School Intervention to Early Detection of Mental Disorders Among 15-19 Aged, in Sri Lanka

T.A.D.K.A.Tharika

169337P

Faculty of Information Technology

University of Moratuwa

February 2019

School Intervention to Early Detection of Mental Disorders Among 15-19 Aged, in Sri Lanka

T.A.D.K.A.Tharika

169337P

Dissertation submitted to the Faculty of Information Technology, University of Moratuwa, Sri Lanka for the partial fulfillment of Degree of Master of Science in Information Technology.

February 2019

Declaration

I declare that this thesis is my own work and has not been submitted in any form for another degree or diploma at any university or other institution of tertiary education. Information derived from the published or unpublished work of others has been acknowledged in the text, and a list of references is given.

Name of Student — Signature of Student

T.A.D.K.A.Tharika ……

……

Date:

Supervised by:

Name of Supervisor — Signature of supervisor

Mr. Saminda Premaratne ……

Senior Lecturer

Faculty of Information Technology

The University of Moratuwa ……

Date:

Dedication

All the school teachers, who dedicate their lives to promote resilience in students who will contribute to better outcomes academically, socially and emotionally.

Acknowledgment

With the humble company of Mr.Saminda Premaratne, Faculty of Information Technology, University of Moratuwa, I could meet the obligation of submitting this dissertation. Without his kind guidance, it could not have been possible to submit this thesis. Apart from being my mentor and supervisor, he always came to my rescue when I was in deep stress. So I am ever indebted to Mr.Saminda Premaratne

The kind-cooperation and assistance extended by Mr. Oshara Panditharathne , Principal of Dharmapala Vidyalaya together with Mrs.Manel Alwis, Counselor, counseling unit of Dharmapala Vidyalaya who support when preparing my Data set, need a special note. Without their sincere support and willingness, this thesis would have been still a dream. Therefore, I express my gratitude to all school counselors who took part in conducting survey and teaching staff including principals.

My Parents and brother, worth mentioning here as they always encouraged and motivated me to pursue my academic engagements.

I express my gratitude to all my Lecturers and demonstrators who taught subjects in my MSc IT degree and the things that I learned from many subjects helped me to fulfill the hard task to be a manageable one.

Last but not least I am also indebted to all my friends who helped me in numerous ways to make this work possible.

Abstract

Presently students that are in the age of 15 to 19, all over the world are experiencing mental disorders. These disorders have become the prominent cause of disability in young people. However, when accurately diagnosis of mental disorders at an early stage improves the quality of life of students and it also helps to avoid problematical events at the later stage.

School Teachers, Counselors, and Mental health-oriented organizations, embedded within schools can perform various kinds of tasks for child's mental care due to those it improves physical health, mental health and educational attainment for adolescents. To strengthen these efforts, optimum child development, a reconfiguration of School education system and mental health systems to aid implementation of the evidence-based system might be required. Having integrative strategies like combine classroom-level and student-level interventions is necessary.

A lot of Ethical, social and scientific justifications exist to integrate the mental health system and Education System. In Sri Lankan education system, Class Teacher and Student have a very close relationship, hence if coupled with the use of evidence-based detection pattern and teachers' hands-on experience to detect and identify the students' behavioral changes are the aid to early detection of Mental Disorders.

This study focuses on detecting fundamental mental health problems, like Depression and Anxiety Symptoms, using Data mining techniques.

Contents

List of Tables

List of Figures

Chapter 1

Introduction

1.1. Prolegomena

In recent years, throughout Sri Lanka, the mental health issues of adolescents (Targeted age group is 15 -19 Years) have been receiving considerable attention. Efforts should be taken to not only to predicting, identifying and to prevent mentally disordered thoughts, but also to develop positive psychosocial thoughts among the age group of 15-19.

Mental health diagnosis is not a very easy task, and it involves several steps. It is not a straightforward process. The diagnosis starts with a specially designed interview with questions about the symptoms and behavioral report of the class teacher and sometimes examines the physical performances, Educational and also interrelationships among the class. Several psychological assessments are also conducted to make sure that the disordered thoughts and behaviors are caused only by mental health and not by any other problems. Various assessment tools are available to evaluate a person for a mental illness.

There are strong links between physical and mental health problems. If not properly treated, these problems severely affect adolescence's mental, physical and development of their educational achievements and their potential to live fulfilling and productive lives. The most significant way to deal with a crisis is to prevent it from happening in the first stage.

A considerable amount of people with mental disorders around the world, become unsuccessful, when obtaining appropriate help in spite of developments in new treatments for mental illnesses, and as a consequence suffer in silence. Early and accurate prediction of mental disorder thoughts should follow an appropriate treatment and management plan, which directed towards recovery and return to a normal lifestyle. This would help to

decrease the global affliction on health and social caring systems caused by mentally disordered thoughts.

If any intervention is not done, Adolescence disorders usually continue into their adulthood. Severity and challenges to recovery for conditions such as psychosis appear to increase with each stage. Since children develop rapidly, it is the necessity of launching mental health services based on schools.

The objective of early detection, prediction, and intervention is to reduce the effects and disabilities connected with mental disorder thoughts during one's adolescent years. Rapid and reliable prediction of disorder thoughts can direct to effective treatments and care to assist in maintaining optimal functioning will reduce the barriers to the likelihood of family, educational performance, social relationship, and physical health. During the early stage of disordered thoughts, risk factors are identified and, strategies determined to support recovery and well-being is implemented.

1.2. Background and Motivation

According to the World Health Organization (WHO), Sri Lanka became the fourth place amongst countries with the highest rates of suicides in the world. Statistically proved that Sri Lanka has a Suicide Mortality Ratio (SMR) of 35.3 (per 100,000 people). And it is the highest SMR in the entire South-East Asia region. WHO statistics shows that suicide is a global phenomenon and in fact, 78% of suicides happened in low and middle-income countries in 2015. It considered as 1.4% of all deaths worldwide, making it the 17th leading cause of death in 2015. Approximately 800, 000 people die due to suicide every year, and that means one person every 40 seconds similarly many more suicidal attempts. Suicide is the second leading cause of death among 15-19 year aged globally.It is identified that

the psychological health of adolescents affected by a variety of environmental factors such as relationships among friends and family, school, educational performance, and continuing education, social and economic status, poverty and deprivation, etc. Other

internal factors that constitute a threat to 15 -19 aged teen's psychological health include exposure to violence in home or school, sexual abuse, stress related to poverty, drug or alcohol abuse, discrimination or other hardships, stress related to exam pressure as well as loss of most essential and loving people in their life, whether through death or parental divorce. However, most of the times these mentally disordered thoughts encountered in adolescence are the result of an interaction of several factors and not be affected by one single factor alone.

Psychological health promotion in this age group can be seen as an intricate and energetic process. It can be easily implemented in schools, other educational centers, families, among peer groups, and in public health and social settings. Problems and troubles in adolescence change considerably from time to time and person to person. It can range from minor behavioral problems to severely disordered thoughts like depression, schizophrenia, anxiety disorders, eating disorders, etc. Most of the students in 15-19 age categories are under a lot of pressure to fit in.

On the other hand the stress they have, effecting on not only for the families and friends, but also to the community and the health, and social relation systems as a whole. Therefore it is important to develop adolescents emotionally, intellectually and spiritually, that will helps them to engage with frustrated and stressful situations. Domestic violence, sexual abuse, parental divorce or separation, school transfer, academic failure, bullying or other criticizing from family and friends, etc. will be significant facts for disordered thoughts. It is important to understand that mentally disordered thoughts can affect anyone and appear in families of all social classes and all Social backgrounds. So psychological promotion is very important and relevant to everyone.[1]

According to Buddha, Health is Wealth; Hence there is no Good Health without mental health!

1.3. Statement of Research Problem

Mentally disordered thoughts will become very critical and dangerous if it's properly untreated. Not only Sri Lanka but also globally, Adolescences have ongoing effects on social life and interpersonal relations.

The Psychology of an adolescent is critical, as it has an influence on the health of this generation currently and for them in their future adult years. Due to mentally disordered thoughts, adolescents may effect on the way of thinking, feel, and behave. Hence this kind of limitations can be the effect on young people's abilities on productivity and their academic achievement.

1.4. Hypothesis

- Identifying mental disorder in an early stage in evidence-based decision pattern.
- Predictor explores feelings, thoughts and behavioral changes attach to a mental disorder.
- Make a prediction on, one's mental condition.

1.5. Aim and Specific Objectives

The main aim of this research is to identify and make a prediction about mentally disordered thoughts in early stage through Evidences based decision pattern in the school.

Thus, Teacher can easily direct Child to more effective, Productive and proper Counseling and Positive Psychology Program to develop their personality, if they reveal as have some kind of mentally disordered thoughts.

Launching the School educational and activity-based Social and Emotional positive thoughts improving programs and Self-esteem developing programs to help Adolescents Targeting , 15 -19 age group to identify and manage and control emotions, build ,set and achieve positive goals and ambitions, listen and appreciate the achievements and

perspectives of others, develop and retain positive relationships, make correct ,effective decisions rapidly and handle interpersonal situations accurate and efficient manner.

1.6. Proposed Solution

To identifying the mentally disordered thoughts in early stage requires a powerful and reliable method. Solution is specially designed to help the teachers to identify the reliable pattern to predict the mental disorder of adolescent in the age group of 15 to 19 years, by using data mining techniques. Hence the teacher can identify the child thoughts, with the support of this tool. This method is more reliable and accurate when compared to what teachers guess with their hands-on experience. Combination of evidence-based detection pattern and teachers' hands-on experience will detect and identify the students' behavioral and emotional changes, and this way will direct the student to proper counseling.

1.7. Summary

Chapter 1 provided the background and the proposed solution for the identified problem. Next chapter will provide a critical review of the literature in relation to developments and challenges of current systems which are available currently.

Chapter 2

Literature Review

2.1. Introduction

Chapter 1 gave a comprehensive description of the overall project described in this thesis. This chapter provides a critical review of the literature in relation to developments and challenges in the early detection of mentally disordered thoughts.

2.2. Exiting Researchers about Early detection and prevention of mental disorders

For this purpose, the reviews of the past researches have been presented below. Most of the researchers are done, for elders, people who caught for criminals. People are who already diagnosed etc. In this chapter defines the research problem as

An increasing amount of researches trying to aim diagnosis the depression and provide systematic treatment as a solution. In this research author proposed early detection and prevention measures of mental disorders with the scoring system of a targeted person. If the score for the particular person is higher than the limit, then it will indicate and give a warning for the further treatment required. The author used the weighing function, theory to determine the probability for depression and carry out few experiments to evaluate the approach and he found its effective.[1]

Several types of research are done to provide evidence about the relationship between the mental health and criminal justice system. These characters who are in jail and prison are suffering from some degree of mental disorders. , According to the authors, this research tracks the prisoners that have been referred for mental health treatments in order to

identify any behavioral or emotional patterns or similarities between these individuals as they are exit the jail system.[2]

M-SEQ using the electronic health records for early detection of anxiety and depression. M-SEQ Authors have implemented a developed tool for the early detection of anxiety or depressive disorders based on the primary care visit data of health centers. Here authors expanded existing work in this domain by considering the temporal diagnoses patterns in models and using those models, and it is easy to identify patients at high risk of anxiety or depression in individuals who are considered as normal. Therefore this practical tools supported by algorithms in this research could also be developed to help users to understand their risk of anxiety or depression according to their medical history.[3]

Researchers are done to propose approaches for mental disorder early warning by observing depression disorder symptoms based on social media such as Facebook, Twitter, etc. As social media become very popular among people, and they have the great sensation to share their feelings and moods on social media platforms. Proposed approach presents weighting function for calculating the weighting factor of appearing some symptom in social media and also provide an effective solution to observe the probability of getting depressed. Authors want to implement the proposed approach with a multi-agent system which can analyze the social media quotes and decide the circumstances if a certain person diagnosed with a high probability of getting depressed thus the system will notify him and his friends through a social network or mobile devices.[4]

re: Mind is a mobile application to support bipolar disorder patients to self-monitor. This tool uses a set of parameters which are identified to affect their disease while they are communicating with the doctor. This could be customized to fit into the specific needs of individual patients. The researcher has combined the data and coupled with a kind of automatic techniques which form a modern tool to express, predict, improve the health behavior and providing individual guidance and it also includes appointment booking and obtaining a prescription as well. Primarily this software introduced as web applications and later it’s adopted as a mobile application due to the significant features, and it’s most popular as a mobile application which is more cost effective as well as web applications.

This research concerning this software as a mobile application which can be used by patients and medical personnel and the software created with the help of information collected from the medical personnel who are currently engaged in work with mental disorders patients and the survey carry directly from mental disorders patients. [5]

The research of the use of intelligent data mining and Machine Learning for Mental Health Diagnosis use Genetic algorithm and is used to reduce inappropriate diagnosis of mental health illnesses. So it leads to wrong treatment and causes irreversible deterioration in the patients' mental health status like hospitalization and premature death. The main objective of this research was to ensure that classifier analyst is capable of making an informed, intelligent, appropriate assessment, and an accurate prediction.[6]

Early detection of depression is important to improve human health. This Researcher proposes a new method to detect depression through time-frequency analysis of Internet behaviors using the naive Bayes classifier data mining technique.[7]

This research to presenting a machine Learning framework involving electroencephalogram (EEG) signal analysis of stressed individuals. The experiment is doing and convinced by implementing an eminent experimental paradigm based on the Montreal imaging stress task. Validation of stress simulation is considered the task performance and subjective feedback. The suggested ML framework consider EEG feature extraction, feature selection classification including logistic regression, support vector machine and naïve Bayes classifiers, etc. and cross-validation. As the researcher found, the results showed that the proposed framework produced 94.6% accuracy for two-level identification of stress and 83.4% accuracy for multiple level identification. The suggested mining procedure can be beneficial in implementing a computer-aided diagnostic tool for stress detection.[8]

2.3. Study of Research Problem

2.3.1. **Mental Health**

According to the World Health Organization “Mental health is defined as an of well-being in which every individual realizes his or her own potential, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to her or his community.[9]

2.3.2. Mental Disorder

Mental disorders involve a various range of problems, with different symptoms. However, they are generally characterized by some combination of abnormal thoughts, emotions, behavior, and relationships with others.[9]

2.3.3. Depression

According to an American Psychiatric Association “Depression (major depressive disorder) is a common and serious medical illness that negatively affects individuals, how they feel, and the way they think and their actions. Depression is treatable. It causes feelings of sadness, loss of interest in activities once enjoyed. It can lead to a variety of emotional and physical problems and can decrease a person’s ability to function at day to day lives.”[10]

2.3.4. Anxiety

Anxiety disorders are a collection of mental disorders categorized by particular feelings of anxiety and fear. Anxiety is a feeling of worry about future events and things, and due to this thought fear to react to current events. Anxiety may cause physical symptoms, such as a fast heart rate and shakiness thoughts also.[11]

2.3.4. Teacher’s capacity to support student mental health

In the Sri Lankan education system, there is a very close and intimate relationship with the teacher and students. Teacher's role in supporting the support student in Sri Lanka is in a very wide area. Teachers are the most likely to detect mental disorder and abnormal behavior issues because they spend a great deal of the day with students who came from different social and economic levels. Teachers learn the personalities of each student in their class, and often they may notice the significant changes in an individual very accurately.[12]

2.4. Summary

This chapter denoted for Literature review. By review of current literature detail analysis defined the research problem and also identified the possible technology addressing the research problem. Next chapter will discuss the technologies adapted for solving our problem.

Chapter 3

Technology Adapted in School Intervention to Early Detection of Mental Disorders

3.1. Introduction

The Previous chapter we discussed the previous approaches which researched to Identify mental disorders. Here this third chapter is allocated for describing the Technology Adapted in School Intervention to Early Detection of Mental Disorders among Students 15-19 Aged in Sri Lanka.

3.2. Data Mining

Currently, society comes across a large, complex set of data generated by computers, networks, and humans, etc. Various fields include Educational, Agricultural, Health, Transportation, Governments, Science and Technology, etc., dedicated a huge amount of resources and assets to collect and keep data. Although a huge amount of data is available, only a few amounts of data is used due to issues like unmanageable huge data volumes, and the data structures are too complex and complicated to analyze the efficiency and effectiveness.

Data Mining is a concept which supports to extract useful hidden knowledge from these data this will become very important to act on that knowledge is becoming important in this economical world. Therefore the data mining process is emerging. The entire process of applying a computer-based - methodologies including new procedures for discovering knowledge can be treated as "Data Mining." Researchers have identified data mining as an interesting, beneficial subject area, because of successful knowledge discovery applications.

Data mining mainly focuses on the four-step process

- Classification – Arrange into predefined groups
- Clustering – Arrange into groups which are not predefined
- Regression – To find a function that models the data with the least error
- Association Rule learning – Exact for the relationship.

Data mining includes

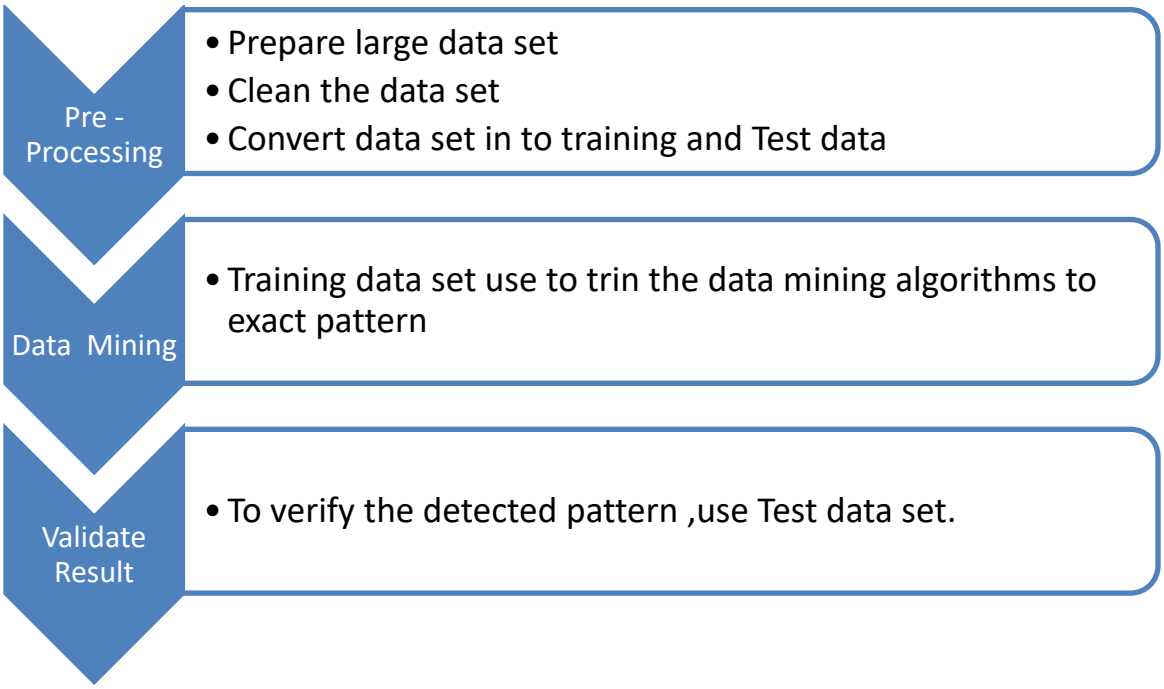


Figure 1 Data Mining Process

Data mining is considered as the process of analyzing big data from different perspectives; summarizing transform them into useful information by means of different techniques. Formally this is defined as the non-trivial process of identifying valid innovative, potentially useful and eventually understandable patterns in data.

3.3. Rapid Miner

Rapid Miner and Rapid Analytics deliver an integrated mining environment for all steps of the data mining process, user-friendly graphical user interface. It provides an easy method of interactive data mining procedure design, data and results visualization,

validation and optimization of data mining processes. It facilitates computer-based deployment and possible integration into more complex systems.

Rapid Miner enables one to design data mining processes by simple drag and drop of boxes without writing any programming scripts.

Rapid Miner stores the data mining processes in a machine-readable XML format, which is directly executable in Rapid Miner and gain graphical visualization of the data mining process. Rapid miner optimally supports all steps of the overall data mining process and the flexible deployment of the processes and results within their framework and also integrated into other solutions via web services, Java API, or command-line calls. The processes can be serving as documentation and for the reproducibility and reusability of scientific results as well as business applications.

The open source nature of Rapid Miner and Rapid Analytics several import and export and web service interfaces, flexibility, and extendibility by custom extensions, operators, and scripts make them the ideal solutions for scientific, industrial, and business applications. Rapid miner also has the ability to reproduce and reuse processes, modify and adapt or to extend.Rapid Miner allows you to quickly build working prototypes and also quickly deploy them on real data of all types like files, Databases, time series, text image or audio data, web pages and services, social media, etc.

3.4. Reasons for Using Data Mining for Mental Disorder Identifying

Emotional and behavioral data associated with Mental Disordered teenagers ‘provides thinking patterns, which are huge in size and vary in complexity. Usually, this kind of data which kept in confidentially and these data rarely use for analyzing purposes.

To understand and get an idea about a thinking pattern of a mentally disordered person we need a huge amount of data in other words "Big Data." Big data is a term given to data which is huge in volume, variety, and velocity. Literature review which compares different data analysis methods used by researches proved that data mining is the best option for big data analysis. Data mining is a standard database querying which allows

examining multiple complicated areas simultaneously. Therefore data mining can be used as the most suitable method to identify mental disordered persons' thinking patterns, according to the literature review.[12]

3.5. How to Use Data Mining for Detect Thinking Pattern

Analyze and detect mental disordered teens' thinking pattern, may need to find out factors related to particular disorder and the relationship of causes for a particular phenomenon. Furthermore, need to find out in detail view how some problems occur and 14 combinations of causes that lead to some phenomena.

As early detection of mental disorder to avoid social issues like suicidal conditions, it is essential to find out the root causes for them and their nature. Therefore this research utilizes different data mining techniques in the predictive stream and descriptive stream according to selected research sub-question.[13]

For example, research sub-question to reveal the feelings trends causes Depression or normal can use predictive data mining as an effective technique. For analyzing the thinking pattern of a depressed person, primarily need to take data such as behavioral data, Education Performance data, Data of Physical changes and parental conditions from their class teacher. If the teacher is identifying the changes in those factors, it is required to go with the survey of what they feel during the last two or three weeks.[14] Then using data preprocessing techniques in data mining can reduce the uncertainty of data by removing erroneous data and missing values. As the next task, by analyzing the significance of factors, major data fields can be chosen. To exactly find out the correlation between these data fields which contribute to Depression or anxiety, classification technique in data mining can be utilized. Revealing hidden thinking pattern behind the depression and anxiety which may cause suicidal issues can be effectively done through classification as it is a predictive mining task.

3.5.1 Decision Tree

A decision tree is a method for classification by modeling a tree structure model. Leaves are representing class labels and branches representing conjunctions of features. The output of the learning process is a classification tree where the split at each node of the tree represents one if -then decision rule and each leaf corresponding to one value of the target variable. Its target could be predicted by starting from the root and going down to a leaf of the decision tree by matching the variables.The procedure of the training algorithm chooses at each step the best variable to split the set of training. The criterion to compare between variables is how well the variable split the set of training into homogeneous subsets of examples with respect to the values of the target variables. A decision tree is a very simple and informal model and can be understood by nonprofessional people. Hence it may not perform well on complex classification problems.

3.5.2 Naïve bay

The Naive Bayesian classifier is based on Bayes' theorem with the independence assumptions between predictors. A Naive Bayesian model is easy to build. It is not a very complicated iterative parameter estimation.It is particularly useful for very large datasets. In spite of its simplicity, the Naive Bayesian classifier provides surprisingly well outputs. It is widely used since it outperforms more sophisticated classification methods.

The Naive Bayesian classifier holds conditional independence assumptions, because of that this classifier will converge quicker than discriminate models like logistic regression, so we need less training data. If it is not held assumption, the classifier still performs well in speed. The main disadvantage is that it can't learn and show the connections between features.

Navïe Bayes algorithm is used for this project will be discussed more detail in the Implementation chapter.

3.5.3 KNN (K-Nearest Neighbors)

The k-nearest neighbors' algorithm (k-NN) is a non-parametric method used for classification and regression in pattern recognition, KNN is a sort of instance-based learning algorithm, Here function is approximated locally, and all computation is deferred until classification. The k-NN algorithm is the simplest of all machine learning algorithms.

Both for classification and regression, a useful technique can be used to assign weight to the contributions of the neighbors, so that the nearer neighbors contribute more to the average than the more distant ones. The neighbors are taken from a set of objects for which the class (for k-NN classification) or the object property value (for k-NN regression) is known. This can be thought of as the training set for the algorithm, though no explicit training step is required. A peculiarity of the k-NN algorithm is that it is sensitive to the local structure of the data.

3.4. Summary

This chapter presented data mining as the technology proposed to Detect mental disorder student in early stage according to the given scenario for making strategic decisions to provide necessary treatments or refer him/or for necessary counseling programs. In this sense, Basically Rapid miner can be used as a data mining tool also it is pointed out how the classification data mining algorithm offers an efficient and accurate solution for Identify mental disorder person in school. The next chapter shows a novel approach to predict the outcome of the mental condition of a particular student through technology presented here.

Chapter 4

Data Mining Approach For School Intervention to Early Detection of Mental Disorder

4.1. Introduction

In this chapter focuses, after gathering the required information, the data is being preprocessed and then train using data mining technique and create a model using the data. Gain the most suitable model and after that, can apply the model for detection and prediction.

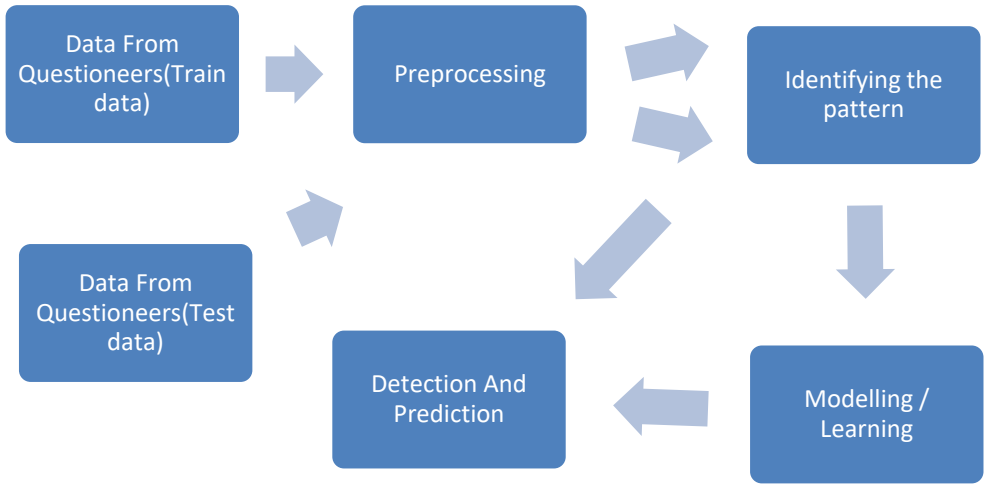


Figure 2 Data Mining Methodology to identify the pattern

4.2. Hypothesis

Using data mining techniques can predict or explore feelings, thoughts and behavioral changes attach to the mental disorder. Predictive data mining can be used to predict the thoughts affecting various kinds of social issues like suicidal conditions, murder incidents, immature personalities, difficulty in obtaining jobs, the inability to create and maintain lasting relationships, etc.

4.3. Input

As the initial input for this process, data obtained from counseling units of several schools are used. This data provided by students themselves, if the data reveals that students have some problem in their thoughts counselor or psychiatrist individually interview them and diagnose whether they need treatments for that mental disorder. For this research chosen input data to obtain by counseling unit which identified and labeled as “ DEPRESSION THOUGHTS," "ANXIETY THOUGHTS” or “NORMAL” by counselor or psychiatrist

4.4. Output

As the main output of this process, the System will be provided a prediction about the mental condition of a particular student. Generated prediction result is written to the Excel sheet. As the output of this process, different data patterns related to the thinking pattern of mentally disordered teenagers can be reveled according to the research question identified. The prediction will be given as output for the research question attach with predictive tasks.

4.5. Process

In this process of analyzing answers given by students, with data mining all the standard steps in the knowledge discovery process which include data selection to evaluation are

carried out. Throughout the process, the data set is cleaned, formatted and prepared for mining and interpretation. Prediction generates Using Rapid Miner Data mining tool as the main technologies.

4.6. Users

Class Teacher and the Counselor of the school counseling unit will be gain the benefits of this research.

4.7. Features

The solution proposed by this research can be used to analyze a huge volume of data about feelings and thoughts which are in different forms in a consistent manner. Through the predictive mining tasks, this solution allows to make predictions for future instances. Moreover, descriptive tasks allow describing the pattern described by the dataset. This solution provides the output by extracting previously unknown patterns dynamically.

4.8. Summary

This chapter presented our novel approach to early detect the mentally disordered teenagers in the school. This approach provides an evidence-based prediction with the student report based on student behavior provided by the class teacher. In this sense, it is pointed out how the novel approach offers an efficient and accurate solution for identifying mentally disordered students early, using data mining. The next chapter shows the design of the novel approach presented here.

Chapter 5

Research Design for Early Detection of Mental Disorders

5.1. Introduction

Chapter 4 presented the Data mining approach to early detection of mental disorders based on their thinking pattern. This chapter explains the approach and focuses on the design of the research.

5.2. Research Design

5.2.1 Participants

Participants who were selected by class teachers are having some behavioral issues, developing social relationships issues or issues in educational performances. (teacher report)

Class teacher and Counselor of the school counseling unit created an occasion for them to problematize, and take action on, specific aspects of the classroom or school activity, then the counselor or psychiatrist conducting the survey. Here not only gaining the answers from them but also psychiatrist interviewing the person. This help to get a diversity of data collection processes working by participants (data collection for a student).

According to the literature review several types of research have been conducted to prevent the mentally disordered thoughts but effectiveness will very less as they were targeting high age group and even the treatment also shows less effective whereas this

research will be the more effective as the targeting group is school students and helpful to create healthy Sri Lanka in the future.

This research will help to detect and prevent the mentally disordered thoughts from an early stage at school level by their own teachers. This will be the use of friendly and able to use by ordinary people to identify the disorders and get the appropriate solutions. Especially this research and findings will be most helpful in such a way to guide the mentally disorders people in 15 to 19 years of age and lead them in a proper way in later age and make them live a happy life.

In this research, Design planed as instead of trying to explain each and every separate thought or behavior, and the researcher seeks a general explanation that incorporates and links together many behaviors and thoughts. Hence, this research planned as a systematic, controlled, experimental, public and critical investigation of natural phenomena.

This research carried out with both quantitative data analysis and qualitative data analysis. In analyzing the sensitive data like feelings and thoughts of a teenager who identify the teacher as, who have an abnormal behavioral pattern, need systematic analysis and investigation of human behavior through controlled, realistic observation and scientific experimentation to draw the conclusion

This research starts with the observation of the existence of social-economic issues like suicidal, criminal and personality developing issues in age 15-19 teenagers. Then a study was carried out to get information about the factors we should focus on to solve these kinds of problems and how similar problems are solved.

Furthermore, researcher can exactly identify thoughts influencing socio-economic issues in the age of 15-19. Hence through this research, focus on to avoid socio-economic issues.

Hypothesis development related to this research questions had conducted, and experimental design is done using Rapid Miner.

Various kinds of data mining techniques provide a variety of results for particular sub-research questions are based on data gathered for the sub research question. Those

generated results or the output data are further analyzed for efficiency and accuracy. By considering the analyzed results for a particular research question conclusion can be given.

5.3. Top Level Design

5.3.1 Attribute Selection

For the data model construction and prediction, the existence of an association between the independent variables and the dependent variable was supported. Further analyzed by stepwise backward elimination to check where the least significant attributes will be removed until other non-significant attributes contribute to the model.

By following that procedure attributes listed below, for the data model of "Depression Thoughts" and "Anxiety Thoughts."

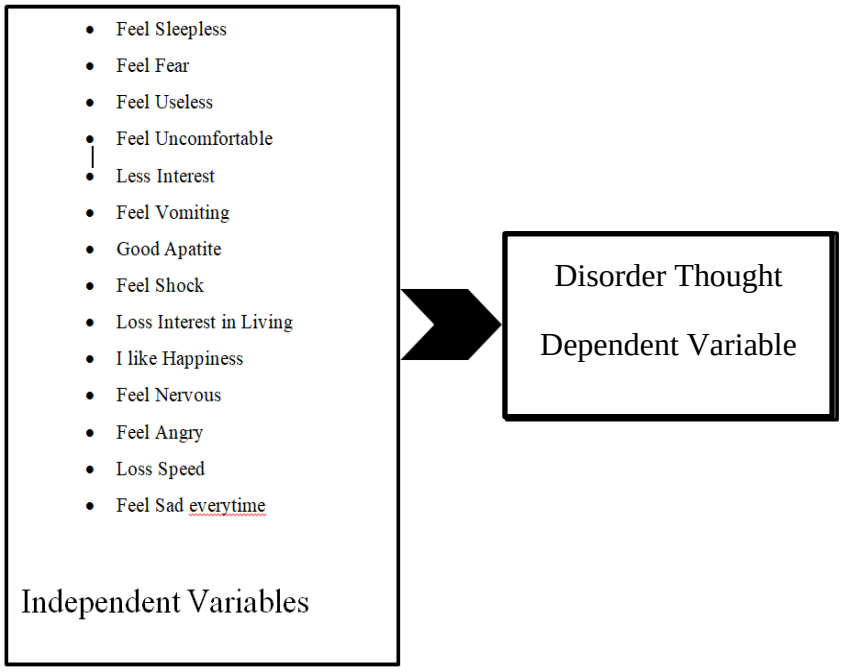


Figure 3 Independent and Dependent variables

5.3.2 Training Data Sample

The psychiatrist had a particular mark for each and every answer that they have provided. After That according to the mark, psychiatrist decides the mental condition of the student. Data set is created under the supervision of a psychiatrist of the school.

5.3.3Test Data set

Class Teacher is doing the survey and gain the answers for each question. And Load the answers into the Microsoft Excel Sheet.

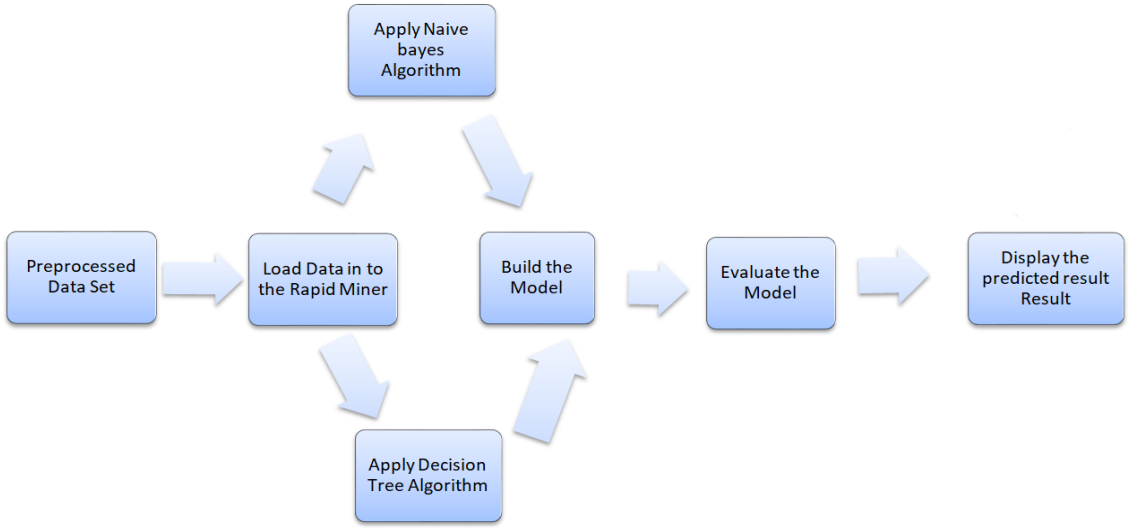


Figure 4 Flow of Identifying a Disordered Thinking pattern

5.4. Research Question

Identify mental disorder in the early stage in evidence-based decision pattern in the school, is identified as the primary research question in this research.

5.4.1. Primary Research Question

There is no acceptable research carried out in the Sri Lankan education system to identify the Thinking patterns attach to mental conditions. Hence primarily propose an evidence-based system on data mining to analyze sensitive data like thoughts and emotions, attach with students who were considered as having abnormal behaviors in the classroom.

5.4.2. Sub Research Question 1

It is crucial to find out the gap between the real emotions of a student who needs treatment and who considered as normal. Here this system can be used to predict mentally disordered thoughts at their early stage and redirect them to proper treatments including counseling and meditation.

5.5. Summary

This chapter provided details on research design and also, focuses on top level design for the research and how sub research questions are structured with in the research. Next section will be discussed about implementation details according to this design.

Chapter 6

Implementation

6.1. Introduction

Chapter 5 discusses the design of the solution to the research question. This chapter describes the implementation of each research question regarding software, algorithms, method…etc. In that sense, this chapter includes the implementation procedure of the system.

6.2. Discussion about this Procedure

In Sri Lanka, there doesn't exist any good method to detect the Mentally disordered thoughts as early as possible of the patients who will go into a critical phase. Early detection and conduct proper counseling can help to prevent it. Implementing a Model to identify mentally disordered thoughts in the early stage will help to control the strange behavioral incidents, murder cases, rape cases, and suicides.

6.2.1. Data Input Procedure

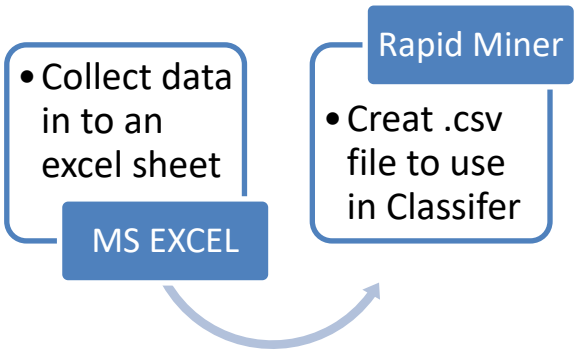


Figure 5 Load Data into Rapid Miner

6.2.2. Data Preprocessing

After gathering the data set, did Pre-processing like identifying missing values and converting numeric values into nominal values, etc. were performed on the dataset. After pre-processing, 114 instances were obtained for training.

6.3. Solution for Primary Research Question:

Identify the thinking pattern of the student who suffers from a mental disorder can be developed as followings.

6.3.1. Discussion about this Domain

The dataset for the research was collected from the clinical psychiatrist who had conducted a survey in 5 different schools included Boys' school, Girls' school, and Mixed school. These schools include both rural and leading schools in Sri Lanka. The sample consists of 114 children whose age between 15-19, answered 14 questions relevant to the thoughts of depression and anxiety.

Students, who were eligible for this survey, have shown behavioral changes and low educational performance levels than other students. According to the Class, Teacher provides report school counseling unit, Psychiatrist who engaged with the unit conducting the survey. Every Answer is getting a mark, and according to the marks gained, the psychiatrist decided the condition of the mentality of the student.

Data set prepared using the answers provided and the decision of the psychiatrist.

6.3.2. Model Building Using Suitable Classification Technology

For analyzing and Model Building, used three different supervised learning methods. They are Decision Tree, Naïve Bay, and KNN

6.3.2.1. Decision Tree Model

The objective of using Decision Tree to this research is, it is straightforward and easy to understand and interpret and tree models can be visualized easily. And it required a few amounts of data preparation, does not require domain Knowledge or parameter settings. Decision Tree is able to handle high dimensional data and create a prediction model that predicts the value of a target or dependent variable by learning simple decision rules inferred from the data features.

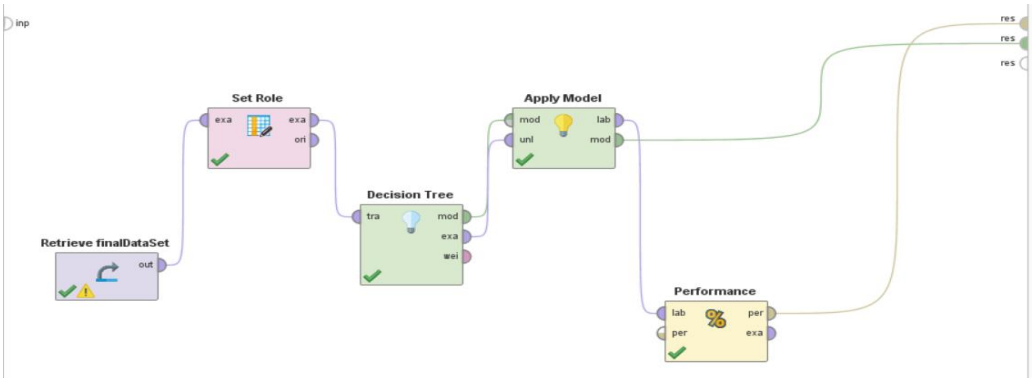


Figure 6 Decision Tree Modeling Process

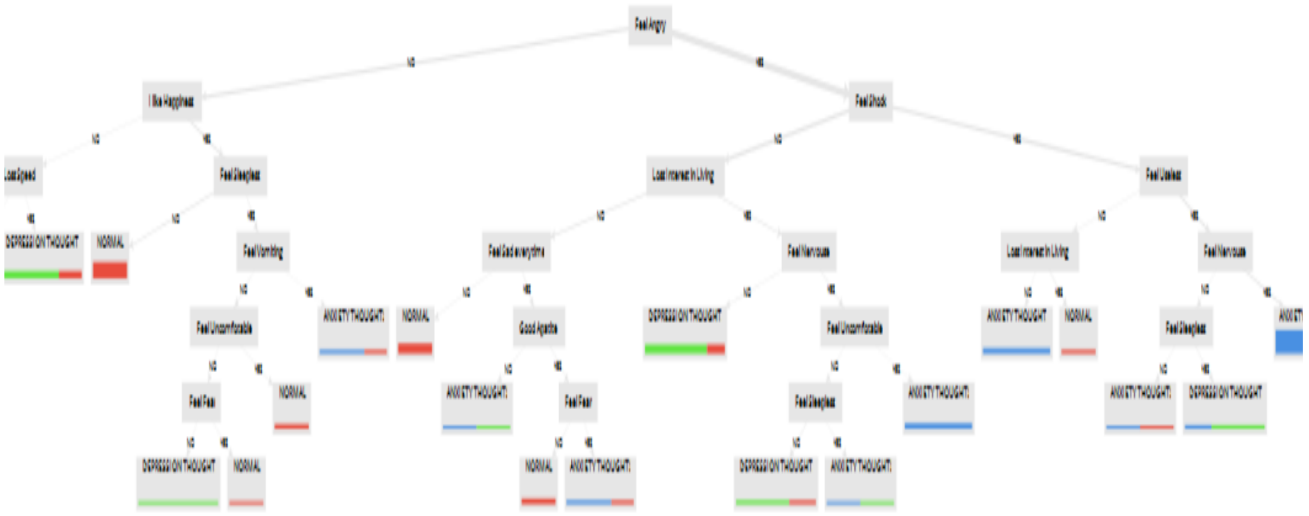


Figure 7 Decision Tree Model

6.3.2.2. Naïve Bayes Model

The Naive Bayesian classifier is based on Bayes' theorem, and it is a statistical classifier which can handle in many complex real-world situations, with the independence assumptions between predictors. A Naive Bayesian model is easy to build. There is no complicated iterative parameter estimation for huge datasets. Not only is its simplicity, the Naive Bayes classifier commonly used because it is a very sophisticated classification method.

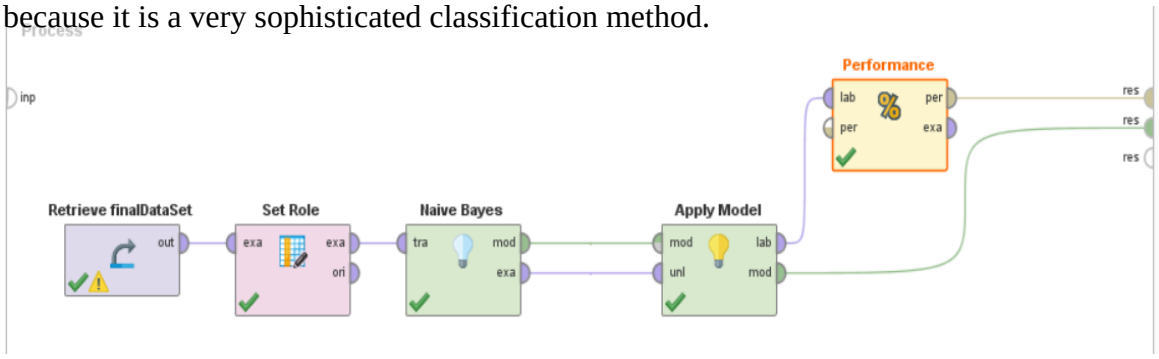


Figure 8 Naïve Bayes Modeling Process

6.3.2.3. K-Nearest Neighbor's algorithm (k-NN) Model

The k-nearest neighbor's algorithm (k-NN) is a classifier for classifying objects based on closest training data in the feature space. K-NN is using very often because it is most straightforward of all machine learning algorithms and also it based on instance-based learning. But the accuracy of the k-NN algorithm can be very high when the Data set not containing noisy or irrelevant features.

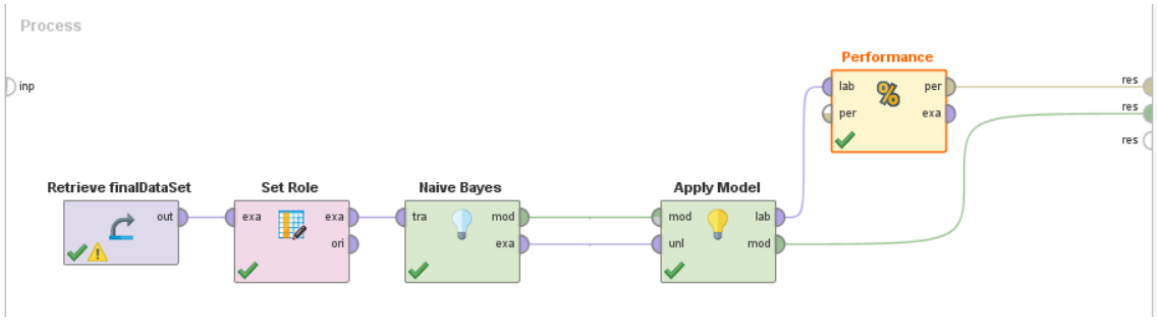


Figure 9 k-Nearest Neighbor's Algorithm Modeling Process

6.3. Solution for Sub Research Question 1:

Make predictions and early detection of the student who suffers from a mental disorder can be developed as followings.

6.3.1 Discussion about this Domain

Early detection to the prevention of mental disorders in the early stage is very important especially during 15-19s which will prevent the beginning of mental illness in adolescent life. The taking actions and directing them at the school level will be more cost-effective and confidential. According to articles and researches refer in above, the prevention of mental disorders will be the most effective action rather than cure, but for that, people have to be more optimistic as it requires training of staffs, screening, and initial cost is high. This research will be more cost effective, and anybody can handle the tool with minimum knowledge. This research will be more helpful in the school to detect the mentally disordered thoughts of students by teachers to identify in advance and treat them in the right way. This will bypass all the traditional way of diagnosing and treating the mental disorder mentions in the other articles and researches. Considering the report of the teacher, counselor or class teacher can get the answers from the student for the questioner. This data are used to make predictions about disorder thoughts. Predicted values are written to the Microsoft Excel sheet.

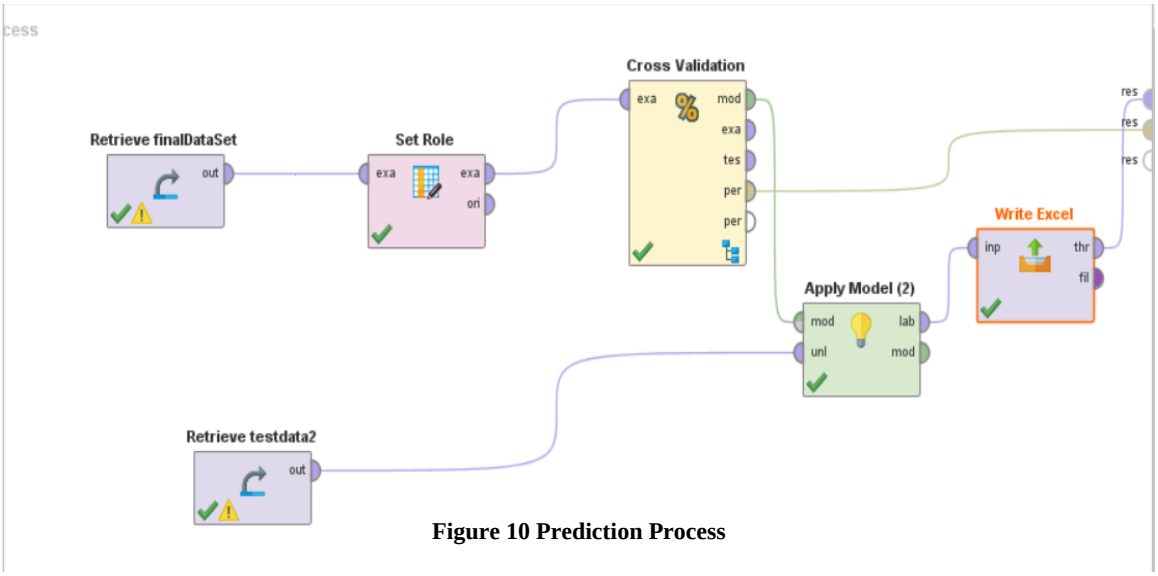


Figure 10 Prediction Process

6.3.1.1. The process of Prediction using Decision Tree

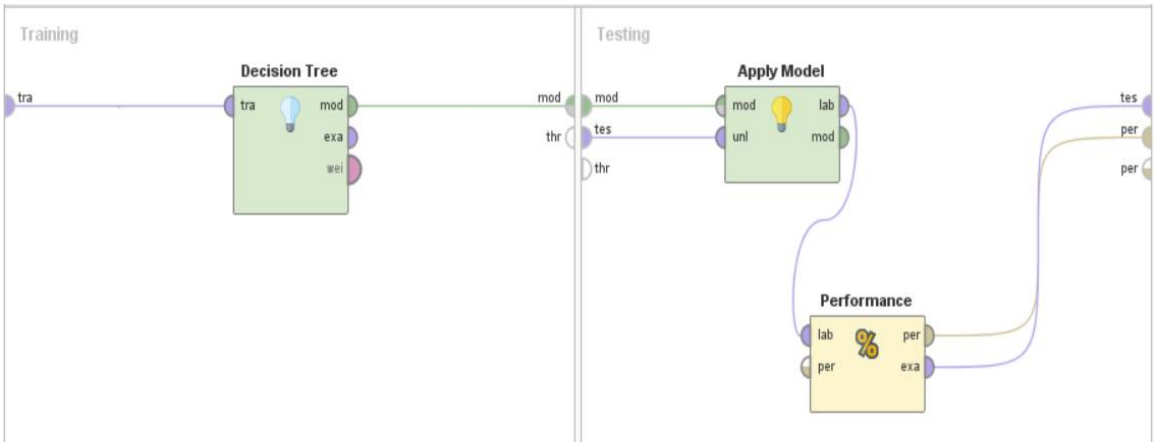


Figure 11 Decision Tree Prediction Process

6.3.1.2. The process of Prediction using Naïve Bayes

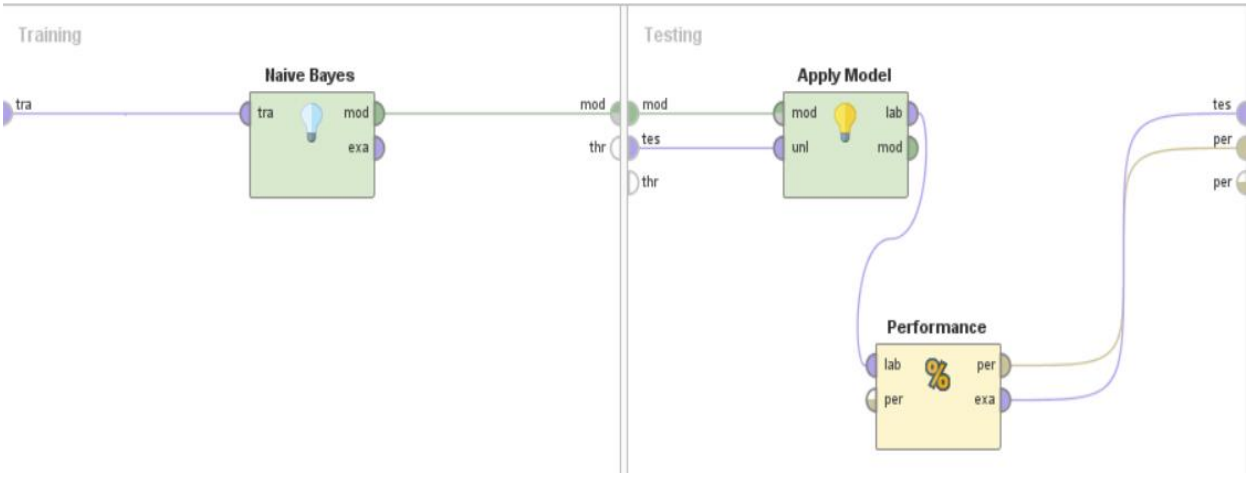


Figure 12 Naïve Bayes Prediction Process

6.3.1.2. The process of Prediction using k-nearest neighbor's algorithm (k-NN)

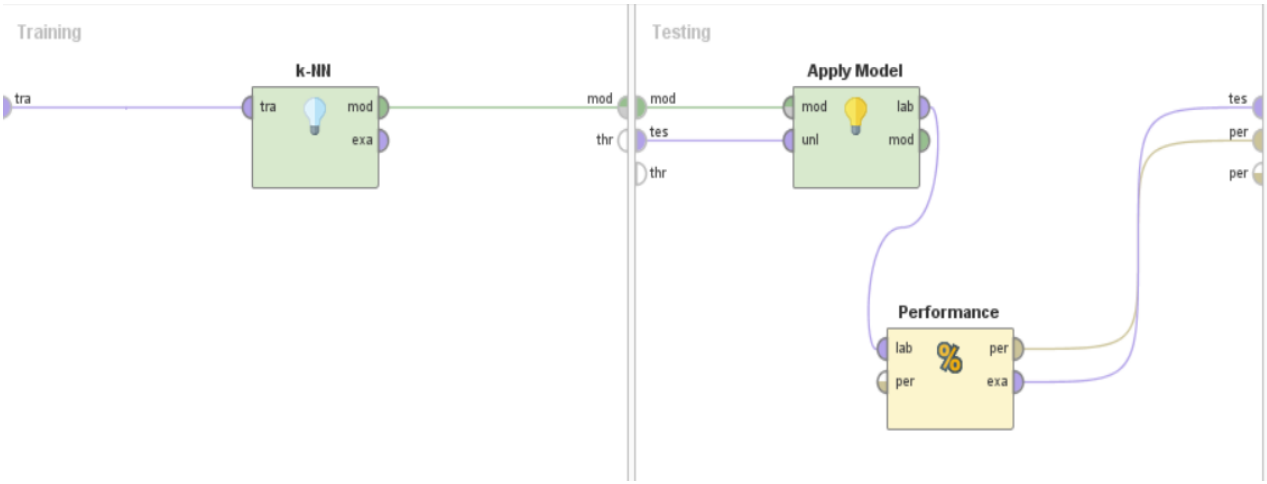


Figure 13 k-NN Prediction Process

6.4 Summary

This chapter provided details on research implementation procedures for research questions separately. Furthermore, this chapter focuses on data mining techniques for the research and how the research question is structured within the research. Next section chapter will be discussed about implementation details according to this design.

Chapter 7

Evaluation

7.1. Introduction

The previous chapter discussed the details on the implementation of all the models mentioned in the proposed solution. This chapter justifies and evaluates the overall solution, data mining techniques and data models used in this Research.

7.2 Testing and Evaluation

The data evaluation stage is the most critical one as it integrates knowledge from mined data. After the training process, the performance of the revealed “thinking pattern” is evaluated by applying another known data model and checking whether its outputs are still relevant to the targets.

There are two essential issues.

- How to decide the commercial value from knowledge patterns discovered in the data mining stage.
- Which technique or visualization tool should be used to demonstrate the data mining results.
- The degree of accuracy of the predicted output.

In this research Evaluation done by selecting different techniques, can be used for the same dataset with different algorithms and best out of them should be chosen to match with accuracy level. Therefore evaluation of mined patterns should be done with respect to goal or objective to maximize the efficiency. In order to properly evaluated knowledge patterns, it's important to choose an appropriate visualization tool. Many visualization packages and tools are available in, including line charts, histograms, plots, trees, and

distribution networks. The research is performed using the training data set consists of 114 instances with 14 different attributes. The dataset is used for training, and another unknown data set is used for testing.

7.3 Evaluation of Classification techniques

We have trained collected data set using different classification techniques namely Naïve Bayes, Decision Tree and k-NN by the help of Rapid Miner tool. Mental condition prediction is the main outcome of this research.

7.3.1. Model Performance of Classification techniques

For evaluating a classifier quality, we can use a different matrix which can be evaluated various measurements such as accuracy, recall, and precision.

7.3.1. 1. Decision Tree Model Performance

PerformanceVector

```
PerformanceVector:
accuracy: 89.47%
ConfusionMatrix:
True:   ANXIETY THOUGHTS        DEPRESSION THOUGHTS     NORMAL
ANXIETY THOUGHTS:       41      3       3
DEPRESSION THOUGHTS:    1       18      5
NORMAL: 0       0       43
kappa: 0.836
ConfusionMatrix:
True:   ANXIETY THOUGHTS        DEPRESSION THOUGHTS     NORMAL
ANXIETY THOUGHTS:       41      3       3
DEPRESSION THOUGHTS:    1       18      5
NORMAL: 0       0       43
```

Figure 14 Decision Tree Model Performance

7.3.1. 2. Naive Bayes Model Performance

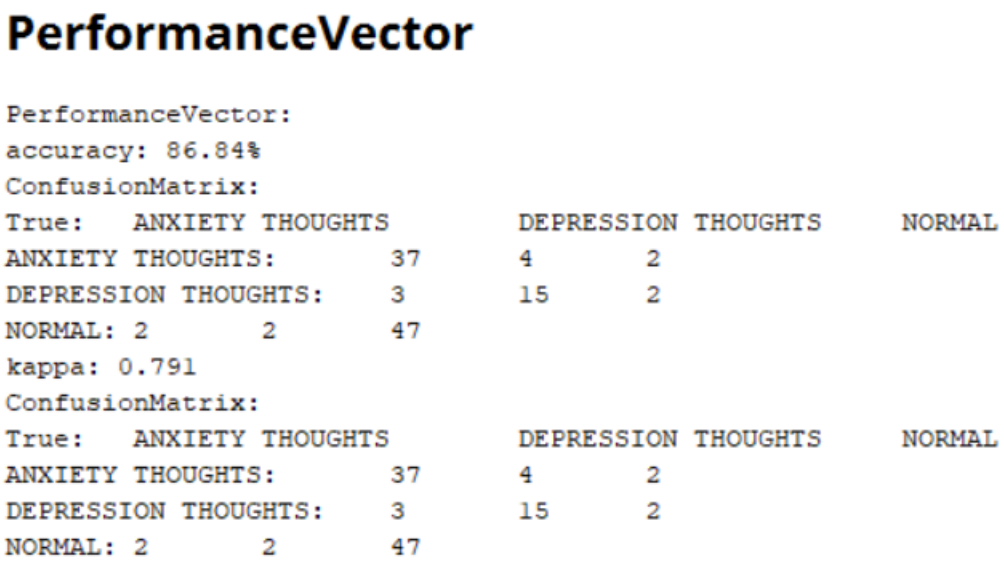


Figure 15 Naïve Bayes Model Performance

7.3.1. 3. k-NN Model Performance

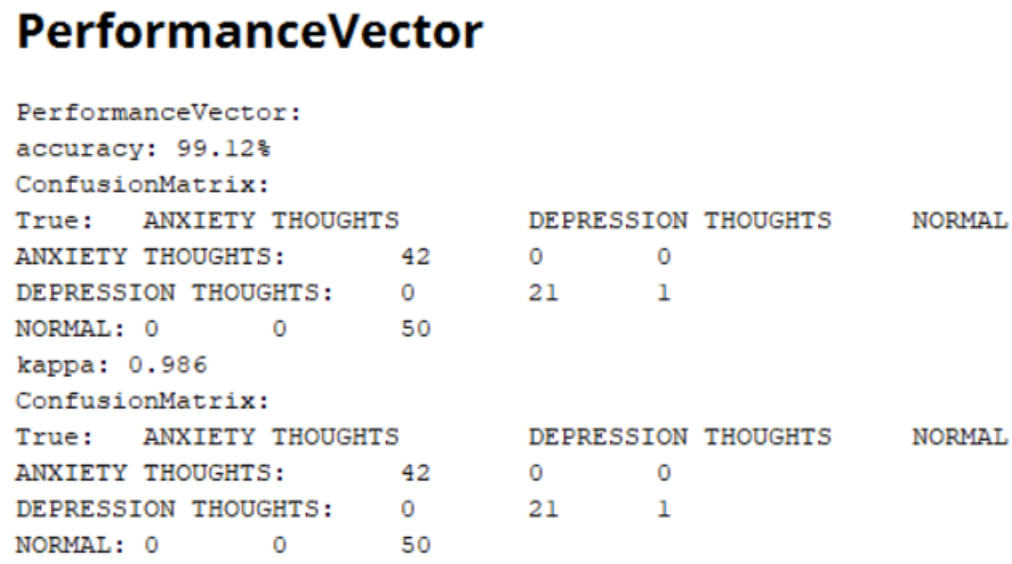


Figure 16 k-NN Algorithm Model Performance

7.3.2. Model Evaluation of Classification techniques

7.3.2. 1. Decision Tree Model Evaluation

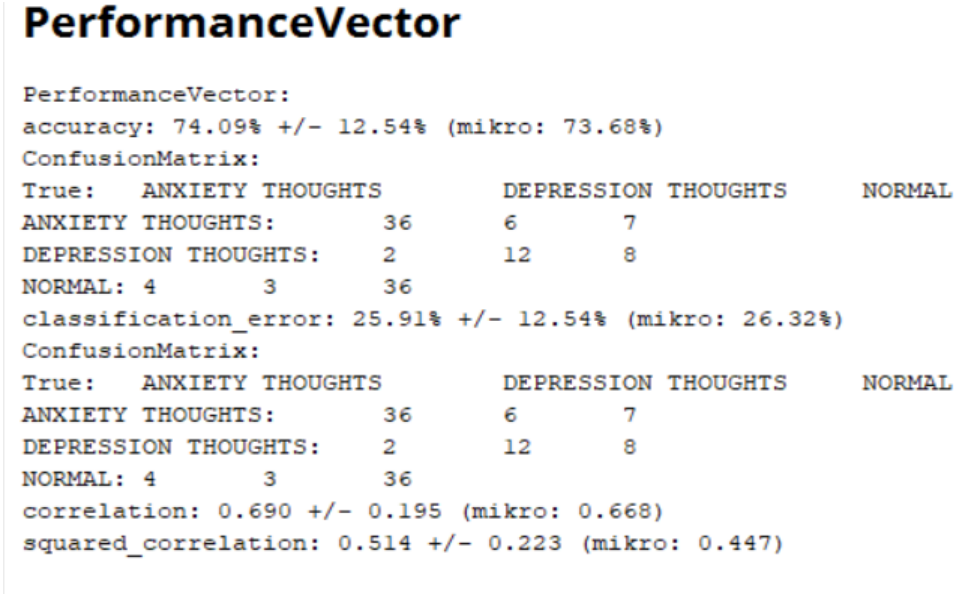


Figure 17 Decision Tree Model Evaluation Performance

7.3.2. 2. Naïve Byes Model Evaluation

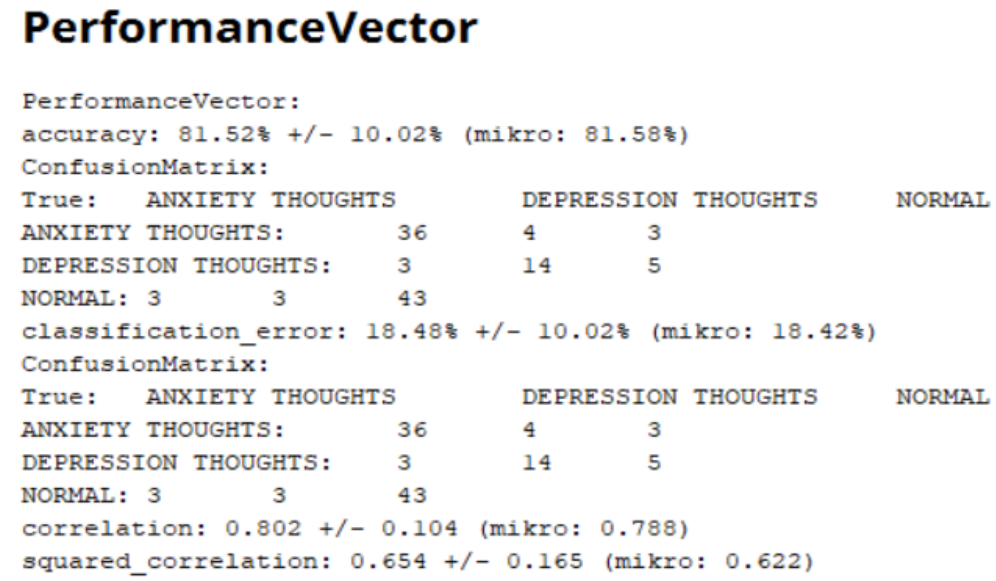


Figure 18 Decision Naïve Bayes Model Evaluation Performance

7.3.2. 3. K-NN Model Evaluation

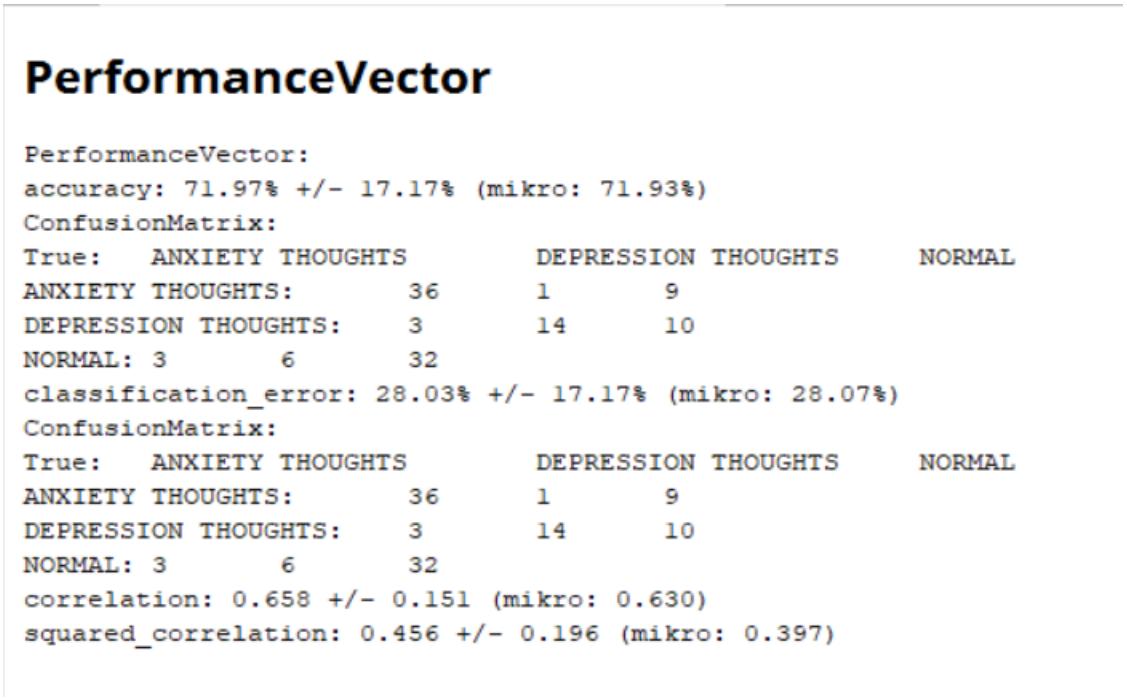


Figure 19 k-NN Algorithm Model Evaluation Performance

7.4. Conclusion of Evaluation of Classification Techniques

Algorithm	Accuracy
Decision Tree	74.09%
Naïve Bays	81.52%
k-NN Algorithm	71.97%

Table 1 Comparison of Algorithm Accuracy

Based on the experimental results shown in Evaluation figures it is clear that the classification accuracy of Naive Bayes algorithm is better compared to other algorithms.

7.5. More Research Findings

7.5.1. Some Significant thoughts that can be felt due to disorders

Based on the experimental results shown in below will say that people who are having anxiety thoughts has high probability of having feeling of fear and uncomfortable always.

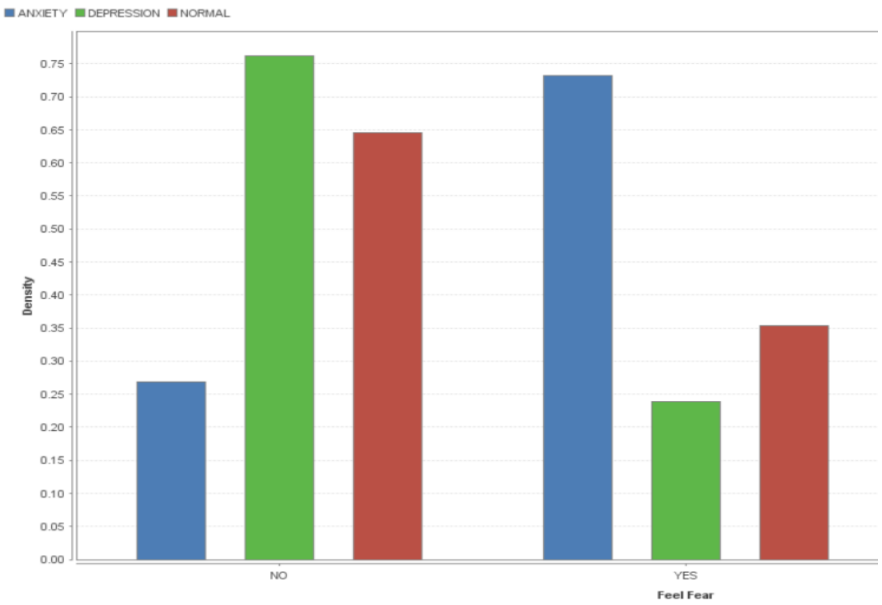


Figure 20 Feeling of Fear

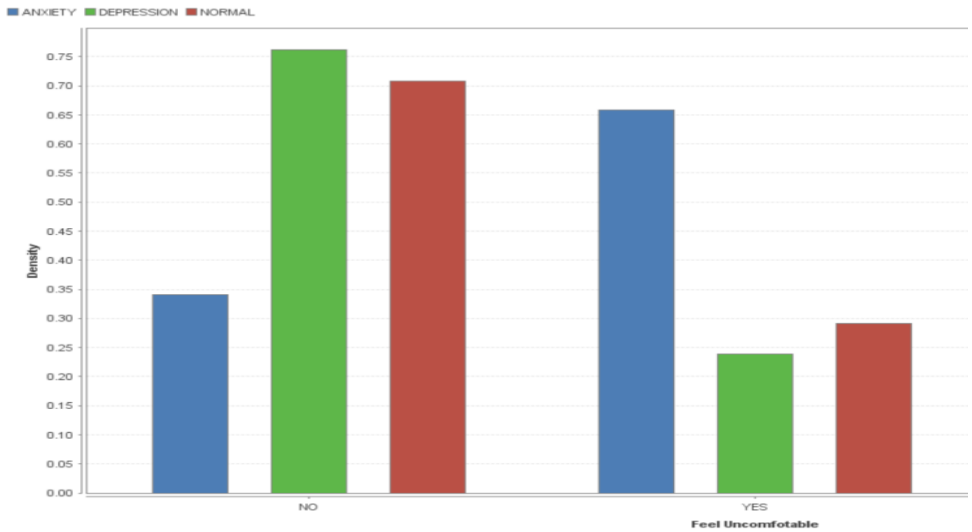


Figure 21 Feeling of Uncomfortable

People who are having Depression thoughts has high probability of having feeling of uselessness.

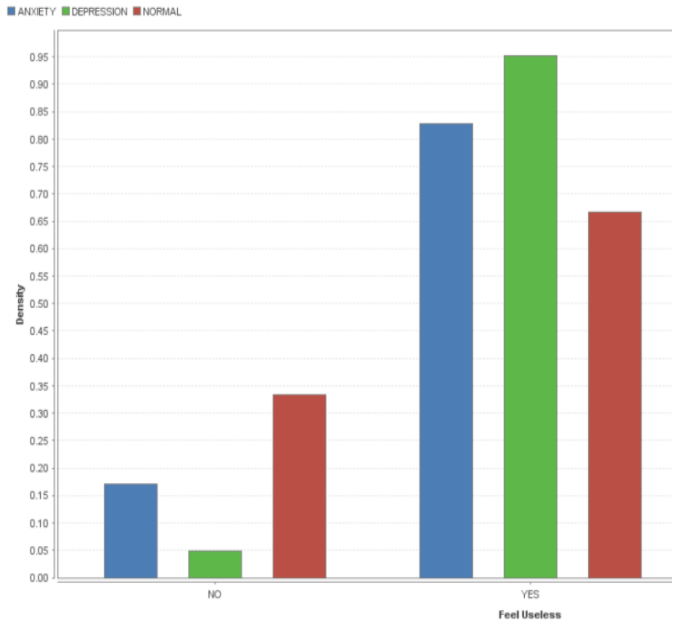


Figure 22 Feeling of Useless

7.5.2. Some Significant Answering patterns

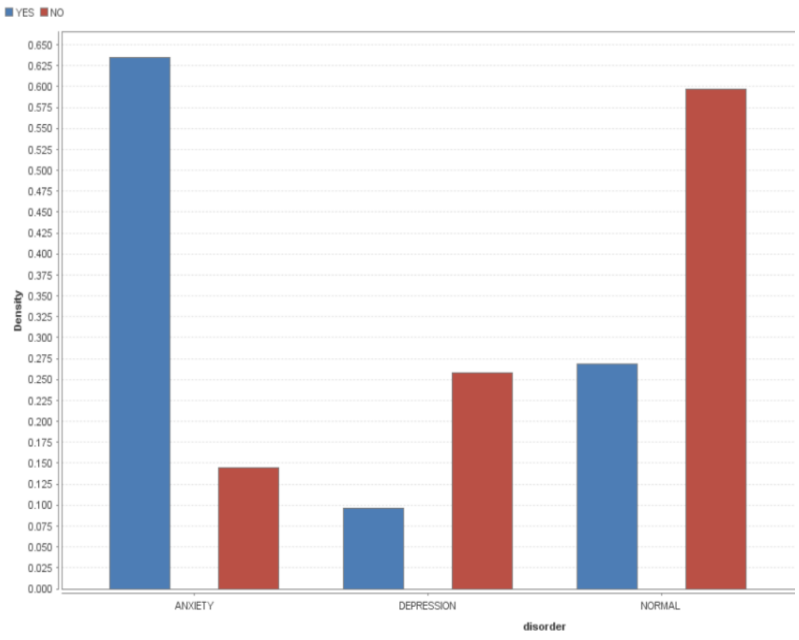


Figure 23 Feeling Shocked Vs. Distribution of Mental Disorders

7.5.3. Conclusion of other Research findings

Based on the figures mentioned under the section of more research findings Researcher can be able to say that Normal students have mixed feelings about the moments.

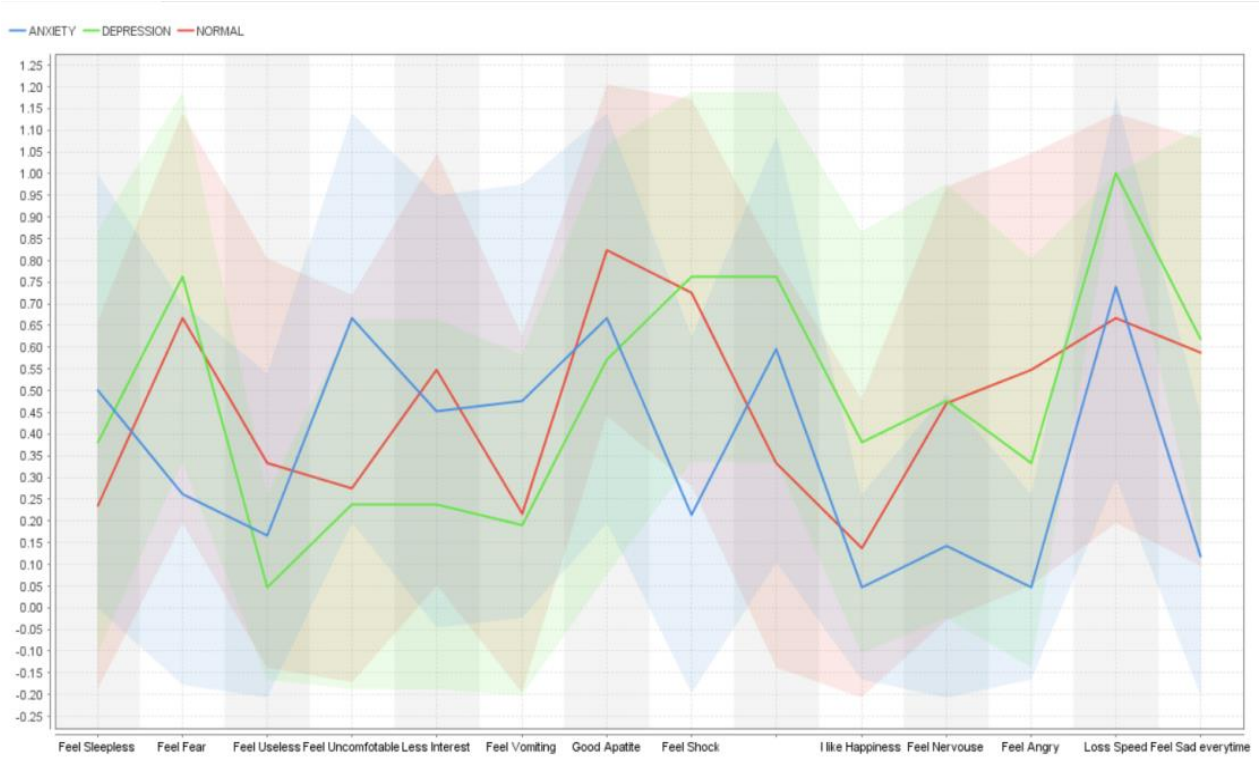


Figure 24 Distribution of Thoughts

7.6. Summary

This chapter discussed the research finding and the conclusion of the evaluation. Also according to the accuracy of the techniques research can able to take a decision. Results were analyzed, and increased performances carried the solution into an acceptable level.

The following chapter will describe the conclusion of the research project and further work that can be implemented.

Chapter 8

Conclusion and Further Work

8.1. Introduction

In this research, we have addressed the problem of detecting the thinking pattern of teenagers who are suffering from depression and anxiety. By analyzing different attributes related to the depression and anxiety thoughts, we have been able to predict the thinking pattern which tends depression or anxiety thoughts using attributes from the dataset. We have proposed and implemented a thinking pattern and predict the mental condition, based on our study.

8.2. Conclusion

The main goal of this research is to build a model for predicting mental condition through an evidence-based system. There are many types of research going on to detect and prevent mental disorders. Many researchers are mainly focused on cognitive training in psychiatric illnesses and to prevent it. Research on its neural and behavioral targets, Summarize the factors that appear to relate to a successful response, including learner characteristics that influence clinical outcome will support to get valuable predictions.

Naïve Bayes algorithm is used to predict the mental condition in any given situation. We demonstrated the quality and accuracy of our predictions with an extensive set of experiments on real thoughts of teenagers' who need proper treatments for depression, anxiety and have normal health condition, data.

8.2. Contribution

Prediction can also be helped to make strategic decisions to increase detection of affected minds. Main contributions of School intervention to early detection of mental disorders research include,

- Data mining techniques comparison which revealed that classification is the best approach to solve the problem.
- Evaluation of various classifiers over real data which proved that Naïve Bayes provide the best prediction over the concerned datasets.
- Model a thinking pattern to identify the discorded teenagers' thoughts.
- Development of the mental condition Predictor tool that can be reused

8.3. Limitations

For Research, more schools were approached than agreed to participate. Therefore the research sample was smaller than expected. The "work-load" of school teachers' create barriers to engaging them, as each school was struggling to overcome the priorities.

Those who suffer from mental illness are stronger than we think. They must fight to go to work, care for their families, be there for their families, be there for their friends, and act normal while battling unimaginable pain. Therefore sometimes class teacher could not recognize them properly, or they might be evasion.

Any research in this type prefers to direct the patients and the victims toward the bright full future through the medications and the counseling, but it's not so easy. So, many researchers have done studies and found about course of actions that the researchers have to take and assess the reasons for their success and failure.

Some thinking and behavioral patterns and educational performance based on their family history and this kind of things can be misled with a mental disorder.

8.4. Future Developments

As future work, we are planning to expand our analysis using more attributes and identify other disorders such as Personality Disorders with Distorted Thinking Patterns

Researcher is focusing on implementing Desktop Application and Mobile Application. So that it will increase usability. And furthermore, the researcher wants to increase the dataset to reduce the prediction error while identifying some more interesting patterns. Moreover, we intend to predict mental condition and suggest psychological treatment therapies to teachers for students.

8.5 Summary

This chapter concludes the thesis by describing the solution given with data mining solution to early detect the mentally disordered and how outcome prediction and Suggestion help to make decisions to identify mentally disordered students in schools with an evidence-based system.

References

[1] M. H. Europe, “Mental Health Promotion of Adolescents and Young People. Directory of Projects in Europe,” p. 109, 2001.

[2] M. Nardi, C. Levinson, M. Lawrence, A. Kamauff, J. Wilby, and W. Burge, “Evidence-Based Decision Support for Managing the Mentally III InmatePopulation,” *2017 Syst. Inf. Eng. Des. Symp.*, pp. 150–155, 2017.

[3] J. Zhang, H. Xiong, Y. Huang, H. Wu, K. Leach, and L. E. Barnes, “M-SEQ: Early detection of anxiety and depression via temporal orders of diagnoses in electronic health data,” *Proc. - 2015 IEEE Int. Conf. Big Data, IEEE Big Data 2015*, pp. 2569–2577, 2015.

[4] Y. E. Fang, C. H. Tai, Y. S. Chang, and C. T. Fan, “A mental disorder early warning approach by observing depression symptom in social diary,” *Conf. Proc. - IEEE Int. Conf. Syst. Man Cybern.*, vol. 2014–Janua, no. January, pp. 2060–2065, 2014.

[5] P. L. Festersen and A. Corradini, “re : Mind A mobile application for bipolar disorder patients,” pp. 343–346, 2014.

[6] G. Azar and C. Gloster, “Intelligent Data Mining and Machine Learning for Mental Health Diagnosis using Genetic Algorithm,” pp. 201–206.

[7] C. Zhu and B. Li, “Predicting Depression from Internet Behaviors by Time-frequency Features,” 2016.

[8] A. R. Subhani, W. Mumtaz, M. Naufal, B. I. N. Mohamed, N. Kamel, and A. S. Malik, “Machine Learning Framework for the Detection of Mental Stress at Multiple Levels,” vol. 5, pp. 13545–13556, 2017.

[9] “Investing in M E N TA L H E A LT H.”

[10] A. J. Gelenberg *et al.*, “Treatment of Patients With Major Depressive Disorder,”

no. October, 2010.

[11] A. Disorders, T. Role, and E. Treatment, “Anxiety Disorders : The.”

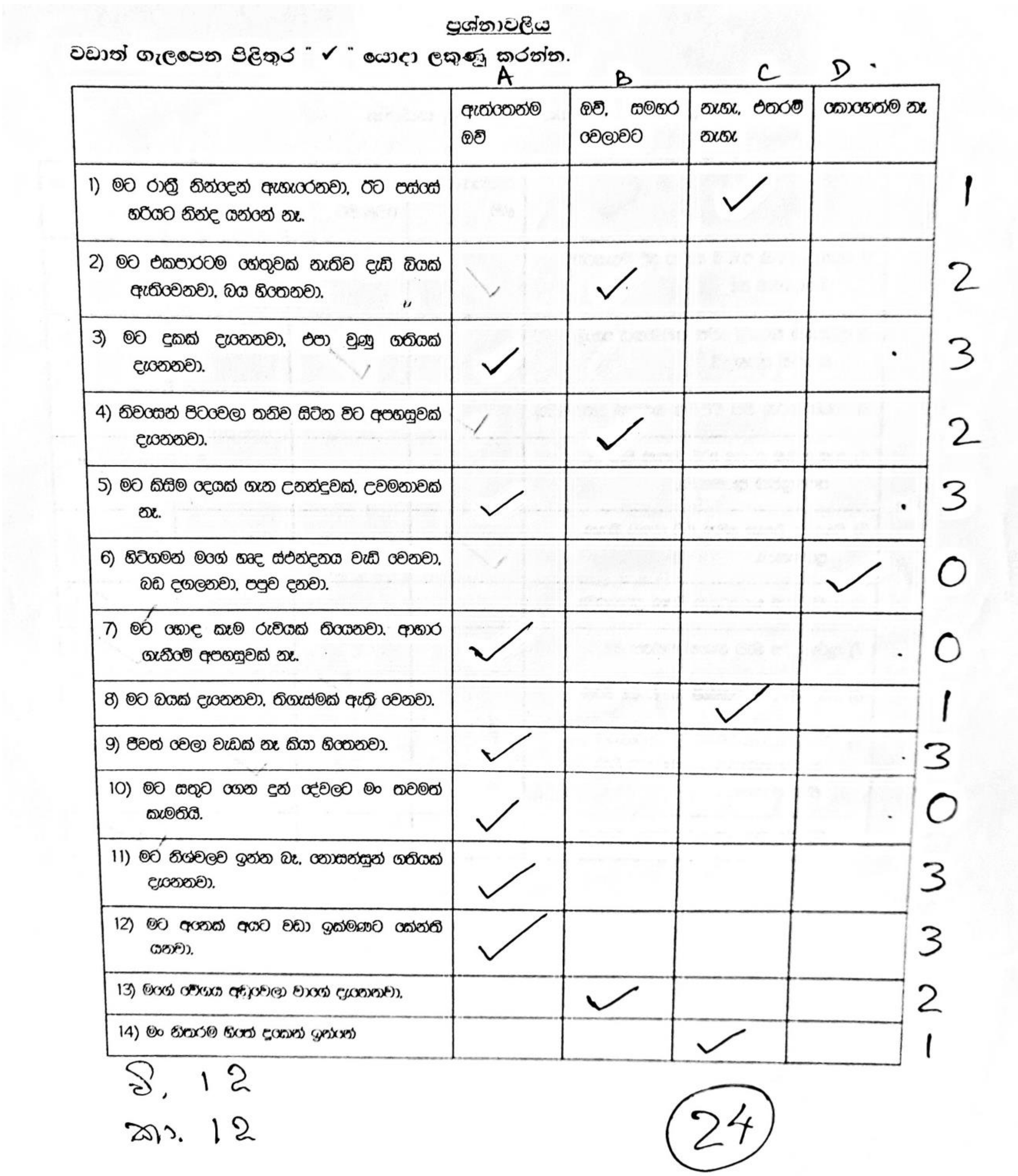
[12] S. R. Thornton, “Supporting children ’ s mental well-being in primary schools : problem-solving through communication and action Supporting Children ’ s Mental Well-being in Primary Schools : Problem-Solving Through Communication and Action,” 2011.

[13] N. O. N. C. Diseases, M. Illnesses, and D. Consumption, “Non communicable diseases, mental illnesses, suicides, smoking and drug consumption,” pp. 221–239, 2016.

[14] R. L. Mccrea, “Rethinking the nature of mental disorder : a latent structure approach to data from three national psychiatric morbidity surveys,” 2013.

Appendices

Appendix – A : Sample Answers to the questioner



ප්‍රශ්නාවලිය

වඩාත් ගැලපෙන පිළිතුර " ✓ " යොදා ලකුණු කරන්න.

	A	B	C	D	
	ඇත්තෙන්ම ඔව්	ඔව්, සමහර වෙලාවට	නැහැ, එතරම් නැහැ	කොහෙත්ම නෑ	
1) මට රාත්‍රී නින්දෙන් ඇහැරෙනවා, ඊට පස්සේ හරියට නින්ද යන්නේ නෑ.			✓		1
2) මට එකපාරටම හේතුවක් නැතිව දැඩි බියක් ඇතිවෙනවා, බය හිතෙනවා.		✓			2
3) මට දුකක් දැනෙනවා, එපා වුණු ගතියක් දැනෙනවා.	✓				3
4) නිවසෙන් පිටවෙලා තනිව සිටින විට අපහසුවක් දැනෙනවා.		✓			2
5) මට කිසිම දෙයක් ගැන උනන්දුවක්, උවමනාවක් නෑ.	✓				3
6) හිටිගමන් මගේ හෘද ස්පන්දනය වැඩි වෙනවා, බඩ දගලනවා, පපුව දනවා.				✓	0
7) මට හොඳ කෑම රුචියක් තියෙනවා, ආහාර ගැනීමේ අපහසුවක් නෑ.	✓				0
8) මට බයක් දැනෙනවා, තිගැස්මක් ඇති වෙනවා.			✓		1
9) ජීවත් වෙලා වැඩක් නෑ කියා හිතෙනවා.	✓				3
10) මට සතුට ගෙන දුන් දේවලට මං තවමත් කැමතියි.	✓				0
11) මට නිශ්චලව ඉන්න බෑ, නොසන්සුන් ගතියක් දැනෙනවා.	✓				3
12) මට අනෙක් අයට වඩා ඉක්මණට කේන්ති යනවා.	✓				3
13) මගේ ජීවිතය අඳුරුවෙලා වාගේ දැනෙනවා.		✓			2
14) මං නිතරම හිතේ දුකෙන් ඉන්නේ			✓		1

ඩි, 12

කා. 12

24

Appendix A:1 Sample Answers to the questioner - Student

Appendix – B : Marks for Questioner

කාංසාව සහ විශාදය පිළිබඳ මිනුම

	ඇත්තෙන්ම ඔව්	ඔව්, සමහර වෙලාවට	නැහැ, එතරම් නැහැ	කොහෙත්ම නෑ
1) මට රාත්‍රී නින්දෙන් ඇහැරෙනවා, ඊට පස්සේ හරියට නින්ද යන්නේ නෑ.	3	2	1	0
2) මට එකපාරටම හේතුවක් නැතිව දැඩි බියක් ඇතිවෙනවා, බය හිතෙනවා.	3	2	1	0
3) මට දුකක් දැනෙනවා, එපා වුණු ගතියක් දැනෙනවා.	3	2	1	0
4) නිවසෙන් පිටවෙලා තනිව සිටින විට අපහසුවක් දැනෙනවා.	3	2	1	0
5) මට කිසිම දෙයක් ගැන උනන්දුවක්, උවමනාවක් නෑ.	3	2	1	0
6) හිටිගමන් මගේ හෘද ස්පන්දනය වැඩි වෙනවා, බඩ දැගලනවා, පපුව දනවා.	3	2	1	0
7) මට හොඳ කෑම රුචියක් තියෙනවා. ආහාර ගැනීමේ අපහසුවක් නෑ.	0	1	2	3
8) මට බයක් දැනෙනවා, තිගැස්මක් ඇති වෙනවා.	3	2	1	0
9) ජීවත් වෙලා වැඩක් නෑ කියා හිතෙනවා.	3	2	1	0
10) මට සතුට ගෙන දුන් දේවලට මං තවමත් කැමතියි.	0	1	2	3
11) මට නිශ්චලව ඉන්න බෑ, නොසන්සුන් ගතියක් දැනෙනවා.	3	2	1	0
12) මට අනෙක් අයට වඩා ඉක්මණට කේන්ති යනවා.	3	2	1	0
13) මගේ වේගය අඩුවෙලා වාගේ දැනෙනවා.	3	2	1	0
14) මං නිතරම හිතේ දුකෙන් ඉන්නේ	3	2	1	0

33

කාංසාව 2, 4, 6, 8, 11, 12, 14

විශාදය 1, 3, 5, 7, 9, 10, 13

ලකුණු ක්‍රමය 3, 2, 1, 0 (7 හා 10 ප්‍රශ්නවලට ලකුණු ආරෝහණ ක්‍රමයට යි)

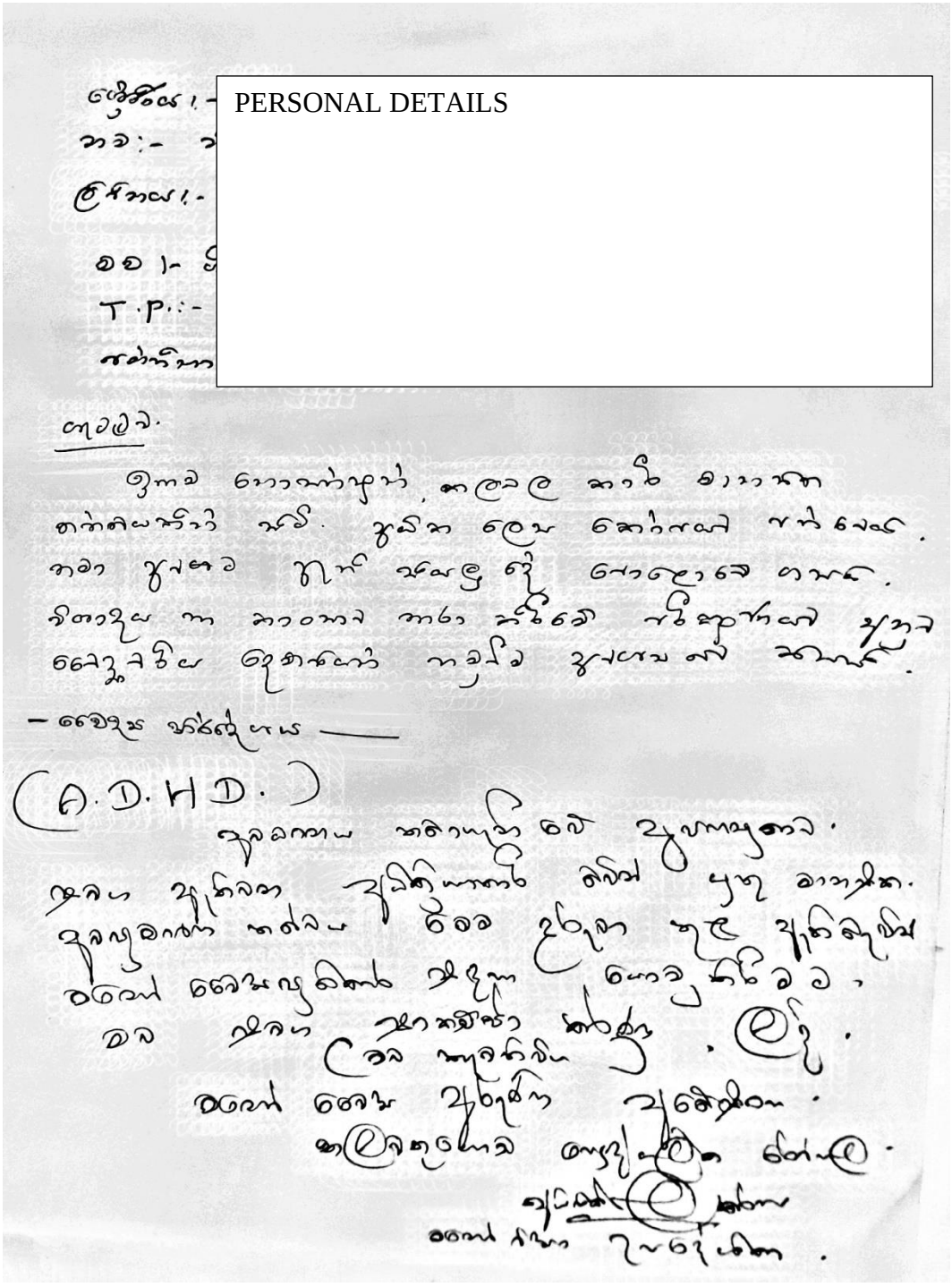
තරාව: 0 - 7 සාමාන්‍ය, 8 - 10 [illegible] ඇත 11ට වැඩි නම් ප්‍රතිකාර අවශ්‍යයි

Normal

Need Treatments

Appendix B:1 Marks for Questioner

Appendix – C : Teacher Report and psychiatrist Inscription



Appendix C:1Teacher Report and psychiatrist Inscription

Appendix – D Final output – Prediction

Final output – Prediction will write to a MS EXCEL sheet.

Feel Sleep	Feel Fear	Feel Usele	Feel Unco	Less Inter	Feel Vomi	Good Apa	Feel Shoc	Loss Inter	I like Happ	Feel Nervc	Feel Angry	Loss Spee	Feel Sad	e disorder	confidence(AN	confidenc	confidenc	prediction(disorder)
NO	NO	YES	NO	NO	YES	NO	YES	YES	NO	NO	YES	YES	YES	DEPRESSIC	.1	.7	.1	DEPRESSION THOUGHTS
NO	NO	NO	NO	NO	YES	NO	YES	YES	YES	NO	YES	YES	YES	NORMAL	.6	.1	.4	ANXIETY THOUGHTS
NO	NO	NO	NO	NO	NO	NO	NO	NO	YES	NO	NO	YES	YES	NORMAL	.0	.0	1.0	NORMAL
NO	YES	YES	YES	NO	YES	NO	YES	YES	YES	YES	YES	NO	YES	ANXIETY	1.0	.0	.0	ANXIETY THOUGHTS
YES	YES	YES	YES	YES	NO	NO	NO	NO	YES	NO	NO	YES	YES	NORMAL	.1	.3	.6	NORMAL
YES	YES	NO	YES	YES	YES	YES	YES	NO	YES	NO	YES	YES	YES	ANXIETY	1.0	.0	.0	ANXIETY THOUGHTS
YES	YES	YES	YES	YES	NO	YES	NO	YES	YES	NO	YES	YES	YES	DEPRESSIC	.7	.2	.1	ANXIETY THOUGHTS
NO	YES	YES	YES	YES	NO	YES	NO	YES	YES	YES	YES	YES	NO	ANXIETY	.3	.4	.3	DEPRESSION THOUGHTS
YES	YES	YES	YES	YES	NO	YES	NO	YES	YES	YES	YES	YES	NO	ANXIETY	.5	.4	.1	ANXIETY THOUGHTS
NO	NO	YES	YES	NO	YES	YES	YES	NO	YES	YES	YES	YES	YES	ANXIETY	.9	.0	.1	ANXIETY THOUGHTS
YES	NO	YES	YES	YES	YES	NO	YES	NO	YES	YES	YES	YES	YES	ANXIETY	1.0	.0	.0	ANXIETY THOUGHTS
YES	YES	YES	NO	NO	NO	YES	NO	YES	YES	NO	YES	NO	YES	NORMAL	.4	.0	.6	NORMAL
YES	YES	YES	NO	YES	NO	YES	YES	YES	YES	YES	YES	YES	NO	ANXIETY	.6	.3	.1	ANXIETY THOUGHTS
NO	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	DEPRESSIC	.0	.8	.2	DEPRESSION THOUGHTS
YES	NO	YES	NO	YES	NO	YES	NO	YES	YES	YES	NO	YES	NO	DEPRESSIC	.0	.7	.3	DEPRESSION THOUGHTS
NO	NO	YES	NO	YES	NO	YES	NO	YES	YES	NO	YES	YES	NO	DEPRESSIC	.0	.7	.3	DEPRESSION THOUGHTS
NO	YES	YES	NO	NO	NO	YES	YES	YES	YES	YES	NO	YES	NO	NORMAL	.0	.1	.8	NORMAL
NO	NO	NO	NO	NO	NO	YES	YES	YES	YES	NO	YES	YES	YES	NORMAL	.1	.0	.8	NORMAL
NO	NO	YES	NO	YES	NO	YES	NO	YES	YES	NO	YES	YES	NO	DEPRESSIC	.0	.7	.3	DEPRESSION THOUGHTS
NO	NO	YES	NO	NO	YES	NO	NO	YES	YES	NO	YES	YES	NO	DEPRESSIC	.0	.7	.3	DEPRESSION THOUGHTS
NO	NO	YES	NO	YES	NO	YES	NO	YES	YES	NO	YES	YES	YES	DEPRESSIC	.0	.7	.3	DEPRESSION THOUGHTS
YES	NO	NO	YES	NO	NO	YES	YES	NO	YES	YES	YES	YES	YES	ANXIETY	.9	.0	.1	ANXIETY THOUGHTS
YES	NO	NO	NO	NO	YES	YES	YES	NO	YES	NO	YES	YES	YES	NORMAL	.4	.0	.6	NORMAL
NO	NO	YES	NO	NO	NO	YES	NO	NO	YES	YES	YES	YES	YES	NORMAL	.1	.1	.8	NORMAL
NO	NO	NO	NO	YES	NO	YES	YES	YES	NO	YES	YES	YES	YES	NORMAL	.2	.3	.4	NORMAL
YES	NO	YES	YES	NO	NO	YES	NO	YES	YES	YES	YES	YES	NO	NORMAL	.2	.5	.4	DEPRESSION THOUGHTS
NO	YES	YES	NO	YES	YES	YES	YES	YES	YES	YES	YES	YES	NO	NORMAL	.7	.1	.1	ANXIETY THOUGHTS
YES	YES	YES	NO	YES	YES	YES	NO	NO	YES	YES	YES	YES	YES	ANXIETY	.8	.0	.1	ANXIETY THOUGHTS
YES	NO	NO	NO	YES	NO	NO	NO	YES	NO	YES	YES	YES	NO	DEPRESSIC	.0	.9	.1	DEPRESSION THOUGHTS
NO	YES	YES	YES	NO	NO	YES	NO	NO	NO	YES	YES	YES	NO	NORMAL	.1	.2	.8	NORMAL
NO	NO	YES	NO	YES	NO	YES	NO	YES	YES	NO	YES	YES	YES	NORMAL	.0	.7	.3	DEPRESSION THOUGHTS

PREDICTION

Appendix D:1 Final output – Prediction will write to a Micro Soft EXCEL sheet