.

43. Rakibul Islam and **Md. Rabiul Islam**, **"Detection of fake online reviews using semi-supervised and supervised learning"**, International Conference on Electrical, Computer and Communication Engineering (ECCE 2019), 7-9 February, 2019, Cox'sBazar, Bangladesh. IEEE Xplore Digital Library.

44. Salam Akter Lima and **Md. Rabiul Islam**, **"A Modified Method for Brain MRI Segmentation Using Dempster-Shafer Theory"**, 22nd International Conference on Computer and Information Technology (ICCIT), 18-20 December, 2019, Dhaka, Bangladesh, IEEE Xplore Digital Library.

45. Ananya Sarker, **Md. Rabiul Islam** and Azmain Yakin Srizon, **"A Comprehensive Pre-processing Approach for High-Performance**

Classification of Twitter Data with several Machine Learning Algorithms", IEEE Region 10 Symposium (TENSYMP) 5-7 June 2020, Dhaka, Bangladesh, IEEE Xplore Digital Library.

46. Md. Alif Rahman Ridoy and Md. Rabiul Islam, **"An Automated Approach to White Blood Cell Classification Using a Lightweight Convolutional Neural Network"**, 2nd International Conference on Advanced Information and Communication Technology (ICAICT), 28-29 Nov. 2020, Dhaka, Bangladesh,IEEE Xplore Digital Library.

47. Nakib Aman Turzo, **Md. Rabiul Islam**, **"Ada Boost Classifier based Binary Age Group Stratification by CASIA Iris Image",** Springer Nature Book Series: Algorithms for Intelligent Systems (AIS), ISSN 2524-7565, February 2021, pp.490-502, DOI:10.1007/978-981-16-0586-4.

48. Md. Alif Rahman Ridoy and **Md. Rabiul Islam**, **"A Lightweight Convolutional Neural Network for White Blood Cells Classification"**, 23rd International Conference on Computer and Information Technology (ICCIT), 19-21 December, 2020, IEEE Xplore Digital Library.

49. S.M. Shovan, Md. Al Mehedi Hasan and **Md. Rabiul Islam**, **"Accurate Prediction of Formylation PTM Site using Multiple Feature Fusion with LightGBM Resolving Data Imbalance Issue"**, 23rd International Conference on Computer and Information Technology (ICCIT), 19-21 December, 2020, IEEE Xplore Digital Library.

50. Rakibul Hassan and **Md. Rabiul Islam**, **"A Supervised Machine Learning Approach to Detect Fake Online Review"**, 23rd International Conference on Computer and Information Technology (ICCIT), 19-21 December, 2020, Dhaka, Bangladesh, IEEE Xplore Digital Library.

51. Rakibul Hassan and **Md. Rabiul Islam**, **"Impact of Sentiment Analysis in Fake Online Review Detection"**, International Conference on Information and Communication Technology for Sustainable Development (ICICT4SD), 27-28 February, 2021, Dhaka, Bangladesh, IEEE Xplore Digital Library.

52. S.M. Shovan, Md. Al Mehedi Hasan and **Md. Rabiul Islam**, "Improved Prediction of Glutarylation PTM Site using Evolutionary Features with LightGBM Resolving Data Imbalance Issue", International Conference on Information and Communication Technology for Sustainable Development (ICICT4SD), 27-28 February, 2021, Dhaka, Bangladesh, IEEE Xplore Digital Library.

C: Workshop

1. ***Md. Rabiul Islam*** and Md. Waselul Haque Sadid, "**A New Approach to Video Compression using JPEG based Low Bit-Rate Video Coding System over Mobile Networks**", *Workshop on Prospects and Problems of Mobile and Land Phones in Bangladesh*, Independent University, Bangladesh, pp. 34-41, 08 December, 2005, Dhaka, Bangladesh, ISBN: 984-32-2817-9.

D: Books

1. ***Md. Rabiul Islam*** and Md. Fayzur Rahman, ***Improvement of Noise Robust Speaker Identification***, LAP Lambert Academic Publishing AG & Co. KG, Germany, 2010, ISBN: 978-3-8383-6415-5.
2. ***Md. Rabiul Islam,*** Md. Sohrab Mahmud and Md. Fayzur Rahman, ***Vector Quantization based Speech Recognition System***, LAP Lambert Academic Publishing AG & Co. KG, Germany, 2010, ISBN: 978-3-8383-6891-7.
3. ***Md. Rabiul Islam*** andM. Abdul Goffar Khan, ***Retina Recognition: Secure Biometric Authentication System,*** LAP Lambert Academic Publishing AG & Co. KG, Germany, 2012, ISBN: 978-3-8484-1653-0.
4. RizoanToufiq and ***Md. Rabiul Islam, Face Recognition Using Multiple Classifier Fusion,*** LAP Lambert Academic Publishing AG & Co. KG, Germany, 2012, ISBN: 978-3-8473-0734-1.
5. ***Md. Rabiul Islam, Audio-Visual Speaker Identification,*** LAP Lambert Academic Publishing AG & Co. KG, Germany, 2012, ISBN: 978-3-659-27296-7.

Curriculum Vitae of Assistant Researcher
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OBJECTIVES

To perform and nurture my skills in the area of Computer Science & Engineering for developing a challenging career in the domain of modern research and technology with integrity, commitment, and enthusiasm where technical expertise is a must and communication skills are appreciated.

WORK EXPERIENCE

Feb 2021 – Present **Lecturer · Full Time**
Department of Computer Science & Engineering,
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Rajshahi-6204, Bangladesh.

Sep 2019 – Sep 2020 **Lecturer · Full Time**
Department of Computer Science & Engineering,
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Jul 2018 – Present **Research Candidate**
Machine Learning Research Group,
Supervised By: Dr. Md. Al Mehedi Hasan,
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EDUCATIONAL QUALIFICATION

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Thesis Topic: Bornomala-Net: An Effective Deep Learning Approach

for Handwritten Bengali Characters Recognition
Supervisor: Dr. Md. Ali Hossain, Professor, Dept. of CSE, RUET

Courses Taken: Pattern Recognition, Machine Learning, Biometrics, Advanced Digital Image Processing, Evolutionary Algorithms and Software Testing.

2015 – 2019 **Bachelor of Science in Computer Science & Engineering (B.Sc. Engg.)**
CGPA: 3.86 (out of 4.00), Position: 3rd
Department of Computer Science & Engineering,
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Thesis Topic: Prognostic Biomarker Identification for Pancreatic Cancer by Analyzing Multiple mRNA Microarray and microRNA Expression Datasets
Supervisor: Dr. Md. Al Mehedi Hasan, Professor, Dept. of CSE, RUET

2012 – 2014 **Higher Secondary Certificate (H.S.C.)**
Science, GPA: 5.00 (out of 5.00), Board: Rajshahi,
Rajshahi College, Rajshahi-6100, Bangladesh.

2010 – 2012 **Secondary School Certificate (S.S.C.)**
Science, GPA: 5.00 (out of 5.00), Board: Rajshahi,
Rajshahi University School and College, Rajshahi-6205, Bangladesh.

SKILLS AND INTERESTS

Research Domains	Pattern Recognition, Data Mining, Computer Vision, Machine Learning, Deep Learning, Transfer Learning, Natural Language Processing, Biomedical, Digital Image Processing and Bioinformatics
Languages	English – Full Professional Proficiency, Bengali – Full Professional Proficiency
Interpersonal Skills	Presentation, Documentation, Public Speaking, Time and Event Management
Programming Scripts	Python, R, C, C++, Java, C#, MATLAB, PHP, Latex
Applications	Anaconda, Kaggle, Visual Studio, Google Collab

PUBLICATIONS

ICCIT, 2022 ComNet: A Deep Convolutional Neural Network Capable of Classifying Compound Bengali Handwritten Characters High Number of Classes in a Data-Scarce State. In *2022 25th International Conference on Computer and Information Technology (ICCIT)*, pp.1-5. IEEE, 2022.

Human Activity Recognition Utilizing Ensemble of Transfer-Learned Attention Networks and a Low-Cost Convolutional Neural Architecture. In *2022 25th International Conference on Computer and*

Information Technology (ICCIT), pp.1-6. IEEE, 2022.

An Ensemble Approach for Identification of Distracted Driver by Implementing Transfer Learned Deep CNN Architectures. In *2022 25th International Conference on Computer and Information Technology (ICCIT)*, pp.1-5. IEEE, 2022.

Post-Pandemic Sentiment Analysis Based on Twitter Data Using Deep Learning. In *2022 25th International Conference on Computer and Information Technology (ICCIT)*, pp.1-6. IEEE, 2022.

ICECTE, 2022 BornomalaNet: An Effective Approach for Handwritten Bengali Characters Recognition by Using a Low-cost Convolutional Neural Network. In *2022 4th International Conference on Electrical, Computer & Telecommunication Engineering (ICECTE 2022)*, pp.1-4. IEEE, 2022.

STI 4.0, 2022 An Effective Approach for Handwritten Punctuation Recognition by Using a Low-cost Convolutional Neural Network. In *2022 4th International Conference on Sustainable Technologies for Industry 4.0*, pp.1-6. IEEE, 2022.

RTIP2R, 2022 A Hybrid Campus Security System Combined of Face, Number-plate, and Voice Recognition. In *2022 5th International Conference on Recent Trends in Image Processing & Pattern Recognition (RTIP2R)*, pp.1-13. Springer, 2022.

IEEE Access, 2022 Ensembled Transfer Learning Based Multi-channel Attention Networks for Human Activity Recognition in Still Images. IEEE Access, 10(X), p.47051.

Sensors, 2021 American Sign Language Alphabet Recognition by Extracting Feature from Hand Pose Estimation. *Sensors*, *21*(17), p.5856. MDPI.

Applied Sciences, 2021 BengaliNet: A Low-Cost Novel Convolutional Neural Network for Bengali Handwritten Characters Recognition. *Applied Sciences, 11*(15), p.6845. MDPI.

ICCIT, 2021 Improving Performance of a Pre-trained ResNet-50 Based VGGFace Recognition System by Utilizing Retraining as a Heuristic Step. In *2021 23rd International Conference on Computer and Information Technology (ICCIT)* (pp. 1-6). IEEE.

Low Resolution Hand Gestures Recognition of Bengali Sign Alphabet by Using a Convolutional Neural Network. In *2021 23rd International Conference on Computer and Information Technology (ICCIT)* (pp. 1-6). IEEE.

Exploring Spectral and Spatial Features Using a Hybrid Approach Combining Stacked AutoEncoder and a Novel Convolutional Neural Network for Hyperspectral Image Classification. In *2021 23rd International Conference on Computer and Information Technology (ICCIT)* (pp. 1-6). IEEE.

BIM, 2021 Probing Skin Lesions and Performing Classification of Skin Cancer Using EfficientNet while Resolving Class Imbalance Using SMOTE. In *2021 International Conference on Big Data, IoT and Machine*

Learning. Taylor & Francis. [Accepted]

A Deep Learning Approach in Detailed Fingerprint Identification. In *2021 International Conference on Big Data, IoT and Machine Learning*. Taylor & Francis. [Accepted]

ICBET, 2020 Identifying Prognostic Features for Predicting Heart Failure by Using Machine Learning Algorithm. In *2021 11th International Conference on Biomedical Engineering and Technology* (pp. 40-46).

ICICT4SD, 2020 High Performance Classification of Caltech-101 with a Transfer Learned Deep Convolutional Neural Network. In *2021 International Conference on Information and Communication Technology for Sustainable Development (ICICT4SD)* (pp. 35-39). IEEE.

ICECE, 2020 Bengali Handwritten Compound Characters Recognition by Utilizing Transfer Learning. In *2020 11th International Conference on Electrical and Computer Engineering (ICECE)* (pp. 218-221). IEEE.

Bengali Sign Language Characters Recognition by Utilizing Transfer Learned Deep Convolutional Neural Network. In *2020 11th International Conference on Electrical and Computer Engineering (ICECE)* (pp. 423-426). IEEE.

Accurate Recognition of Leukemia Sub-types by Utilizing a Transfer Learned Deep Convolutional Neural Network. In *2020 11th International Conference on Electrical and Computer Engineering (ICECE)* (pp. 427-430). IEEE.

High-Performance Object Recognition by Employing a Transfer Learned Deep Convolutional Neural Network. In *2020 11th International Conference on Electrical and Computer Engineering (ICECE)* (pp. 250-253). IEEE.

Handwritten Numerals Recognition by Employing a Transfer Learned Deep Convolution Neural Network for Diverse Literature. In *2020 11th International Conference on Electrical and Computer Engineering (ICECE)* (pp. 431-434). IEEE.

STI 4.0, 2020 Prognostic Biomarkers Identification for Diabetes Prediction by Utilizing Machine Learning Classifiers. In *2020 2nd International Conference on Sustainable Technologies for Industry 4.0 (STI)* (pp. 1-6). IEEE.

ICCIT, 2020 Accurate Recognition of Coronary Artery Disease by Applying Machine Learning Classifiers. In *2020 23rd International Conference on Computer and Information Technology (ICCIT)* (pp. 1-6). IEEE.

Classification of American Sign Language by Applying a Transfer Learned Deep Convolutional Neural Network. In *2020 23rd International Conference on Computer and Information Technology (ICCIT)* (pp. 1-6). IEEE.

Bengali Handwritten Isolated Compound Characters Recognition by Applying Transfer Learned Deep Convolutional Neural Network. In *2020 23rd International Conference on Computer and Information*

Technology (ICCIT) (pp. 1-6). IEEE.

ICAICT, 2020 Classification of Sign Language Characters by Applying a Deep Convolutional Neural Network. In *2020 2nd International Conference on Advanced Information and Communication Technology (ICAICT)* (pp. 434-438). IEEE.

Tensymp, 2020 Effective Data Dimensionality Reduction Workflow for High-Dimensional Gene Expression Datasets. In *2020 IEEE Region 10 Symposium (TENSYMP)* (pp. 182-185). IEEE.

A Comprehensive Pre-processing Approach for High-Performance Classification of Twitter Data with several Machine Learning Algorithms. In *2020 IEEE Region 10 Symposium (TENSYMP)* (pp. 630-633). IEEE.

Classification of Bengali Sign Language Characters by Applying a Novel Deep Convolutional Neural Network. In *2020 IEEE Region 10 Symposium (TENSYMP)* (pp. 1303-1306). IEEE.

IJIRCST, 2019 Twitter data classification by applying and comparing multiple machine learning techniques. *International Journal of Innovative Research in Computer Science & Technology (IJIRCST) ISSN*, pp.2347-5552.

IC4ME2, 2019 Prognostic Biomarker Identification for Pancreatic Cancer by Analyzing Multiple mRNA Microarray and microRNA Expression Datasets. In *2019 International Conference on Computer, Communication, Chemical, Materials and Electronic Engineering (IC4ME2)* (pp. 1-4). IEEE.

COMPLETED THESIS SUPERVISION

Bioinformatics, Machine Learning **A Multi-label Classifier for Identifying Multiple Lysine PTM Site by Integrating Multiple Information Sources**
Author: Rajorshi Bhattacharya

Data Mining **Defense System Engineering**
Author: Nawrin Ahsan

Data Mining, Machine Learning **Effective Workflow for High-Performance Recognition of Fruits using Machine Learning Approaches**
Authors: Abdul Kader, Samiha Sharif and Pranto Bhowmick

Biomedical Imaging, Machine Learning **Detection of Acute Lymphoblastic Leukemia by Applying Machine Learning Classifiers**
Authors: Md. Asifuzzaman and Bibek Kumar

COURSES TAUGHT

Structured Programming, Object Oriented Programming, Data Communication, Mobile Ubiquitous and Computing, Computer Networks, Artificial Intelligence, Machine Learning, Data Mining, Digital Signal Processing and Web Based Application Project.

PROFESSIONAL TRAINING

09-12 February 2022 **Foundation Training on Teaching-Learning**
Rajshahi University of Engineering & Technology, Rajshahi, Bangladesh
Organized By: Institutional Quality Assurance Cell (IQAC), RUET

22 June 2021 **BNQF and BAC Accreditation & Standards**
Rajshahi University of Engineering & Technology, Rajshahi, Bangladesh
Organized By: Institutional Quality Assurance Cell (IQAC), RUET

20-21 January 2020 **Onsite Training on Outcome Based Education**
Bangladesh University of Engineering & Technology, Natore, Bangladesh
Organized By: Department of CSE, BAUET

15-18 September 2019 **Method of Instructions (MoI)**
Bangladesh University of Engineering & Technology, Natore, Bangladesh
Organized By: Registrar Office, BAUET

14-21 September 2018 **Road to 5G, AI, Cloud Computing, 4G-Based Station Configure and More**
Huawei University, Huawei Headquarters, Shenzhen, China
Organized By: Huawei Technologies Co., Ltd.

10-13 September 2018 **Chinese Language and Cultural Experience**
Chinese Language & Cultural University (BLCU), Beijing, China
Organized by: Huawei Technologies Co., Ltd. and BLCU

WORKSHOPS AND CONFERENCES

Workshops **Android App & Game Development**
Rajshahi University of Engineering & Technology, Rajshahi, Bangladesh
Organized By: ICT Division, Bangladesh, 2018

EATL App Contest Bootcamp
University of Asia Pacific, 74/A Green Rd, Dhaka 1205
Organized By: Prothom Alo, GP & ICT Division, Bangladesh, 2016

Conferences **4th International Conference on Electrical, Computer & Telecommunication Engineering (ICECTE)**
Rajshahi University of Engineering & Technology, Rajshahi, Bangladesh
Participation Type: Author, Date: 29-31 December 2022

25th International Conference on Computer and Information Technology (ICCIT)
Cox's Bazar, Chattogram, Bangladesh
Participation Type: Author, Date: 17-19 December 2022

5th International Conference on Recent Trends in Image Processing and Pattern Recognition (RTIP2R)

Texas A&M University, Kingsville, Texas, USA
Participation Type: Author, Date: 1-2 December 2022

24th International Conference on Computer and Information Technology (ICCIT)
North South University, Dhaka, Bangladesh
Participation Type: Author, Date: 19-20 December 2021

International Conference on Automation, Control and Mechatronics for Industry 4.0 (ACMI)
Rajshahi University of Engineering & Technology, Rajshahi, Bangladesh
Participation Type: Participant, Date: 8-9 July 2021

International Conference on Big Data, IoT and Machine Learning (BIM)
Chittagong University of Engineering & Technology, Chattogram, Bangladesh
Participation Type: Author, Date: 23-25 September 2021

Information and Communication Technology for Sustainable Development (ICICT4SD)
Bangladesh University of Professionals, Dhaka, Bangladesh
Participation Type: Author, Date: 27-28 February 2021

23rd International Conference on Computer and Information Technology (ICCIT)
Ahsanullah University of Science and Technology, Dhaka, Bangladesh
Participation Type: Author, Date: 19-21 December 2020

2nd International Conference on Sustainable Technologies for Industry 4.0 (STI 4.0)
Green University of Bangladesh, Dhaka, Bangladesh
Participation Type: Author, Date: 19-20 December 2020

11th International Conference on Electrical and Computer Engineering (ICECE)
Bangladesh University of Engineering & Technology, Dhaka, Bangladesh
Participation Type: Author, Date: 17-19 December 2020

2nd International Conference on Advanced Information and Communication Technology (ICAICT)
United International University, Dhaka, Bangladesh
Participation Type: Author, Date: 27-28 December 2020

IEEE TENSYMP (2020 IEEE Region 10 Symposium)
Bangladesh University of Engineering & Technology, Dhaka, Bangladesh
Participation Type: Author, Date: 5-7 June 2020

5th International Conference on Computer, Communication, Chemical, Materials and Electronic Engineering (IC4ME2)
University of Rajshahi, Rajshahi, Bangladesh

Participation Type: Author, Date: 11-12 July 2019

HONORS AND MEMBERSHIPS

Awards

Champion & Top Performer
Huawei Seeds for the Future, 2018
Huawei Technologies Co., Ltd., Beijing and Shenzhen, China

1st Runner-up
RITS Idea Contest, 2015
Rajshahi University of Engineering & Technology, Rajshahi, Bangladesh

Meritorious Student Award
Session: 2002-2012, 2017
Rajshahi University School and College, Rajshahi, Bangladesh

Programming Coach

International Collegiate Programming Contest Regional 2020, Dhaka University, Dhaka, Bangladesh. Teams: RUET Trinity, RUET WALovers.

National Collegiate Programming Contest 2020, Military Institute of Science and Technology, Dhaka, Bangladesh. Teams: Lazy Propagation, Bit Coders

Ada Lovelace National Girls' Programming Contest 2020, University of Asia Pacific, Dhaka, Bangladesh. Teams: BAUET Semicolon, BAUET Hack Inversion.

Memberships & Others

Reviewer, IEEE Access (2020 – Present)

Reviewer, ICBET, Japan (2021-Present)

Judge, HULT Prize 2020, BAUET

Vice President, BAUET Computer Society (May 2020 – Sep 2020)

Vice President, BAUET Programming Club (Oct 2019 – May 2020)

Head of Web Division, Innovation Society of RUET (Dec 2016 – Jun 2018)

C# & Python Scripter, TRU-BLU Game Studio (Dec 2016 – Jun 2018)

Guest Speaker, Webinar on Competitive Programming

Host & Guest Speaker, Webinar on Research & Development

Consultant, Rajshahi WASA, Rajshahi (Mar 2021 – Present)

Advisor, bdapps, Bangladesh (April 2022 – Present)

Advisor, Astronomy & Science Society of RUET (July 2022 – Present)

Resource Person, iDEA Project, ICT Division (April 2022 – Present)

ADDITIONAL INFORMATION

Nationality	Bangladeshi (By Birth), National ID: 731 247 8675
Passport Information	Passport No: BR0606367, Date of Expiry: 28 January 2023
Marital Status	Unmarried
Religion	Islam
Professional Profiles	**LinkedIn:** linkedin.com/in/azmain-yakin-srizon
	Publons: publons.com/researcher/4365423/azmain-yakin-srizon
	ResearchGate: researchgate.net/profile/Azmain-Srizon
	ORCHID: 0000-0003-4674-0365
	Google Scholar: scholar.google.com/citations?user=6zXjgsEAAAAJ
	GitHub: github.com/Srizon143005
	RUET Website: ruet.ac.bd/azmainsrizon

REFERENCES

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I declare that all information provided is true.

Md. Azmain Yakin Srizon
Date: **31.01.2023**