Predicting Sleep Disturbance During Covid-19 in Bangladesh

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The Thesis report has been submitted in fulfillment of the requirements for the Degree of Bachelor of Science in Software Engineering.

APPROVAL

This thesis titled on **"Predicting Sleep Disturbance during COVID-19 in Bangladesh"**, submitted by **Imrul Quais**, ID: **181-35-2470** to the Department of Software Engineering, Daffodil International University has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of Bachelor of Science in Software Engineering and approval as to its style and contents.

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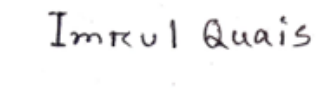

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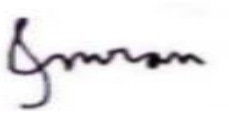

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ABSTRACT

The COVID-19 virus is now considered a hot topic among researchers around the world. Globally, the COVID-19 pandemic has had a serious impact on human life since it began. As a result of this virus, sleeping patterns have changed dramatically and the prevalence of insomnia has increased. Both mental and physical health have been negatively affected.

In this thesis study, it discusses the effect of COVID-19 that influences people highly and the factors which are mostly responsible for these problems. The sample is recruited from the Bangladesh using online self-report measures where (n = 945, 59.2% Male, 40.8% female). Here the ANN (MLP) & LR has been used for analysis of the research and different types of difference has been showed between this two Algorithms with their statistical analysis. Statistical analysis was done in Microsoft excel office and SPSS. But ANN (MLP) which provides best optimal result for the dataset.

This study will help the medical professionalisms & clinicians to get an overview about the Covid-19 factors impact during this long period and the statistical amount of the effect.

Keywords: Covid-19, sleep disturbance, coronavirus, pandemic, anxiety, insomnia.

CHAPTER - 1

Introduction

1.1 Introduction

Coronavirus disease is caused by the SARS-COV-2 virus, which is officially identified as COVID-19. First observed in December 2019, this COVID-19 virus was transmitted from Wuhan in Hubei Province of China (1-3). COVID-19 was declared a pandemic by the World Health Organization (WHO) on March 11, 2020 (4). Covid-19 is spreading throughout the world (4). A total of 264,609,841 COVID-19 cases in the world have been confirmed till December 3, 2021, and 5,253,114 deaths have occurred worldwide for this disease (5). Most of the countries trying to adopt and prevent this virus, for this reason, have taken different steps such as office activities remotely, banning of international travel, lockdowns, and physical distancing from others. All of us recognize that Bangladesh is a decrease- center- profits country and it's also the world's maximum densely peopled country (6). Because of this, Bangladesh also trying to stop the unfold of the criticism the usage of its confined coffers (6). In Bangladesh, the COVID-19 case changed into built on March 7, 2020. The various overall populace instances have been verified around 1,576,827 and 27,986 total deaths in Bangladesh as of December 3, 2021 (7). For this reason, the government of Bangladesh determined to declare lockdown on March 26 so they can prevent the country's humans from this virus (6). Mental health and poverty are related (8). There's a higher burden of mental issues between Low and middle-income countries have in place of economically developed countries (9, 10). Intellectual fitness offerings are noticeably insufficient in low-and middle-profits nations, and the sources for intellectual health are nevertheless scarce, inefficiently applied, and inequitably allotted (11, 12). In comparison with Australia and Canada, the location of Bangladesh is greater than a hundred- fold at the back of in terms of the number of psychiatrists consistent with 100,000 population amongst the overall population (13). The amount of occupational therapists per 100,000 population is zero in Bangladesh (13). However this charge is round 7.65 and 3.7 in Australia and Canada (13). The paying value of intellectual disorders is about 20% of the fee of intellectual health care in Australia and Canada, but in Bangladesh, human beings have to pay the entire cost of the remedy (13). It's noted that intellectual fitness offerings are non-existent virtually at the primary care level of the in the country (14, 15). The shortage of an adequate wide variety of psychiatrists, and maximum of them in large towns which makes the load heavier too much (16). Because of this, intellectual fitness issues throughout the COVID-19 pandemic were an excessive amount of excessive in Bangladesh. Covid-19 has a intellectual impact with the bodily impact (17, 18). With that tension and depression and self-mentioned strain are common psychological outcomes of the COVID-19 pandemic (19). Preceding exceptional research have proven that the superiority of novel infectious sicknesses, like SARS, can boom tension, melancholy, and pressure stages among the overall populace (20). Staying at home, doing homeschooling for kids, working from home, decreasing social interplay, operating many extra hours in disturbing conditions, and fitness dangers will have an intense effect on every day workings and middle of the night sleep (18). As humans stayed

inside the domestic maximum of the days throughout this time it disrupted the sleep nice for the extraordinary forms of the impact of motives (21). Sleep performs a critical position in the emotional law of human beings (22–25). Distinct types of cross-sectional epidemiological research have proven that there is a hard relation between sleep disturbance with new-onset of bad mental health fame and lasting terrible intellectual fitness popularity a few of the people of the country (26–30). Sleep disturbance is likewise considered a causal factor for plenty mental fitness issues (31). We realize that distinct research have proven that proper satisfactory sleep no longer simplest reduces the threat of non-communicable illnesses (NCDs) (32–37) however also facilitates to enhance immunity against viral contamination of the human body (38, 39). Via true best sleep, the immune gadget can be developed and this could play an amazing effect on the susceptibility of COVID-19 contamination. Except it additionally stated that economic burden, own family support, and social assist have an amazing effect on psychological health and sleep (40). This paper will try to investigate the threat elements related to sleep disturbance within the context of COVID-19 and new regular lifestyles throughout the long duration in Bangladesh.

Eventually, on this thesis, the principle goal is to analyze the impact of various factors on insomnia to carry out the essential powerful reasons amongst them all.

1.2 Motivation of the Research

The Corona virus that means Covid-19 has an extra effect at the lifestyles of the humans of Bangladesh. It was estimated the effect of this virus will be increased from the starting because of the human to human. But this Covid-19 has prevalence vast range to the whole world dramatically which was not under consideration to the specialists. So it has kept a great impact on the whole world people for sleeping. There are many reasons for sleep problems this time of the pandemic. Like – demographical or covid-19 related. All the factors are not responsible for all the time for this sleep disturbance. For this, my research study will find out the factors which have the most impact on this sleep problem. According to find out the problem the clinicians will realize and they will be able to easily find out the reason when any patients will come to them for their insomnia during this covid-19.

1.3 Problem Definition

From 2020, we can see that the people are suffering too much from these problems of covid-19 like the other developed countries. This has brought a dramatic change of the normal life of the human that may be physical and mental. So for this reason people are being disrupted from leading a peaceful life. Because many factors have influenced human life and kept them far from their normal sleep. Like – internet use increase, anxiety, sleeping schedule change, staying at home and working from home, and so on. So it has kept negative impact mostly like before the starting of the pandemic. Before the Covid-19 the reasons for sleep problems also existed but they were not so much under consideration like this time of two years. These two years this has increased too much and this is out of our thinking. We all know that sleep is very much important for all people and 6-8 hours sleeping is very much needed every day for a human. But this time the timing has changed highly. For this reason, people are falling different problems which are leading them to sometimes suicidal attacks for being mentally depressed or tense and making them ill in severe. So this problem has become the central discussion and hot topic in recent times.

1.4 Research Question

1. What affect mostly people in their sleeping during this pandemic?
2. Which algorithm is more acceptable for this analysis?

1.5 Thesis Organization

Chapter one describes the introduction, background of this research, objective, motivation of the study, problem statement etc. Chapter two illustrates the literature reviews. Chapter three describes the methodology, data collection, data analysis etc. Chapter four represents evaluation metrics and analysis. Chapter five represents result and discussion. In the end, chapter six represents conclusion, findings and destiny works.

CHAPTER - 2

BACKGROUND

2.1 Introduction

There are no such good papers where they have used artificial analysis with logistic regression for finding the best output of this problem. So, I have thought about creating the analysis using a neural network analysis system that can identify the best result and is more accurate than others.

2.2 Related Works/ Literature review

In ANN the input unit takes input from the environment and weight and bias are also added with the input, then in the hidden layer, there is an activation function where it calculates the mathematical unit. After that, it compares every output with the actual value. It continues the calculation when the expected result is not satisfied with the actual one by changing the weight in every calculation. Besides, in most of the cases, LR has been used for the analysis. So for this reason I have used ANN with LR algorithm to recognize my data set.

In the paper [41] it works on multivariate logistic regression for analysis and they have used the lockdown period for their research and the Dhaka city is used only. But if the ANN can be used it would be better. Those who will work on this paper will get a benefit from the lockdown data analysis.

In the paper [42] there is described of the descriptive analysis because they have worked with previously collected different data. With that, they have used longitudinal studies because they have collected data from a previous certain period. If they would use the recent time of the pandemic analysis it would be better.

In paper [43] their primary intention is to assess adjustments in sleep at some stage in the COVID-19 outbreak and use information-driven tactics to become aware of distinct profiles of modifications in sleep-related behaviors. But they have used retrospective approaches for the data that created recall bias because the participants didn’t realize their history of problems. Here also mentioned about the three month time for research of the starting of thee covid-19. Here they have used the KNN algorithm for classification analysis, U test, ACNOVAs, McNemar's tests and Chi-square test for analysis, multivariate logistic regression. As there have used the starting time do the result of sleep problem may not be too serious for the analysis.

In paper [44] it can be easily found out the comparison between the pre lockdown and the during lockdown sleep situation. But there is recall and response bias because there have collected data from pre-lockdown situations and so that all respondents could not memorize the previous information. With that, the missing values also create the bias of the result. Right here, they have got only used different checks for evaluation like- Chi rectangular, Mann-Whitney U-trying out, Kruskall-Walis, X2 goodness of in form for specific variables. There is no algorithm they have used for their research.

In paper [45], there is research about the university students' sleep problems on lower resilience, preexisting mental health, depression, and anxiety. But there they have used only university students and only undergraduates with that investigation of only for the short period. They needed to use all university students to analyze the students' situation during the pandemic and needed to a long time analyze. There were used t-testing, one -way- ANOVA, and hierarchical evaluation. There is no algorithm or ANN analysis that gives the best output.

From paper [46], we can know about the students and administrative staff's condition during pandemic on sleep which is very much helpful to know the university level analysis. But there is no neural network analysis that could be better for getting the performance of output. They only used normal analytical analysis. With that, this study is explorative and no general people are here for analysis so the whole population assumption will not be calculated.

In paper [47], there is clear evidence about the junior, senior, and college students total analysis. But there is a lack of other older-aged populations which is much important for the total analysis. And there is a vast amount of females which can give a huge result bias for analysis. In the paper, they used the chi-square test and linear and logistic analysis for their research.

According to paper [48], there is clear evidence on physicians about their sleep problems during the pandemic. However on this, they didn't take a look at the impact of many factors as overall working hours/week and materials abuse, which may create lower accuracy and not total result invention. There is no use of the neural network or other algorithms use, which may help to better analyze the result.

In the paper [49] works on statistical analysis using SPSS with chi-square test, spearman's test and linear regression. They worked on only children and adolescents using SDSC. They focused on the anxiety level for sleep measurement. There is no graphical representation which may easily improve the better realization of the analysis.

In the paper [50] works on statistical analysis using SPSS with ANOVA test, and multivariate regression analysis. They worked on only adults. They focused on the psychological distress like stress, depression and anxiety for sleep measurement.

2.3 Bangladesh Perspective

As Bangladesh is not a well-developed country, its people are living with so many struggles for continuing daily life. So, for this reason, the sleep problem is very acute among people. But for the covid-19 it's so much affected from last years. For this reason, this sleep measurement analysis on different factors is very necessary here.

CHAPTER - 3

RESEARCH METHODOLOGY

Research methodology was done by the following factors.

- Introduction
- Data Collection.
- Data Preprocessing
- Research Population.
- Research Sample.
- Data Analysis.
- Research Model.

3.1 Introduction

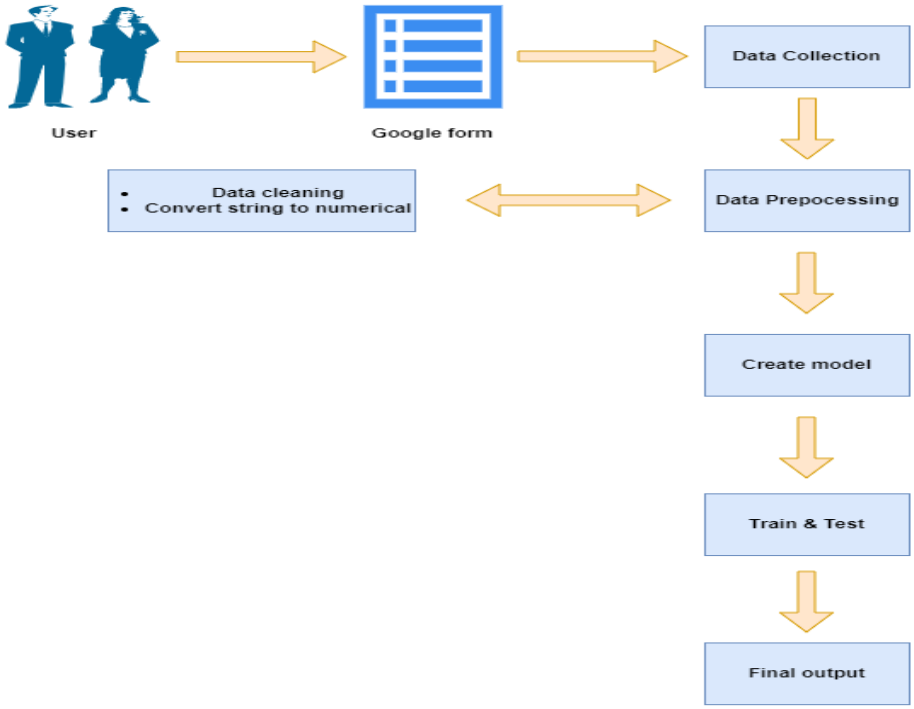

Fig 1: Working steps

In Fig 1, I have shown the steps of the working procedure of my research. Firstly, I will create a questionnaire form to fill up the respondents. Then I will preprocess the dataset for its vulgarity. After preprocessing all the data, we will apply data exploration to visualize our dataset. Then we will create a model and according to the model of target and independent factors, I will fit my dataset. After that, I will train all the data. Finally, I will test a particular input by using the model to identify if the model is right or wrong to predict.

3.2 Data Collection

The survey was done in google forms. The questions of this survey were collected from a published journal [42]. Besides that there are seven questions of the Insomnia severity index are taken from another research paper [50] which are collected from and the survey link was distributed through an online social media platform (Facebook). Users who are aged 11 and live in Bangladesh are eligible to complete the survey.

3.3 Data Preprocessing

After collecting g the data the total data set is preprocessed whether there is an invalid or null value existing or not. As the question form was restricted through the required option for each question for this reason there was no null value found after using the analysis function.
But before loading to the dataset in SPSS for analysis all the string types values are converted using a numerical value. Because for better and easy analysis we need the numerical format.

3.4 Research Population

Male and females aged 11 are eligible for this research study and they live in different parts of Bangladesh.

3.5 Research Sample

The total sample collected data is about 945 from all over Bangladesh via the online platform and all are selected for research sample for this study because there is no invalid data.

3.6 Research Model.

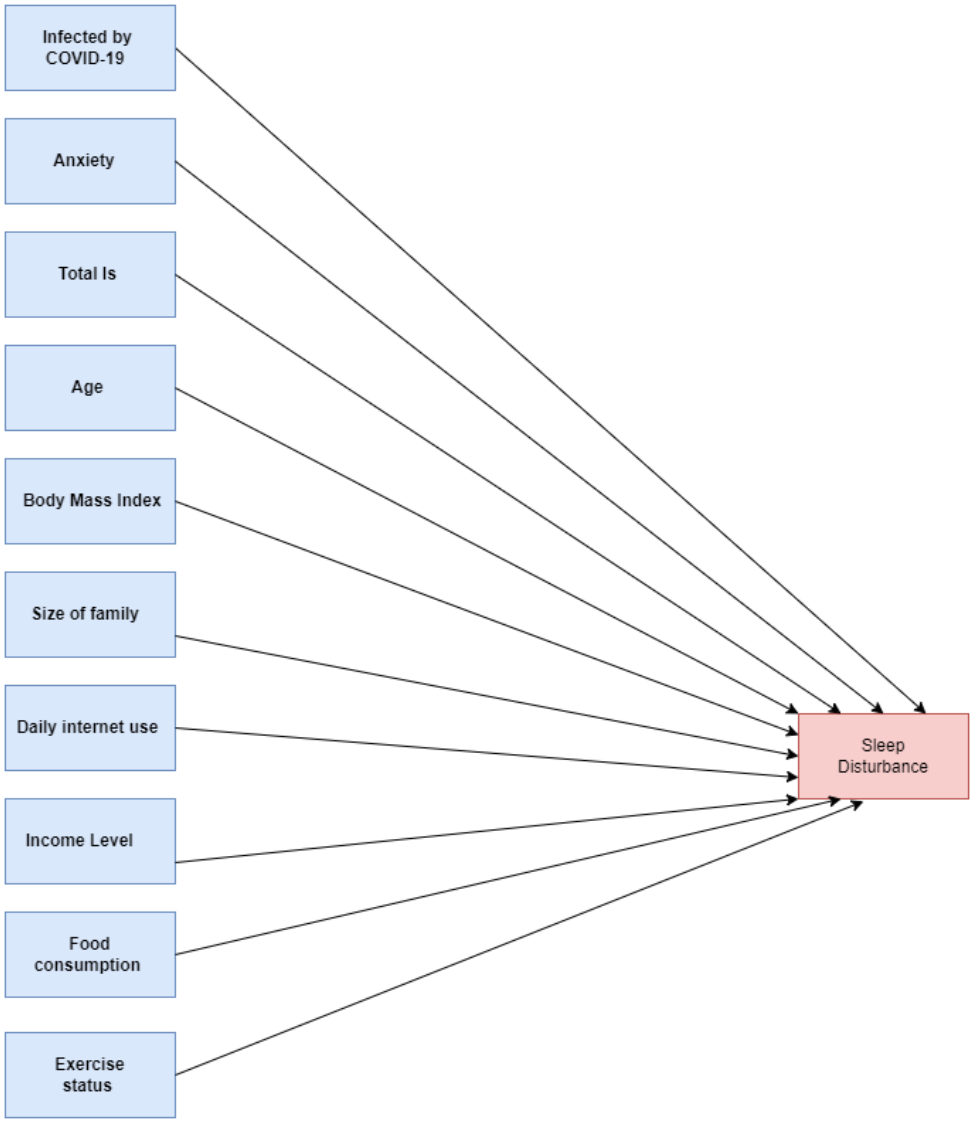

Fig 2: Factors that affects the sleep disturbance.

CHAPTER - 4

EVALUATION METRICS AND ANALYSIS

AUC - ROC Curve

The Auc-Roc curve tells us how much the model is capable of distinguishing between classes. Higher the AUC, better the model is at predicting the probability of class YES higher than the probability of class NO.

There is a scale for the auc-roc curve measurement-

(A) .90-1 = excellent

(B) .80-.90 = good

(C) .70-.80 = fair

(D) .60-.70 = poor

(F) .50-.60 = fail

4.1 Logistic Regression analysis

4.1.1 Confusion Matrix using LR

		Prediction	
Actual		Sleep disturbance = No	Sleep disturbance = Yes
	Sleep disturbance = No	True Negative (TN) = 85	False Positive (FP) = 14
	Sleep disturbance = Yes	False Negative (FN) = 25	True Positive (TP) = 112

Table 1: Confusion matrix of LR

Precision / Positive Predictive value = $\frac{\text{True Positive}}{\text{True positive+ False Positive}} = \frac{112}{112+14} = 0.89 = 89\%$

Sensitivity / Recall / True Positive Rate = $\frac{\text{True Positive}}{\text{True positive+ False Negative}} = \frac{112}{112+25} = 0.82 = 82\%$

F1-Score = $2 * \frac{\text{Precision} * \text{Recall}}{\text{Precision+ Recall}} = 2 * \frac{0.89*0.82}{0.89+0.82} = 0.85 = 85\%$

Specificity / True Negative Rate = $\frac{\text{True Negative}}{\text{True Negative+ False Positive}} = \frac{85}{85+14} = 0.86 = 86\%$

Negative Predictive Value = $\frac{\text{True Negative}}{\text{True Negative+ False Negative}} = \frac{85}{85+25} = 0.77 = 77\%$

Miss Rate /False Negative Rate = $\frac{\text{False Negative}}{\text{False Negative+ True Positive}} = \frac{25}{25+112} = 0.18 = 18\%$

False Positive Rate = $\frac{\text{False Positive}}{\text{False Positive+True Negative}} = \frac{16}{16+73} = 0.18 = 18\%$

False Discovery Rate = $\frac{\text{False Positive}}{\text{False Positive+True Positive}} = \frac{14}{14+112} = 0.11 = 11\%$

4.1.2 AUC-ROC curve using LR

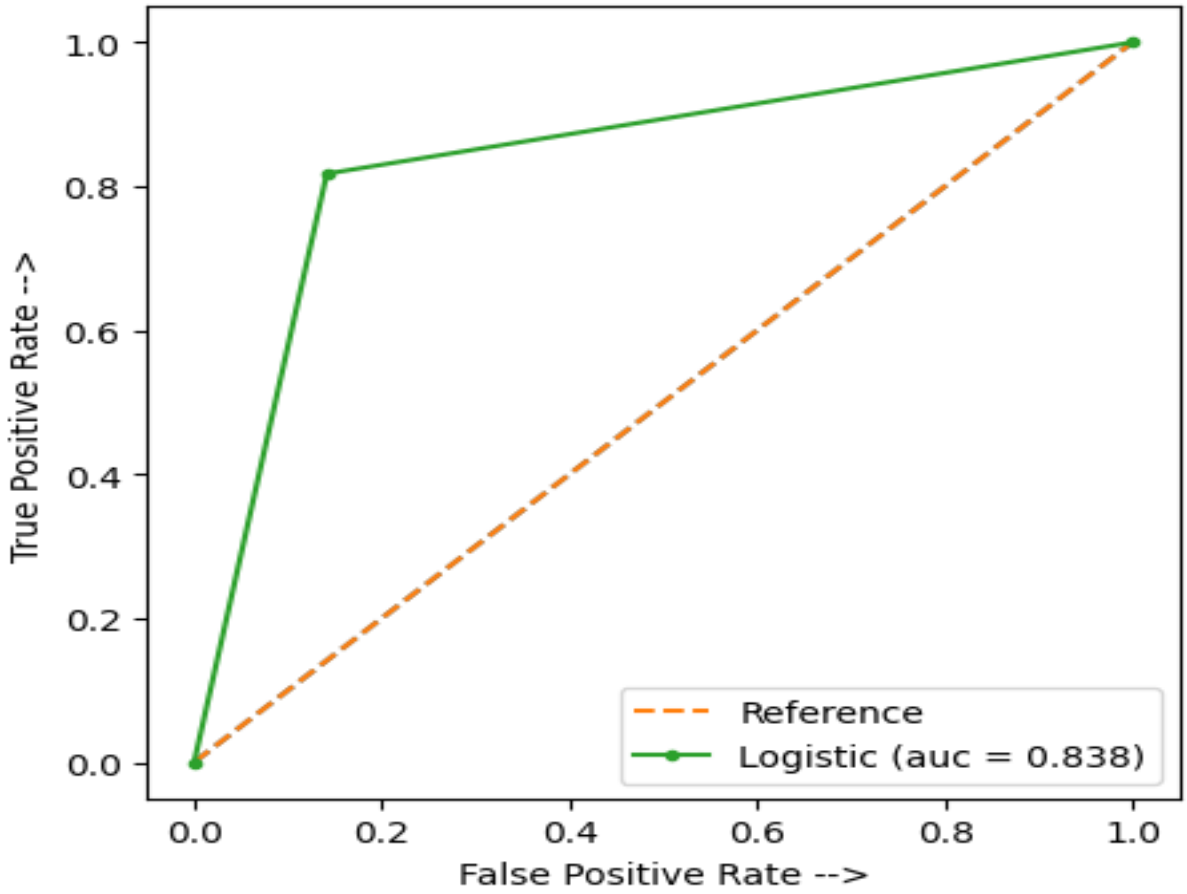

Fig 2: AUC-ROC curve using LR

The ROC curve in (fig: 3) is obtained from the Logistic Regression (LR). Here in the curve X-axis: True Positive (sensitivity), Y-axis: False Positive (1—specificity). The reference line is shown in the dashed line. The ROC curve of the LR model is simply shown in the yellow line. The area under the green line and the reference dashed line indicates the area under the curve. LR has AUC = 0.828, which is very good for the model estimation. Because the area will be more and will be closest to 1 the model will be a more estimate able model for the prediction.

So, according to the area under the curve, our model is a good and well-fitted model.

4.1.3 LR model & factor importunacy check

Dependent Variable: Sleep Disturbance (Target)

		Chi-square	df	Sig.
Step 1	Step	493.658	18	.000
	Block	493.658	18	.000
	Model	493.658	18	.000

Table 2: Omnibus Tests of model significance

Omnibus Tests of Model Coefficients are used to test the model fit. If the Model is significant, this shows that there is a significant improvement in fit as compared to the null model, hence, in the table p-value is less than 0.05, for this reason, it can be said that the model is describing the data petty well and the model is showing a good fit.

	B (weight)	Sig.	Exp(B)/ Odds Ratio	95% C.I.for EXP(B)/ Odds Ratio	
				Lower	Upper
age		.624			
age(1)	.232	.531	1.261	.611	2.603
age(2)	.355	.267	1.426	.762	2.668
age(3)	.354	.310	1.425	.719	2.821
age(4)	.490	.123	1.632	.875	3.042
bmi_level		.867			
bmi_level(1)	.323	.481	1.381	.563	3.386
bmi_level(2)	-.078	.784	.925	.530	1.615
bmi_level(3)	.012	.956	1.012	.655	1.564
size_of_family(1)	-.200	.418	.819	.505	1.328
income_level		.232			
income_level(1)	-.142	.656	.868	.466	1.617
income_level(2)	.379	.262	1.460	.754	2.829
income_level(3)	.008	.984	1.008	.467	2.173
food_consumption(1)	-2.874	.000	.056	.034	.093
exercise_status(1)	-.396	.053	.673	.451	1.005
internet_use		.136			
internet_use(1)	.227	.282	1.255	.830	1.899
internet_use(2)	.502	.046	1.652	1.008	2.707
infected_covid(1)	-3.588	.000	.028	.015	.051
anxiety(1)	-.376	.095	.686	.441	1.067
total	.135	.000	1.145	1.105	1.186
Constant	4.274	.000	71.784		

Table 3: Variables in the Equation of LR

Binary logistic regression became accomplished to evaluate the impact of numerous elements at the probability that respondents might record that that they had a trouble with their sleep. This model contains ten independent variables (age, bmi_level, size_of_family, income level, food consumption, exercise status, internet use, infected_covid, anxiety, and total). The full model containing all predictors was statistically significant, $\chi 2$ (18, N = 944) = 493.66, $p < .001$, indicating that the model was able to distinguish between respondents who reported and did not report a sleep problem. The model as a whole explained between 40.7% (Cox and Snell R square) and 55.1% (Nagelkerke R squared) of the variance in sleep status, and correctly classified 83.9% of cases. As shown in Table 1, only three of the independent variables made a unique statistically significant contribution to the model (food consumption, infected_covid19, and total Is), where these variables p-value is 0.000 which is less than the significant p-value of 0.05.

The strongest predictor of reporting a sleep problem was total Is, recording an odds ratio of 1.145. This indicated that respondents who had sleep problems on total Is sleep reasons were over 1.145 times more likely to report a sleep problem than those who did not have sleep problems on total Is sleep reasons, controlling for all other factors in the model.

The odds ratio of 0.056 for food consumption problems was less than 1, indicating that for every additional unit of food consumption problem, respondents were 0.056 times less likely to report having a sleep problem, controlling for other factors in the model.

The odds ratio of 0.028 for infected by covid19 was less than 1, indicating that for every additional unit of infected by covid19, respondents were 0.028 times less likely to report having a sleep problem, controlling for other factors in the model.

Here total Is is the most important because the coefficient beta that's called the weight of the factor is positive and with the increase of it the odds ratio will increase and the ratio of happening the factor influence will also increase with every 1 unit and the odds of sleep disturbance will increase. So that its 95% CI lower and upper range is greater than 1. But on the other hand, for food consumption and Infected_by_covid19, the coefficient beta or weight is negative which means the increase of these units will decrease the ratio of happening sleep disturbance problem (yes). That means there is an opposite relation between coefficient beta and odds ratio. For this reason, their 95% confidence interval of lower and upper boundary is less than 1.

4.2 Artificial Neural Network (MLP) analysis

4.2.1Confusion matrix Using ANN (MLP)

		Prediction	
Actual		Sleep disturbance = No	Sleep disturbance = Yes
	Sleep disturbance = No	True Negative (TN) = 83	False Positive (FP) = 16
	Sleep disturbance = Yes	False Negative (FN) = 19	True Positive (TP) = 118

Table 4: Confusion matrix of ANN (MLP)

Precision / Positive Predictive value = $\frac{\text{True Positive}}{\text{True positive+ False Positive}} = \frac{118}{118+16} = 0.88 = 88\%$

Sensitivity / Recall / True Positive Rate = $\frac{\text{True Positive}}{\text{True positive+ False Negative}} = \frac{118}{118+19} = 0.86 = 86\%$

F1-Score = $2 * \frac{\text{Precision} * \text{Recall}}{\text{Precision+ Recall}} = 2 * \frac{0.88*0.86}{0.88+0.86} = 0.87 = 87\%$

Specificity / True Negative Rate = $\frac{\text{True Negative}}{\text{True Negative+ False Positive}} = \frac{83}{83+16} = 0.84 = 84\%$

Negative Predictive Value = $\frac{\text{True Negative}}{\text{True Negative+ False Negative}} = \frac{83}{83+19} = 0.81 = 81\%$

Miss Rate /False Negative Rate = $\frac{\text{False Negative}}{\text{False Negative+ True Positive}} = \frac{19}{19+118} = 0.13 = 13\%$

False Positive Rate = $\frac{\text{False Positive}}{\text{False Positive+True Negative}} = \frac{16}{16+83} = 0.16 = 16\%$

False Discovery Rate = $\frac{\text{False Positive}}{\text{False Positive+True Positive}} = \frac{16}{16+118} = 0.12 = 12\%$

4.2.2 AUC-ROC curve using ANN (MLP)

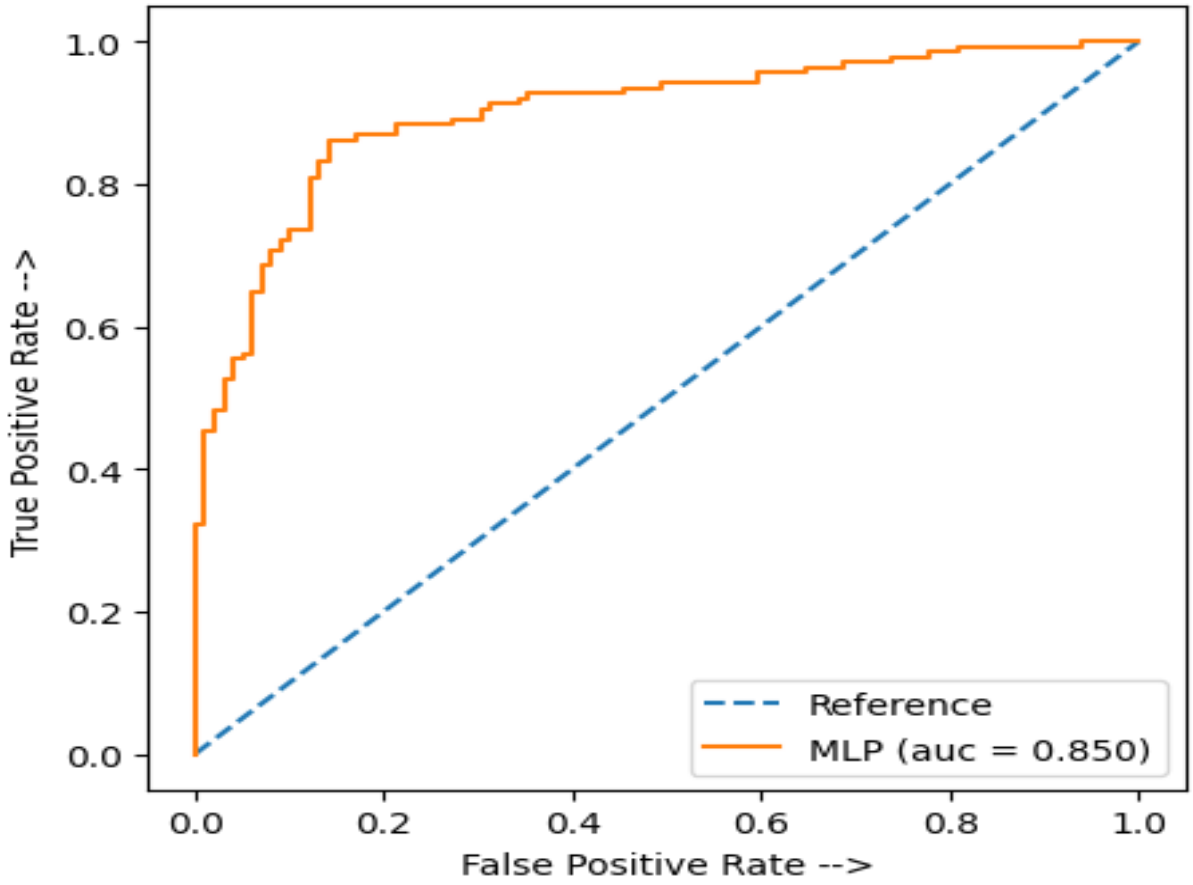

Fig 3: AUC-ROC curve using ANN (MLP)

The ROC curve in (fig: 4) is obtained from the artificial neural network model (ANN). Here in the curve X-axis: True Positive (sensitivity), Y-axis: False Positive (1—specificity). The reference line is shown in the dashed line. The ROC curve of the ANN model is simply shown in the yellow line. The area under the yellow line and the reference dashed line indicate the area under the curve. ANN (MLP) has AUC = 0.841, which is very good for the model estimation. Because the area will be more and will be closest to 1 the model will be a more estimate able model for the prediction.

So according to the area under the curve, our model is good and well-fitted.

4.2.3 ANN (MLP) factor importunacy check

Dependent Variable: Sleep Disturbance (Target)

	Normalized Importance	Normalized Importance	Normalized Importance	Normalized Importance	Normalized Importance	Normalized Importance	Normalized Importance	Normalized Importance	Normalized Importance	Normalized Importance	Importance Percentage	Network
Age	22.2%	16.0%	18.6%	14.5%	18.6%	15.1%	17.9%	26.3%	17.8%	24.7%	19.2%	**N1**
BMI_Level	14.0%	20.6%	13.1%	17.9%	18.4%	14.5%	13.5%	34.4%	15.9%	11.0%	17.3%	**N2**
Size_of_family	7.2%	5.0%	6.2%	3.4%	7.5%	2.9%	11.9%	7.5%	8.4%	8.6%	6.9%	**N3**
Income level	21.1%	21.5%	13.1%	17.8%	23.5%	14.8%	20.2%	29.5%	17.7%	33.2%	21.2%	**N4**
Food consumption	70.8%	96.2%	85.2%	82.4%	90.8%	100.0%	86.8%	93.5%	97.9%	100.0%	90.3%	**N5**
Exercise status	10.4%	8.8%	14.2%	15.2%	12.7%	17.7%	12.3%	6.2%	13.2%	6.1%	11.7%	**N6**
Daily_internet_use	15.2%	20.4%	12.1%	12.0%	13.8%	15.6%	10.8%	21.9%	16.1%	11.7%	15.0%	**N7**
Infected_by_COVID19	72.8%	89.7%	86.3%	85.6%	100.0%	97.5%	76.4%	91.2%	100.0%	94.1%	89.4%	**N8**
Anxiety	13.9%	24.9%	18.5%	12.0%	6.3%	8.0%	7.4%	18.3%	15.3%	13.2%	13.8%	**N9**
Total Is	100.0%	100.0%	100.0%	100.0%	90.1%	95.6%	100.0%	100.0%	96.3%	89.1%	97.1%	**N10**

Table 5: Variables importunacy of ANN (MLP)

The ANN analysis has been performed 10 times to measure the above calculation of the importunacy of the factor analysis. From the above table, we can see that among the 10 factors of sleep disturbance for covid-19 the Total Is factor is most important because its percentage of importunacy is 97.1%, which is greater than the other factors. The Total Is the value is calculated from the 7 Insomnia severity indexing questions.

So, according to the ANN (MLP) analysis, we can say that the Total Is keeps a more powerful impact than the other factors for Covid-19 duration.

4.2.4 Analysis prediction using statically graph of ANN (MLP) model

Network	Training-Testing Percentage	Sum of square error (Training) (InT)	Sum of square error (Testing) (InT)	RMSE (Training) (InT)	RMSE (Testing) (InT)	RMSE(Training)(InT)-RMSE (Testing) (InT)
1	80-20	184.987	47.816	0.497	0.494	0.003
2	80-20	197.032	47.832	0.508	0.514	0.006
3	80-20	205.578	50.888	0.521	0.522	0.001
4	80-20	193.732	48.789	0.508	0.503	0.005
5	80-20	195.712	56.998	0.512	0.537	0.024
6	80-20	213.928	49.981	0.533	0.513	0.020
7	80-20	184.571	55.357	0.500	0.518	0.018
8	80-20	197.628	46.183	0.511	0.498	0.012
9	80-20	202.335	56.166	0.514	0.560	0.046
10	80-20	202.646	46.281	0.520	0.487	0.033
	Mean	197.815	50.629	0.512	0.515	
	Std. Dev	8.977531057	4.107679757	0.010385815	0.021626198	

Table 6: Graph calculation of ANN (MLP)

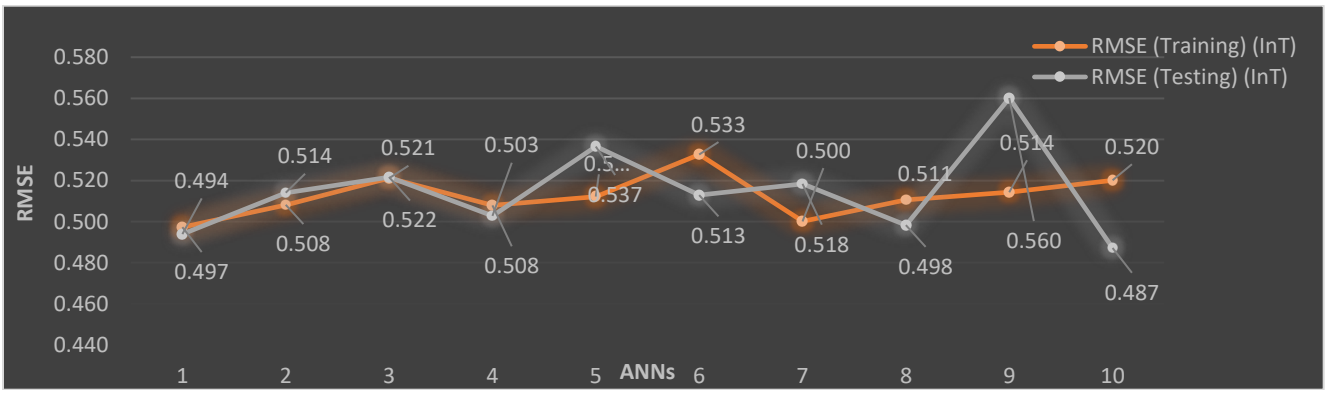

Fig 4: Model prediction graph using ANN (MLP)

In the above table, there is shown the ANN (MLP) calculation and the calculation has happened 10 times on the dataset. After 10 times network calculation, there is calculated the RMSE score for the Training and Testing split of the dataset. The network calculation there have been used 80%-20% ratio of training and testing percentage on the dataset. The main fact of the training and testing ratio is to show how much the output varies. With that it is also in the target to see the training and testing output difference from the graphical system, whether how much the model can

predict the best model by keeping a lower distance between RMSE training and RMSE testing value.

From the ANN graph, we can see that the RMSE score difference between the training and testing values is too low except the 9 no. network calculation there is some difference between them. In some points of the network analysis, the testing values have given better performance from the training score. From the graph, we can see the lower difference between training and testing line and they are very near with one another. So from that, it can be said that the ANN model will give a very good performance and good result for analysis of other types of training testing ratios.

CHAPTER - 5
RESULTS AND DISCUSSION

5.1 Environments and Tools

In this section, the details of the environment and toolkit that were used for the implementation are briefly described below-:

Software and Hardware configuration: The implementation of the proposed Framework was performed on Processor: Intel(R) Core(TM) i3-7100U CPU @ 2.40GHz, 2401 MHz, Installed RAM 4.00 (3.67 GB usable), system type 64-bit operating system, X64-based processor, System model HP ProBook 450 G4, running under Windows 10 Pro operating system. The algorithm was in-house developed using Python-based Jupyter Notebook 2020 software. Apart from having used Matplotlib tools, Pandas tools, Sci-kit learn tools, and so on.

ITEM	DETAILS
System Model	HP Pro-Book 450 G4
OS	Windows 10 Professional
Processor	Intel(R) Core(TM) i3-7100U
CPU	2.40GHz, 2401 MHz
RAM	4.00 GB
SSD	120GB
System Type	64-bit operating system
Tools	Jupyter Notebook, Pandas for data analysis and processing, Numpy for calculations with arrays and matrices, Matplotlib for visualization, Scikit-learn, and Seaborn for advanced visualization.

Table 7: Software and Hardware configuration

5.2 Performance Comparison

5.2.1 Confusion matrix comparison

	LR	ANN
Precision / Positive Predictive value	0.89 (89%)	0.88 (88%)
Sensitivity / Recall / True Positive Rate	0.82 (82%)	0.86 (86%)
F1-Score	0.85 (85%)	0.87 (87%)
Specificity / True Negative Rate	0.86 (86%)	0.84 (84%)
Negative Predictive Value	0.77 (77%)	0.81 (81%)
Miss Rate /False Negative Rate	0.18 (18%)	0.13 (15%)
False Positive Rate	0.18 (18%)	0.16 (17%)
False Discovery Rate	0.11 (11%)	0.12 (11%)

Table 8: Model comparison using confusion matrix

Initially, numerous experiments were performed to test the output matrix of different machine learning algorithms using sleep disturbance for covid19.

From the table (1) & table (4) of confusion matrix of LR and ANN (MLP), here is made an output comparison box of confusion matrix to see the performance of those models according to their different output parameters have been used to test our models successfully.

For estimation of the model we always need the highest sensitivity, specificity. If we can keep it higher the model will be better. Here the specificity and precision are very near for both. Although the specificity and precision are lower than LR it's not too bad and with that ANN's sensitivity is higher than the LR and from the mathematics, calculation, analysis, and investigation has been found that ANN has achieved the highest sensitivity, f1-score, and good specificity. When the sensitivity increased and is greater at that time the negative predicted value is also greater. As the sensitivity is higher than the LR, so that the negative predictive value is also higher (81%) than the LR (77%) & it's also a condition for being a good model. Though both outputs of the algorithms are too close for measurement the ANN is best according to the overall prediction of the model.

We also need the lowest miss rate, lowest false positive, and lowest false discovery rate for the best performance of the model. Here these rates are not too bad for the model performance. Because these rates are too low. Although there is very little difference between the two algorithms but ANN's miss rate, the false positive rate is lower than LR, which is another condition for the good model performance. The false discovery rate ANN (12%) and LR (11%), but it's not a bad result because there is a very low difference. So from the comparison of the error, it can be said that ANN is good for the model.

5.2.2 AUC-ROC Curve LR vs ANN

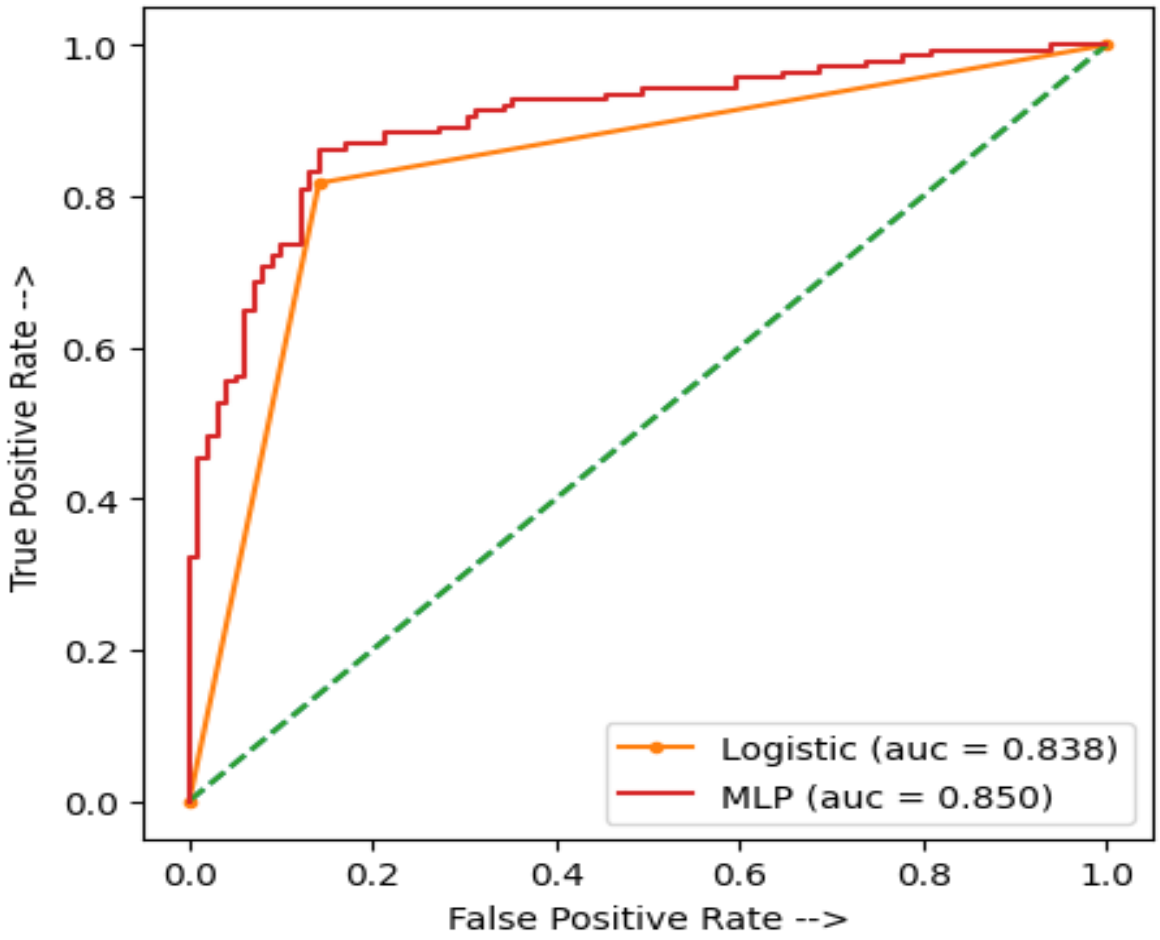

Fig 5: Model comparison using AUC-ROC Curve

AUC-ROC is used for the performance measurement of classification problems at various threshold settings.

The ROC curve is a probability curve and the AUC represents the degree or the measure of separability. It tells how much the model is capable of distinguishing between classes. According to the ROC-AUC curve scale, if the range is between 0.8-0.9 that's a good model for the prediction of the measurement. As the AUC score under the ROC is in this range for both of the Algorithm, so, both model is good for the measurement. With that which score is near to 1, that model is more perfect. So, ANN (MLP) AUC score is 0.850 which is greater than the AUC score of Logistic Regression (LR) 0.838.

So, according to the AUC-ROC measurement, the ANN is the best model for this computation.

5.2.3 Accuracy comparison of LR & ANN

	LR	**ANN**
Accuracy	**84%**	**85%**

Table 9: Model comparison using accuracy

From the model accuracy table, we can see that the accuracy is very near for both models. But The ANN accuracy is greater than the Logistic regression. So ANN is best for this model prediction and measurement.

CHAPTER - 6

CONCLUSION AND FUTURE SCOPE

6.1 Conclusion

COVID-19 virus spread has undoubtedly influenced people's psychological and mental state. But in this research study, the main focus was on the quality of sleep that means how much sleep has been influenced by covid-19, which directly influences many daily activities. For reducing sleep disorders and promoting good quality of sleep and in these critical phases of pandemic anxiety, physical and mental symptoms cannot be ignored. All these factors, being influenced by the COVID-19 and has a great impact on sleep quality. To counteract the increase in sleep disturbances and the worsening of sleep quality due to pandemics. This has kept a long and midterm impact on the people of Bangladesh. So for this reason this study has made for finding the impact of different factors for covid-19 on people and how much they influenced people. However, our results show that the total Is factor leads to psychological diseases that worsen sleep quality. Because the insomnia severity-related questions are too much important for the sleep quality finding and these questions marking indicated the total Is score.

This paper demonstrated the implementation of Logistic Regression & ANN machine learning algorithms with SPSS statistical analysis to detect sleep disturbance for COVID-19. By doing the above experiment and coding all of the machine learning classifier models, it has been found that ANN has provided the best and highest performance classifier to detect sleep problems. Both of the models have indicated the total Is as the most important factor which leads the sleep problems. Our proposed model successfully brings out the estimated result to detect sleeping problems. In the end, Machine Learning techniques may be successfully used to tackle this important problem. In this case, the result strongly encourages us to use our proposed framework in the field of fake news classification.

As the covid-19 has impacted mostly the people of Bangladesh, and it has kept influence on the people's lives in different terms of time. For this reason, governments should provide clinical and counseling centers and with that should start online platforms consisting of psychologists and sleep experts for improving the psychological condition and providing adequate sleep hygiene support.

6.2 Future Scope

A variety of features, and using different other models may be applied for this research. With that the survey was done in online platform, the face-to-face questionaries' method could be done to collect user information

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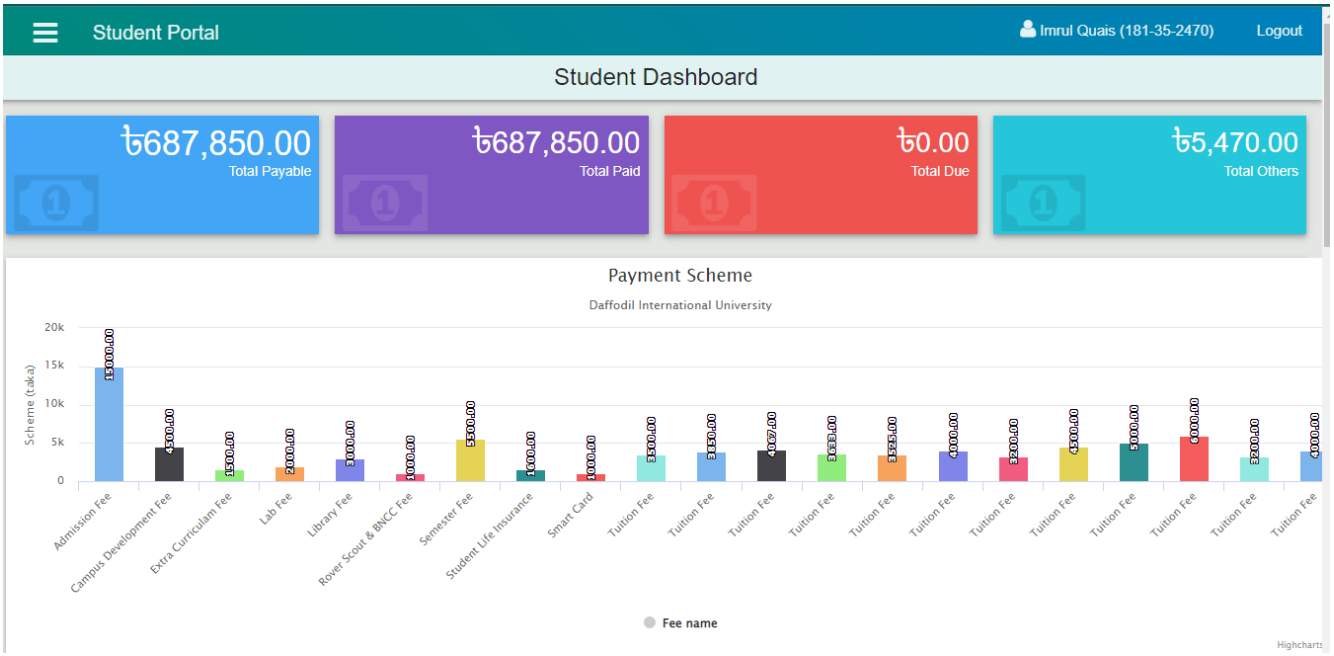

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