

Chapter 7


Automated App for Mental Health Analysis: A Need to Fight Against Growing Crisis in the 21st Century World

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ABSTRACT

Many apps and analyzers based on machine learning have been designed already to help and cure the stress issue, which is an epidemic. The project is based on an experimental research work that the authors have performed at Research Labs and Scientific Spirituality Centers of Dev Sanskriti VishwaVidyalaya, Haridwar and Patanjali Research Foundations, Uttarakhand. In their research work, the correctness and accuracy have been studied and compared for two biofeedback devices named as electromyography (EMG) and galvanic skin response (GSR), which can operate in three modes—audio, visual, and audio-visual—with the help of data set of tension type headache (TTH) patients. They have realized by their research work that these days people have lot of stress in their life so they planned to make an effort for reducing the stress level of people by their technical knowledge of computer science. In their project, the authors have a website that contains a closed set of questionnaires from SF-36, which have some weight associated with each question.

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INTRODUCTION

As we can see that almost everyone is suffering from many kinds of stress and we all get some indicators which shows that we are suffering from stress rather it be physical, emotional, personal, sleep or behavioral. But manually the level of stress is difficult to calculate and also the people are much more reliable on medication for getting relief. Many times, the individual is lost in physical pleasure, accumulation of facilities and due to lack of right understanding about the self, one bears the ignorance about one's own being. Due to which they suffer from stress most of the time. These consist of pharmacological treatment, physical therapy, acupuncture, relaxation therapy or alternative medicine. So the main focus of our project is to check the stress level of a person and give remedies to them accordingly. We are more focused on giving remedies to people which do not include any kind of medications (Singh et al., 2018i; Saini et al., 2018j).

Motivation

The experimental research work done by us has motivated us to use our knowledge and make an effort to reduce the stress level of people. Automation and mechanization is rapidly increasing with intelligent machines. Science has done miracles and almost in all walks of life, most works are being done by scientific gadgets and it has no doubt made human life simpler. It has helped to handle complex issues but contrary to this, there is a dark side of the picture that it has created some negative aspects and challenging situations too. The present crisis of science to human life is that the stress, tension, depression, anxiety, hatred, headache, frustration, suicidal tendencies and violence is increasing in our world day by day. The happiness index has been reduced rapidly everywhere. The Human personality is degraded in terms of value system (Yadav et al., 2018k, 2018j; Gupta et al., 2019a).

Biofeedback

Biofeedback therapy is a non-drug therapy in which patients learn to control physical processes that are usually involuntary, such as muscle tone, high blood pressure, and heart rate.

Useful for various conditions such as chronic pain, urinary incontinence, high blood pressure, tension headaches, and migraine. Because the disease is non-invasive and does not include drug therapy, the risk of side effects is low (Nordqvist, 2018).

Working of Biofeedback

Biofeedback therapy by interpreting factors such as brain electrical activity can help people change their unhealthy habits.

There are three common ways to treat biofeedback.

- Thermal biofeedback measures skin temperature.
- An electromyogram measures muscle tone.
- Neurofeedback or EEG biofeedback focuses on brain electrical activity.

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Biofeedback therapy by interpreting factors such as brain electrical activity can help people change their unhealthy habits.

Uses of Biofeedback Therapy

- Migraine
- Hyperactivity
- Post-traumatic stress disorder
- Incontinence
- Child anxiety at the dentist
- Reynaud's disease

Mental Fitness and Health

There is evidence that exercise can increase mental health, but scientists don't know much about whether physical fitness can prevent mental health. General mental health issues such as depression and anxiety are global issues. They reduce overall well-being and life satisfaction, but may increase the risk of cardiovascular disease and increase the risk of death.

Biofeedback training, also called biofeedback training, helps manage many physical and mental health issues, including:

- Anxiety and stress
- asthma
- Side effects of chemotherapy
- Chronic pain

Biofeedback Appeals to People for a Variety of Reasons

- Non-invasive
- It may reduce or eliminate the need for drugs.
- This may be a cure for those who cannot tolerate medicine.
- There is also an option that the drug does not work well.

Global Annals of Social Mental Fitness Health

The Indian Psychiatric Association has a total of five areas under its wings. The western branch of the Indian Psychiatric Association has been around for nearly 50 years. From the first meeting held in the small Malorian town of Gujarat in 1970, the 50th annual meeting will be held in Thane in 2019. IPSWZB has members who are mental health professionals in three states: Maharashtra, Gujarat and Goa. The region conducts several scientific activities every year, including medium-term CME, annual conference, and PG CME. Throughout the year, we have implemented community outreach programs and won several awards at the national level.

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The three state branches are divided into 13 branches, each producing mental health. There are several subcommittees in the region that review regional performance and goals. Each branch and sub-department sends an annual report to the regional branch about the various activities performed during the year.

IPS WZB recognizes the excellence of young researchers in this field by awarding national awards every year in the fields of psychiatry and mental health at annual meetings, and praises the lifelong success of senior experts.

Psychiatric India is the official journal of the Western West Branch. This site has its own interactive website and archive section that provides members with updates and new information in the hope of making mental health a business priority (Medknow, 2019).

Mental Fitness Data in Indian Society

According to the annual Practo Digital Digital Health Care Map, 82% are psychologists, psychiatrists, psychologists in Tier 2 cities such as Indore, Kanpur, Nagpur, Jaipur, Visakhapatnam, Bhopal, Chandigarh and Lucknow. I met with a therapist., Coimbatore, Ahmadabad, Patna. People in these cities tended to seek management of depression, post-traumatic stress disorder (PTSD), marriage counseling, stress, addiction and anger.

In meetings with psychologists, psychiatrists and psychotherapists, meetings with major cities such as Delhi, Mumbai, Bangalore, Pune, Chennai, Kolkata and Hyderabad have increased by 24%.

According to a World Health Organization (WHO) report, 7.5% of the Indian population suffers some form of mental distress or disability.

OBJECTIVE OF RESEARCH

1. To study and compare the correctness and accuracy of Electromyography(EMG) and Galvanic Skin Response(GSR) biofeedback in three modes: audio, visual and audio-visual.
2. Our project is to check the stress level of a person and give remedies to them accordingly, by classifying them into one of three categories: low, medium and high stress level.
3. Comparing the efficiency of different algorithms used for classification.

SCOPE OF THE RESEARCH WORK

Measuring the effect of various indicators like physical, sleep, behavioral, personal and emotional parameters are indicators of stress on different levels of stress. The purpose is to reduce the use of medication to lower the level of stress. Measuring the accuracy of the range decided to track the level of stress of a person. A runnable system which checks the stress level of a person. The main objective is to develop a system which gives the remedies which do not involve any kind of medication to a person according to their stress level (Singhal et al., 2019b; Saini et al., 2019c).

Automated App for Mental Health Analysis**LITERATURE SURVEY**

MoodKit a popular app based on IOS which uses the foundation of Cognitive Behavioral Therapy (CBT) and provides different mood improvement activities to different users which are more than 200 in number. Developed by two clinical psychologists, MoodKit helps one to change the thinking pattern and method, to develop self confidence, awareness, creativity, situation handling and problem solving and wise healthy attitude (Sharma et al., 2018d).

Another very good mental health helping app is Mind Shift which has been developed to facilitate teenagers and adults to face the challenges of depression and frustration along with anxiety. The app Mind Shift focuses the sight of users about their thought process for.

Khanna A, Paul M, Sandhu JS. exhibited a detailed research work and in depth study to check accuracy and comparison of efficiency of GSR and EMG biofeedback training process and consequently progressive muscle relaxation process for decreasing the blood pressure and respiratory rate for those subjects who were suffering heavily from acute level of headache (Agarwal et al., 2018g).

Biofeedback is getting popular now as an alternate therapy and informs the subject and experimenter both about the current status of headache. It also helps to avoid the excessive use of medications and antioxidants for muscle relaxation. It helps the subjects from shifting the dependency on costly medications and consecutive side effects (Yadav et al., 2019b).

Chronic TTH was found as the most common problem in all subjects of every type of gender, age, rural-urban sector of any demographic regions. Since most of the problems are psychosomatic so psycho and psychosocial factors are in consideration to study it (Gulati et al., 2018f).

According to Julia Anna Glombiewski Biofeedback (BFB) is an ongoing intervention for headache rehabilitation and other pain disorders. Little is known about this treatment option for fibromyalgia syndrome (FMS). The purpose of the author of this review is to integrate and critically evaluate the evidence for the biofeedback effect of FMS. Method.

The author conducted literature search using Pubmed Search, clinicals.gov (National Institutes of Health), Cochrane Central Register, Controlled Trials, PsycINFO, SCOPUS, and manual search. The effect size estimate was calculated using a random effects model.

The methodology used by the author was following: One hundred sixteen records were excluded. The meta-analysis included seven studies of 300 patients on EEG biofeedback and EMG biofeedback. Compared to the control group, BFB had a larger effect size and significantly reduced pain intensity. Subgroup analysis showed that only EMG-BFB, not EEG-BFB, reduced pain intensity compared to the control group.

They described limitations of BFB sleep disorders did not reduce depression, fatigue, or health-related quality of life compared to the control group.

Catherine Bernardi showed that there is limited interpretation of these results due to lack of research on the long-term effects of EMG-BFB on FMS. Further research should focus on the long-term efficacy of BFB in fibromyalgia and identify predictors of treatment response.

According to him, Biofeedback is a promising intervention in the rehabilitation of headaches and other pain disorders, and is also effective in FMS. However, little is known about this treatment option for FMS and it is not part of the usual care of FMS patients. Therefore, they conclude that the purpose of this study is to integrate and critically evaluate the evidence for the biofeedback effect of FMS (Glombiewski et al., 2018).

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According to Rubin, A. Biofeedback therapy has long been known to treat chronic headaches such as TTH due to various psychological challenges, stress, and cognitive and physiological control loss due to stress from TTH, resulting in reduced function. May cause symptoms such as headaches and gastrointestinal tract. Disorder, high blood pressure, chest pain, insomnia, gastric ulcer, sexual dysfunction, skin disease, etc.

MMBD is more efficient than IoT when considering health-related applications. This is because development activities focus on scale sensor data. Unique complexity and nature of IoT MMBD expansion using biofeedback sensors.

He described in this paper, the analysis of two GSR and EMG biofeedback therapies in the treatment of TTH for 12 months in different modes such as acoustic, visual, and visual modalities. Individual physical, mental, and total scores in both electromyography therapy and electro dermal responses to auditory, visual, and compositional processes have been studied.

The author has made attempts to test hypotheses and evaluate the effectiveness of biofeedback methods in individual and potential combination states (Rubin, 1992).

The paper “Audio Visual EMG & GSR Biofeedback Analysis and Spiritual Methods for Understanding Human Behaviour and Psychosomatic Disorders” was written by Biswa Mohan Sahoo, Amar Deep Gupta and Basu Dev Shivahare.

According to him, In young professionals between the ages of 20 and 24, psychological imbalances are caused by emotional inactivity and lack of self-awareness. Spirituality with conscious mind meditation and a positive attitude is the only way you can see everyone coming soon through some discipline.

They have described the purpose of this study is not to compare the effects of EMG and GSR biofeedback on subject headache and quality of life stress. Headache-induced stress (TTH) is the most common primary headache. The purpose of this study is to evaluate electromyogram (EMG) biofeedback and GSR (electric skin resistance) as effective treatments for headaches. There is no such comparative effect of visual and auditory EMG biofeedback for headaches. Tension headache (TTH) is the most common type of primary headache. Biofeedback (BF) is information about biological activities that are normally unconsciously exposed and is an established treatment for TTH². Hypertensive pain therapy, which has a better effect on coping with psychological and psychosocial consequences, highlights the patient’s active role in managing these conditions. BF has few unnecessary side effects. If it is effective for preventive treatment or miscarriage of headaches, the use of drugs is clearly preferred.

They revealed the BF forms was used for migraine, tension headache, hybrid headache, and BF electromyogram (EMG) was shown maximum benefits (Shivahare et al., 2018).

The paper was written by Nagai Y et al., titled as “Galvanic Skin Response (GSR)/ Electro dermal / Skin Conductance Biofeedback on Epilepsy: A Systematic Review and Meta-Analysis”

He described the dynamic changes in psychological arousal appear directly on the skin sympathetic nerves. This activity can be measured as the tonicity of electrode activity and fuzzy oscillations. Biofeedback training can voluntarily control this autonomous response and its central communication. In theory, psychological arousal control is used as a treatment for epilepsy and reduces pre-discovery conditions. Evidence is gathering about the clinical effectiveness of GSR biofeedback training in the management of drug-resistant epilepsy.

They have analyzed evidence on the effectiveness of GSR biofeedback and evaluation of work methods for each study. They have used the following methodology in which they searched published literature on epilepsy intervention GSR biofeedback studies via the MEDLINE and Cochrane databases. Summarizing existing findings using meta-analytic methods has been used as a measure of seizure efficacy

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as a measure of the therapeutic effect of GSR biofeedback. It also compares and contrasts study design and interpretation of results.

The author found the results: Of the twenty one articles received for GSR / EDA / skin-induced biofeedback, four were conducted as interventional trials involving patients with drug-resistant epilepsy. Three of these studies reported positive treatment effects of the control group and biofeedback in each of these cases. This timely assessment is the large scale currently used to more accurately determine the potential value of GSR biofeedback treatment and the application of this non-invasive and non-pharmacological intervention for drug-resistant epilepsy. It emphasizes the design of prospective research designs. Give awareness [Nagai, Y. et al., 2019].

RESEARCH METHODOLOGY

The Whole Process has been completed in following steps.

- The Data Was collected through Questionnaire
- The Data Was Analyzed
- The App through software tools was designed
- By machine Learning Algorithms, the App was predicting the future results.

In our experimental investigation, a website was designed which contains closed set of Questionnaires from SF-36 (Sharma et al., 2019a), which have some weight associated with each question. All those users who have successfully registered then user will be first login to our website and then answer those questions. If they have responded to questionnaire earlier they will be redirected to their dashboard. On their dashboard they will find displayed stress level along with three options: given a re-questionnaire responses, remedies and statics.

The weight of the user is calculated according to the weight, user will be classified into one of three groups: less, average and high level of chronic TTH. After the classification, some remedies were advised to the user depending upon his/her stress level. After practicing those remedies for few days he/she can again give test and check the reduction in his stress level.

For stress level measurements, Short form of health Survey SF-36 questionnaire was used questionnaire and Biofeedback therapy to know current intensity, duration and frequency of headache of subject and for remedy, we applied meditative techniques and alternative therapies. We only used questionnaires to measure the participant's stress level.

Our product measured the subject stress level in specified time and helped them to handle it as per their scores and stress intensity.

We have used 70% data to train four classification algorithms Naïve Bayes, Logistic Regression, SVM and Decision tree and 30% for testing purposes.

During our research work, we used some data visualization techniques that EMG(Electromyography) in audio mode is best among all other modes and in this experiment, we have used a data set of SF-36 and successfully clustered them into three clusters i.e. low, medium and high using K-means algorithm and after clustering we have used classification algorithm to classify a user (depending upon the sum of all the weights of questions he had answered) into one of these three classes. We have also implemented various algorithms for classifications and compared their accuracy.

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We have used in the Decision tree various test cases given as the input to the trained model and by the help of outputs of these test cases we were able to find the range in which the test weight will be classified: low, medium or high. Out of which Decision tree has most high accuracy in our case.

The different diagrams of Mental Health Analyzer (MHA) App are shown in the apportioning of requirements section. This app is analyzer, a guide for those who want immediate and online relaxation in some critical circumstances.

REQUIREMENT SPECIFICATION

Experimental Perspective

The Proposed experimentation and analysis is totally based on our earlier research work named “Chronic TTH analysis by EMG and GSR biofeedback on various modes and various medical symptoms”^[1] and on “Analytical Comparison of Efficacy for Electromyography and Galvanic Skin Resistance Biofeedback on Audio-Visual Mode for Chronic TTH on Various Attributes”. This work has been well published and cited by many in the same domain of research.

In this work, we created a website which comprises Short Form of Health Survey popularly known as SF-36 as the initial survey for the mental status of the subject. Each participants was required to answer the questions and based on their responses, their individual different scores on various parameters were calculated. Some set of questions were giving one kind of score and other set of questions were giving other kind of responses. The scores were clear indicators for the current status of mental, social, physical and inner health of an individual and high score always indicate that one posses good health and he/ she should maintain it. Average score is indicator of precautions and related guidelines and advisory are issued to him/ her. The low score is alarming bell and immediately subject is warned to visit psychiatrist and nearby mental hospital. Since the extreme situation can be panic and worst to be as suicidal tendency. This app is analyzer, a guide for those who want immediate and online relaxation in some critical circumstances (Singh et al., 2019d; Gulati et al., 2019e; Chaturvedi et al., 2012).

SYSTEM INTERFACES

1. Angular6, CSS, JavaScript and Bootstrap are used for front end of web portal.
2. Node Js and Express Js are widely used in web platform as back end.
3. Mongo Db is applied for data storage and database creation purposes.
4. Jupyter is used to implement Machine Learning Algorithm in Python.
5. Visual Studio Code platform is used to develop the website (Chaturvedi et al., 2013).

HARDWARE INTERFACES

The project occurred in different configurations of system as below:

1. **Operating System:** Linux, Unix, Windows

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2. x86 - 64 processor
3. 8 GB RAM
4. **Web Server:** Local host provided by Angular CLI and NPM server
5. For Mongo Db version 4.0 installed in OS
6. NPM packages should be installed (Chaturvedi et al., 2013).

SOFTWARE INTERFACES

Python 3.6, Angular 6, Node 10.0.0, Mongo db 4.0

PyCharm Platform

Currently, it is very popular as an integrated development environment (IDE). Python is especially used for computer programming designed by Czech Jet Brains. Code analysis provides end-user integration with graphical debugging, a single integration tester, version control system (VCS), and supports web development with Django (Singh et al., 2018i).

Machine Learning with Python Language

Machine learning uses data mining techniques and other learning algorithms to create models of what is happening behind some data and predict future results. This is a specific approach to artificial intelligence.

Deep Learning

This is one of a kind of machine learning, and learning to display the world as a nested hierarchy actually gained a lot of power and flexibility concepts, each concept with a simpler concept and It is defined by a more abstract expression.

Artificial Intelligence

These models use models created by machine learning and other methods of reasoning about the world to create intelligent movements, whether in games or robot / machine driving. Artificial intelligence predicts how the world will function and how the world will best achieve its goals. This app is very deployed (Chaturvedi et al., 2004).

Machine learning is the name given to a generalizable algorithm that allows computers to perform tasks by looking at data instead of hard coding. It is a subset of computer science and artificial intelligence that focuses on developing systems that can learn from data and make decisions and predictions based on it. With ML, computers can make decisions based on data rather than explicitly planning specific tasks. Mathematics provides a model. Understand those relationships and apply them to real objects (Chaturvedi et al., 2014).

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Supervised Learning

These are “predictive” in nature. The purpose is to predict the value of a particular variable (target variable) based on values of some other variables or explanatory variables). Classification and Regression are examples of predictive tasks. Classification is used to predict the value of a discrete target variable while regression is used to predict the value of a continuous target variable. To predict whether an email is spam or not is a Classification task while to predict the future price of a stock is a regression task. They are called supervised because we are telling the algorithm what to predict. Methods are Linear Regression, Logistic Regression, Decision Trees, Random Forests, Naïve Bayes Classifier, Bayesian Statistics and Inference, K-Nearest Neighbor (Chaturvedi et al., 2014).

Unsupervised Learning

These are “descriptive” in nature. The purpose is to derive patterns that summarize the underlying relationships in data. Association Analysis, Cluster Analysis and Anomaly detection are examples of Unsupervised Learning. They are called unsupervised because in such cases, the final outcome is not known beforehand. With unsupervised learning there is no feedback based on the prediction results. Methods are K-Means Clustering, Hierarchical Clustering, Clustering using DBSCAN, Feature Selection and Transformation, Principal Components Analysis (PCA) (Chaturvedi et al., 2013).

MEMORY CONSTRAINTS

To run data on python programs, 2 GB memory space will be required and for both to run the node local host server and angular frontend local host, 1 GB space will be used.

OPERATIONS

Operations that will be done by user on our product are:

- A user can do registration if they are new users.
- After successful registration, user will be able to login to our site any time.
- All those registered users, if don't have given any test then they will be redirected to test page as soon as they will login
- All those users who have successfully registered, if they have responded to questionnaire earlier they will be redirected to their dashboard.
- On their dashboard they will find displayed stress level along with three options: given a re-questionnaire responses, remedies and statics.
- He can go to any of the options.
- All the users will get some remedies to follow and practice in their daily life
- After few days they can go through the retest.

FUNCTIONS OF EXPERIMENTAL APP

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- Our product measured the subject stress level in specified time and helped them to handle it as per their scores and stress intensity.
- We are using dataset of SF-36 and we have clustered it into three clusters using k-means algorithm and after clustering we have modified and added the dataset with their respective clusters and used it as new dataset for training and testing of classification algorithms
- We have used 70% data to train four classification algorithms Naïve Baye's, Logistic Regression, SVM and Decision tree and 30% for testing purpose.
- Out of which Decision tree has most high accuracy in our case.
- Now in Decision tree we have used various test cases given as the input to the trained model and by the help of outputs of these test cases we were able to find the range in which the new weight will be classified: low, medium or high.
- We have used the same range limit in website for decided the stress level of the person depending upon the weights of the questions he has answered.

USER CHARACTERISTICS

Subject under considerations were users of all ages (18-65), genders, locality and is mainly focused on adolescents.

CONSTRAINTS

- The system complied with all local regulatory policies and ethical committee.
- The users had to answer all the questions honestly otherwise they may be classified into wrong stress level.
- Our research work was based on EMG and GSR machines with are very costly and very hard to find and do analysis.
- This product will be windows-based. So all the users must have windows operating system running on their pc's.
- Our product will use client server architecture and therefore be able to handle multiple participants at onetime.
- Our product will use cookies to help identify the registered users attempting to use the product via the internet.
- Our product will provide a backup capability to protect the data.

ASSUMPTIONS AND DEPENDENCIES

It is assumed that every user who will use our product will have windows operating system or Linux and all will satisfy the software and hardware requirements mentioned above.

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APPORTIONING OF REQUIREMENTS

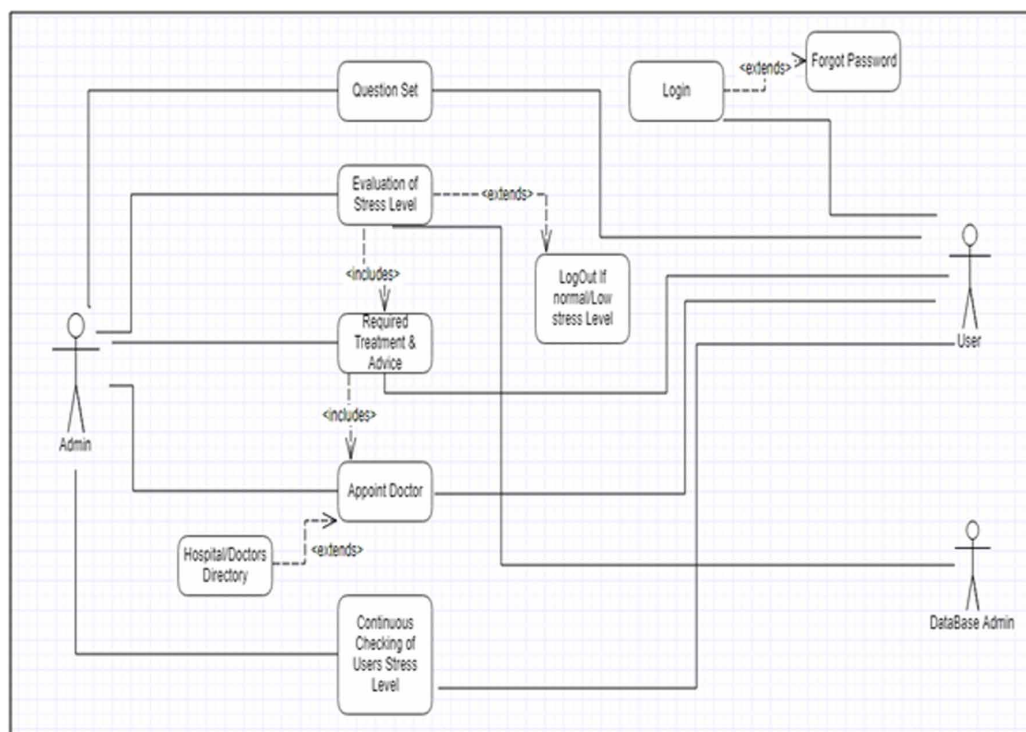
We may not be able to do thermal imaging. We only used questionnaires to measure the participant's stress level. The different diagrams of Mental Health Analyzer (MHA) App are as below.

UML SPECIFICATIONS

Use Case Model

Case diagrams are used to show system performance or parts of a system. They are widely used to describe the functional needs of a system and the interaction with external actors (actors). Use cases are illustrations of different scenarios used in the system. The diagrams used show an overview of what a system or part of a system does without giving a detailed explanation.

Figure 1. Use Case model of MHA app



A use case model was used to represent the functions and activities of all users and participants in the study. It also shows the performance of a program that shows the actions that a particular user can perform depending on the location.

In the figure 1, we can see that a particular participant can login, register on site, can take test, can get a result. An administrator can manage the whole database and login on website. The user will get

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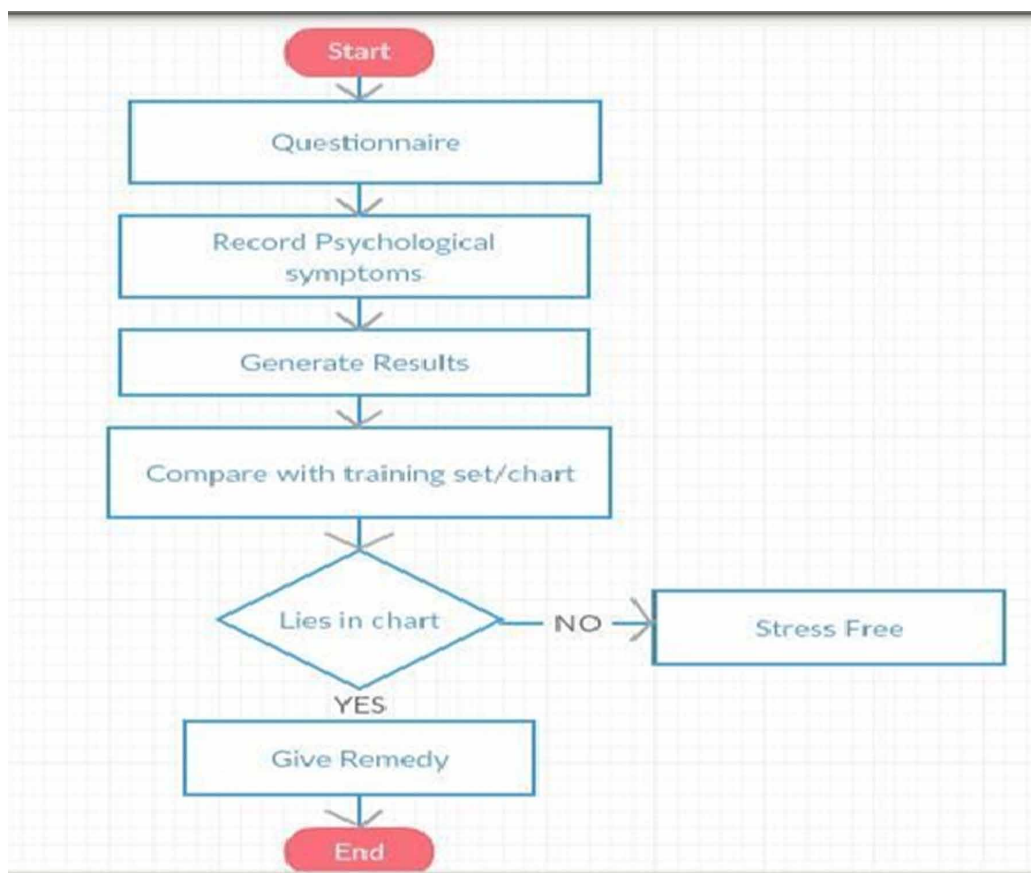
the question set and the evaluation of stress level will be done which will be saved in the database. If the stress level is too high, then he will be advised to go to a doctor or psychiatrist.

SYSTEM DESIGN AND METHODOLOGY

System Design and System Architecture

In figure 2, Flowchart shows the flow in which the whole work of site will go on. In this flowchart, we can see that when the user will login into the site then they will counter a questionnaire. They will attempt that on the basis of given answer their result will be calculated and remedies will be given to them, according to where they lie whether low, medium or high.

Figure 2. Flowchart of MHA App



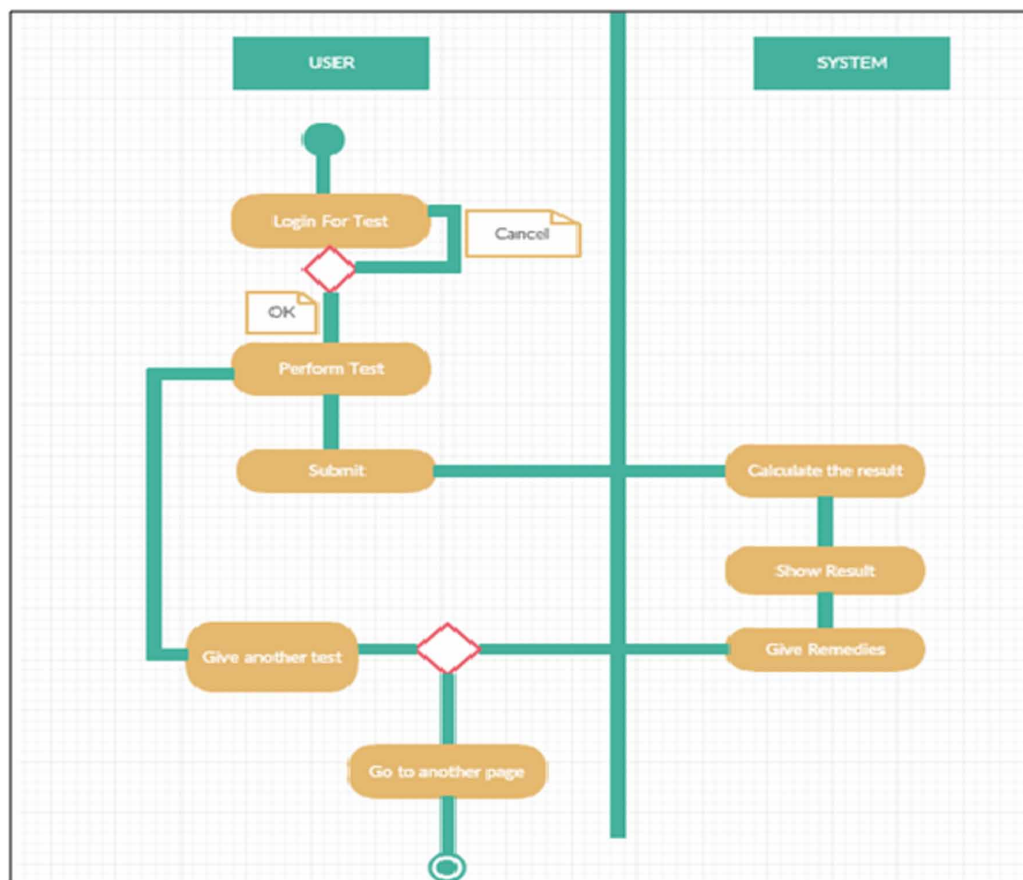
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ACTIVITY DIAGRAM

The activity diagram which shows the control flow of a system. Activity diagram illustrating the steps involved in executing a usage file. Use an activity diagram to model sequential and concurrent activities. Therefore, you basically use an activity diagram to visualize the workflow. The activity diagram focuses on the state of the stream and the order in which the stream occurs. Use activity diagrams to explain or graph the cause of a specific event.

Figure 3, the activity diagram shows all the activities performed in the project are shown.

Figure 3. Activity diagram of MHA app



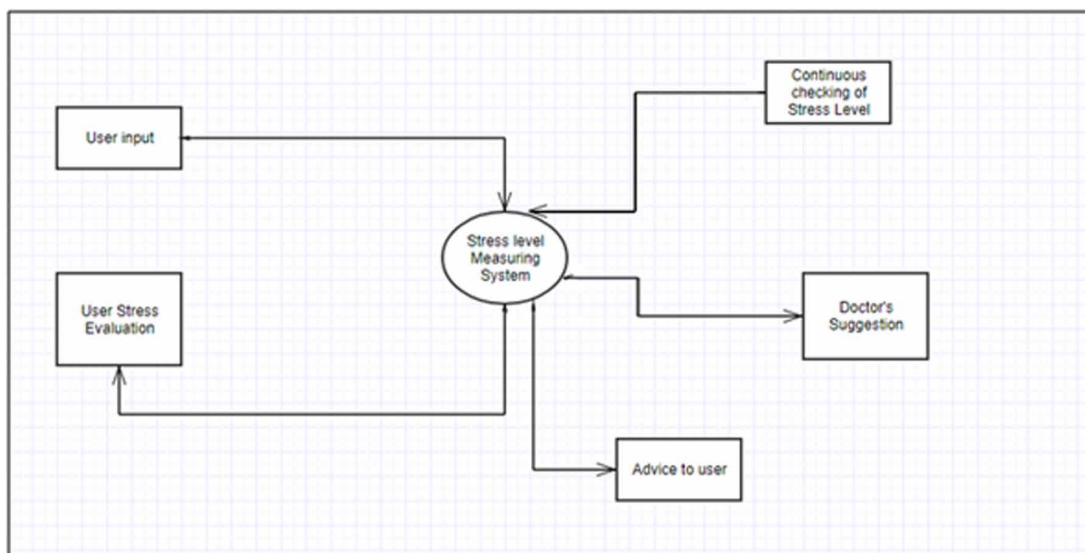
DFD

DFD (Data Flow Diagram) can be drawn to display the system at various levels of abstraction.

This is also called a context diagram. This design is designed as an abstraction and represents the system as a single process with relationships to external entities. Appears as a single bubble containing input and output data represented by input / output arrows.

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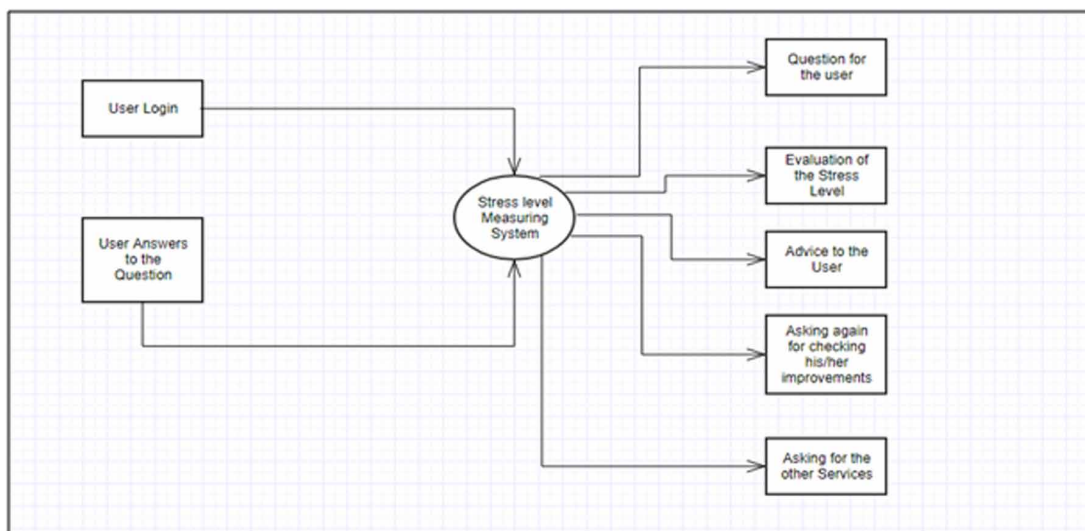
Figure 4. DFD level 0 of MHA app



In figure 4, data flow diagram level 0 is shown.

1 At the DFD level, the field diagram is broken down into several bubbles / processes. This level emphasizes the core functionality of the system and processes 0 level DFD high level processes into sub processes. In the figure 5, data flow diagram level 1 is shown.

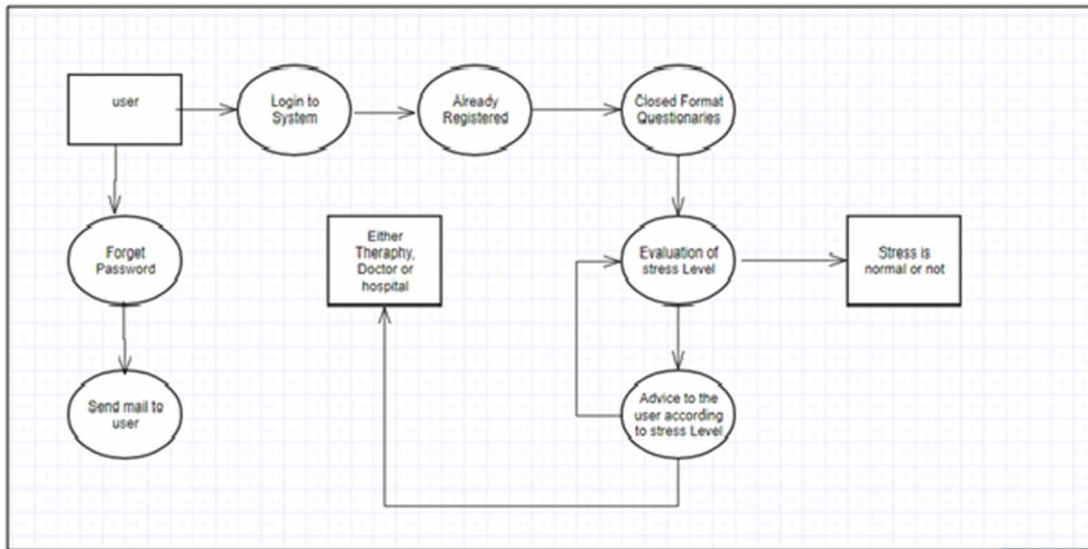
Figure 5. DFD level 1 of MHA app



DFD 2 Level Go deeper into part of DFD Level 1. Can be used to plan or record specific / required details about system performance. In the figure 6, data flow diagram level 2 is shown.

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Figure 6. DFD level 2 of MHA app



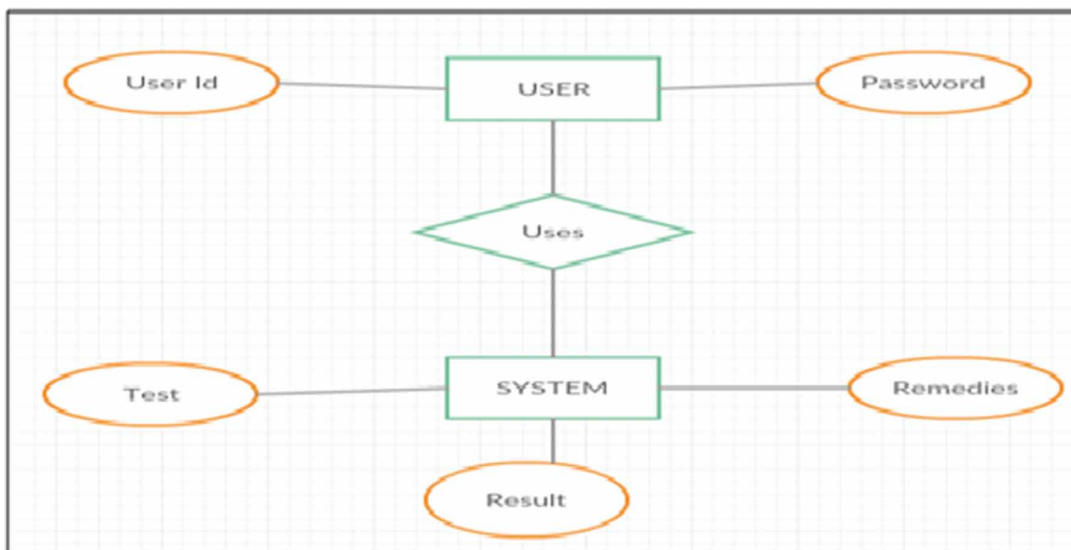
ER DIAGRAM

The ER model is used to model the logical view of the system in terms of data such as:

component: Entity, entity type, entity set, an entity can be an object with a physical entity (a specific person, car, house, or employee), or an object with a conceptual meaning (company, job, university degree).

In figure 7, Entity relationship diagram is shown with entities, attributes and relationships that are used in the project.

Figure 7. ER Diagram of MHA app



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IMPLEMENTATION AND RESULTS

Software Requirements

1. Python 3.6
2. Angular 6
3. Node js 10.0.0
4. Express js
5. Mongo db 4.0
6. PyChar
7. Angular CLI
8. Mongo shell
9. Visual Studio Code
10. Tablue (Data visualization)

Hardware Requirements

1. Operating System: Linux, Unix or Windows
2. . Web Server: Node js and Express js provided by NPM package
3. Ram size: 8 GB
4. x86 - 64 processor
5. EMG (only used for research not for website)
6. GSR (only used for research not for website)

ASSUMPTIONS AND DEPENDENCIES

It is assumed that every user who will use our product will have windows operating system and will satisfy all the software and hardware requirements mentioned above.

IMPLEMENTATION DETAILS

Snapshots of Interfaces

In the figure 8, Home page which will be loaded on the screen of user

In the figure 9, Login screen will be shown after clicking on Know your mental health option the user will have to login or register if he is new to our website.

In the figure 10, Test page is shown in which the user will answer the questions and submit.

In the figure 10- figure 14, dashboard is shown which will be opened after the user has given first time his test. This page will contain the result along with three other options to go with i.e. Retest, Remedy and Statics. He can again give retest or go to the remedy page.

In figure 15 remedies depending upon the stress level of the user is shown. It is expected from the user that they will follow the steps sincerely.

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Figure 8. Home page of the MHA app

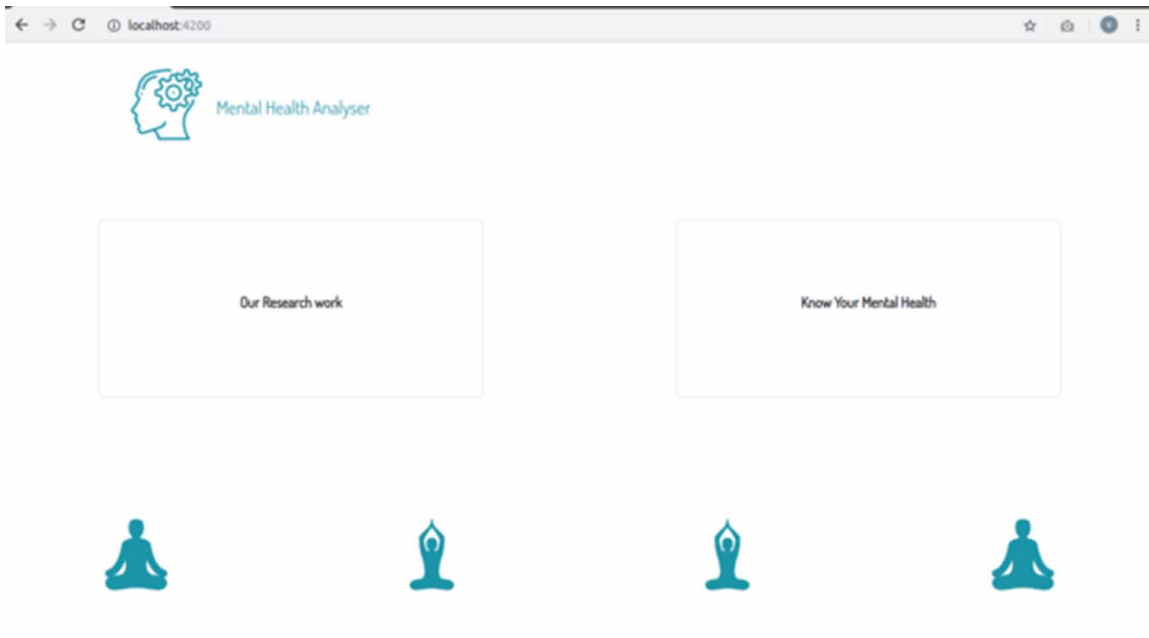
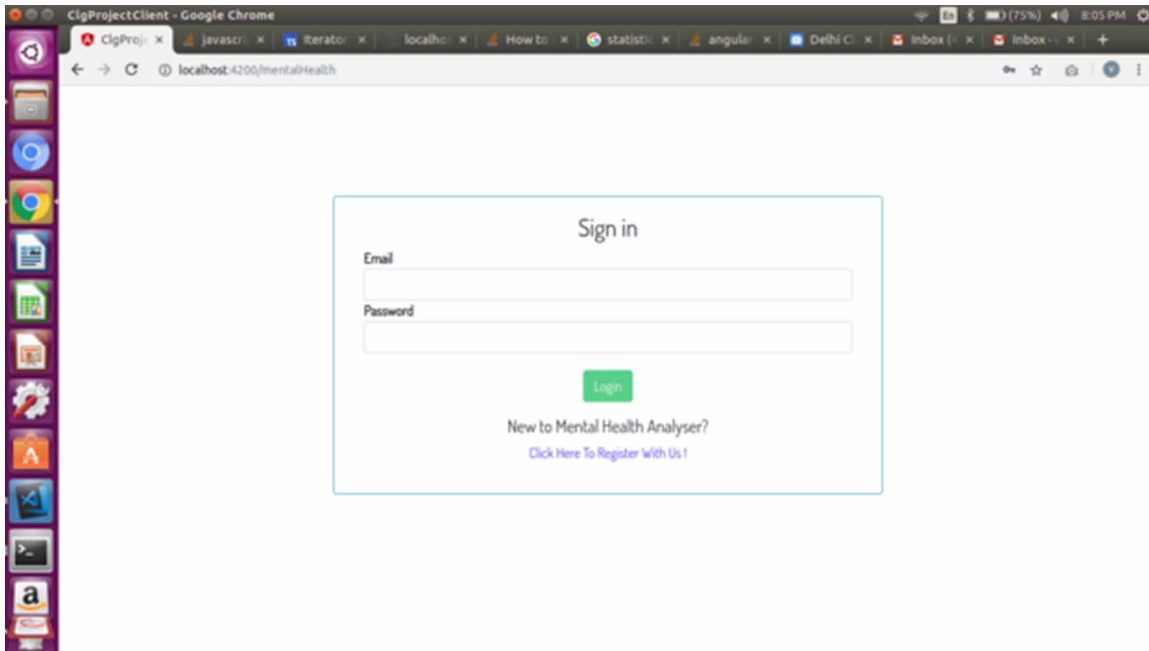


Figure 9. Login page of MHA app



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Figure 10. Test page of MHA app

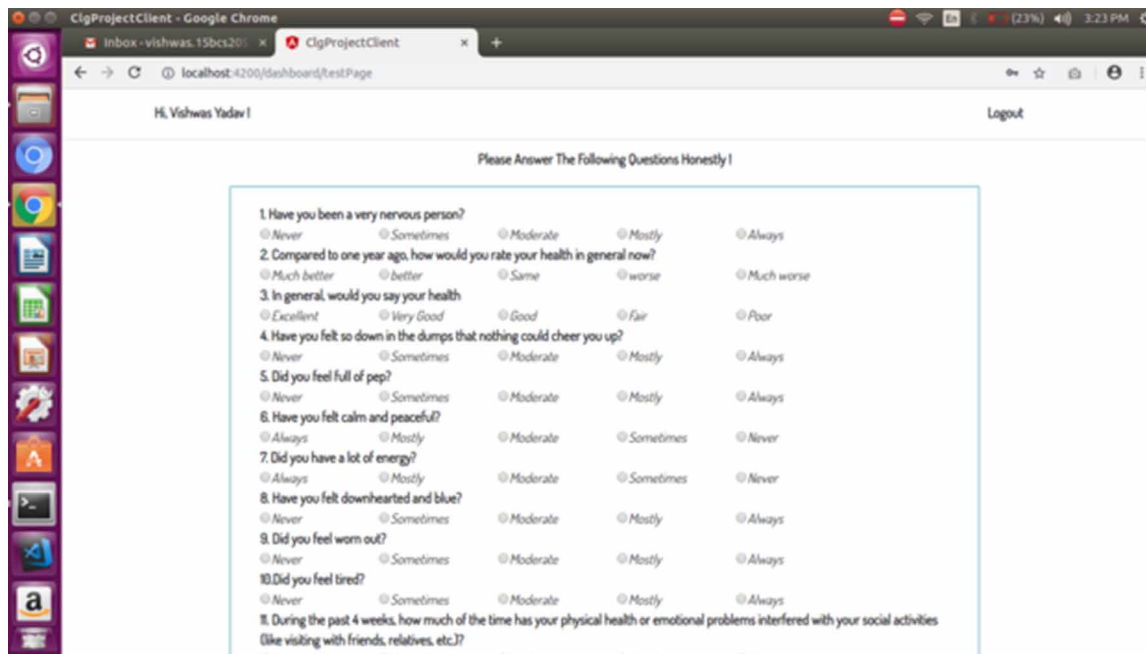
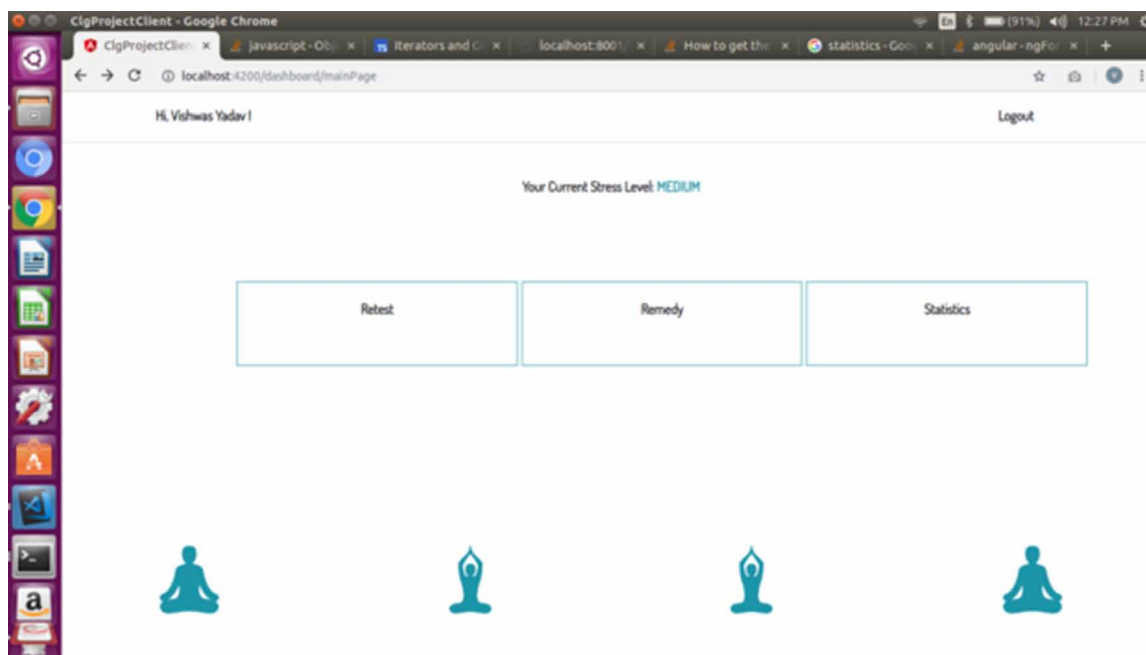


Figure 11. Dashboard of MHA app with medium level of stress



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Figure 12. Dashboard of MHA app with low level of stress

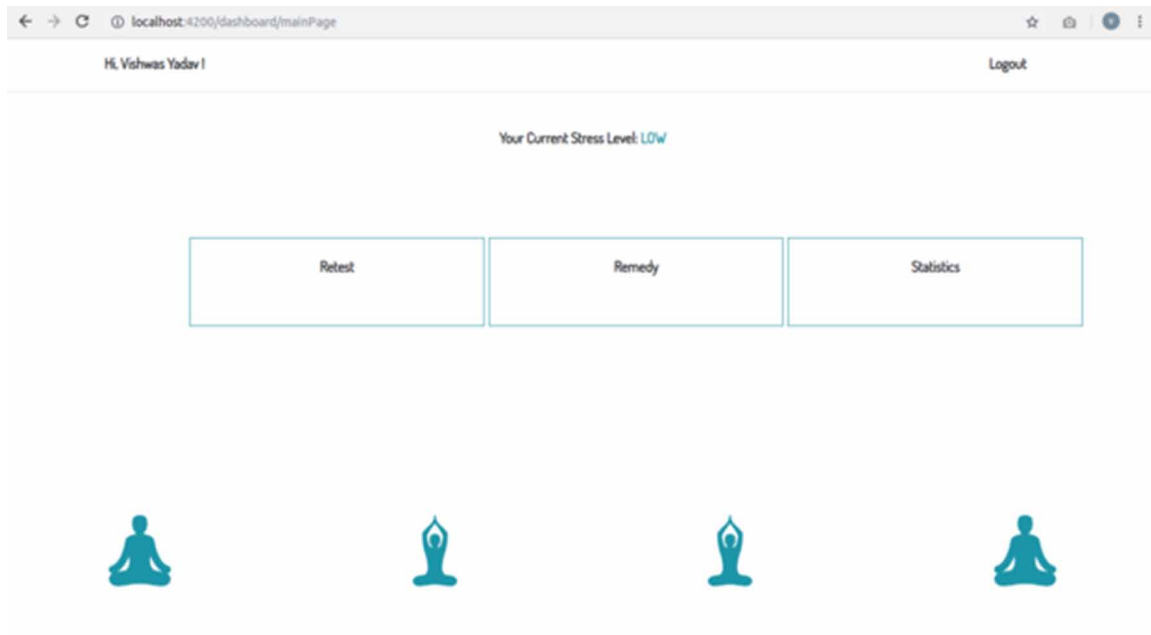
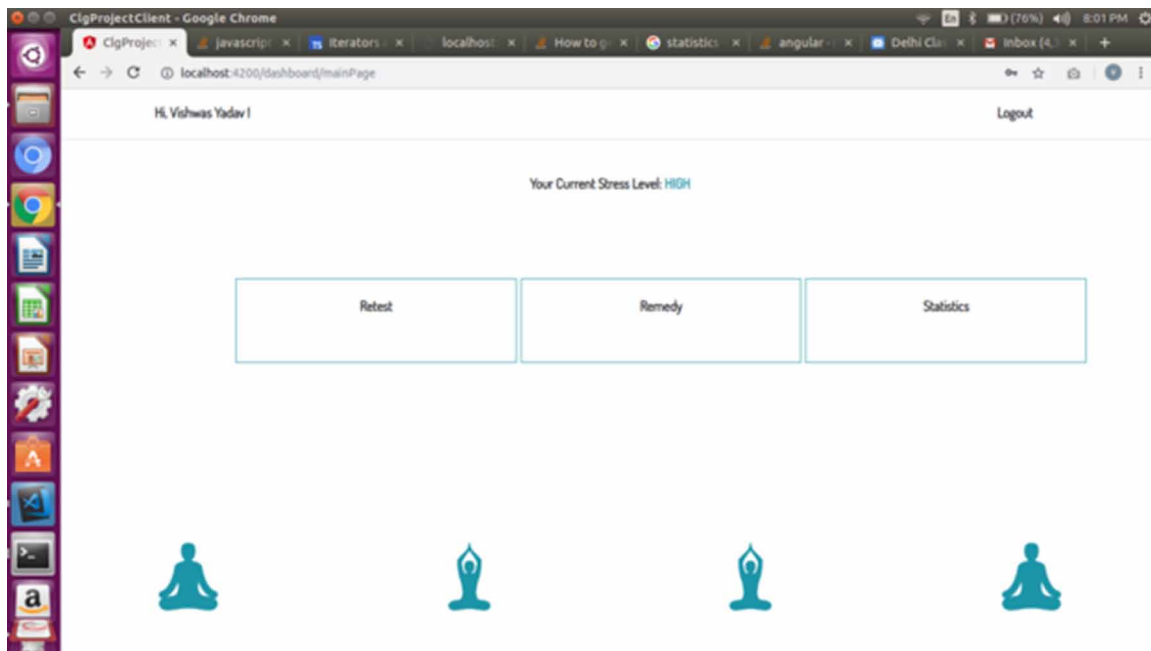
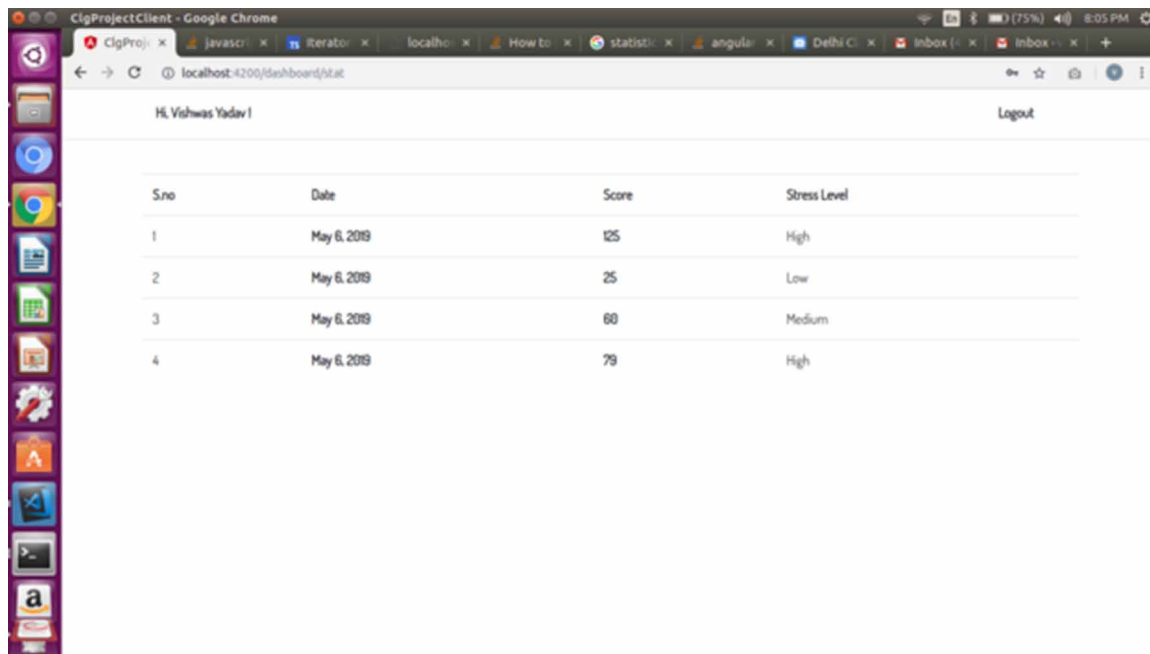


Figure 13. Dashboard of MHA app with high level of stress



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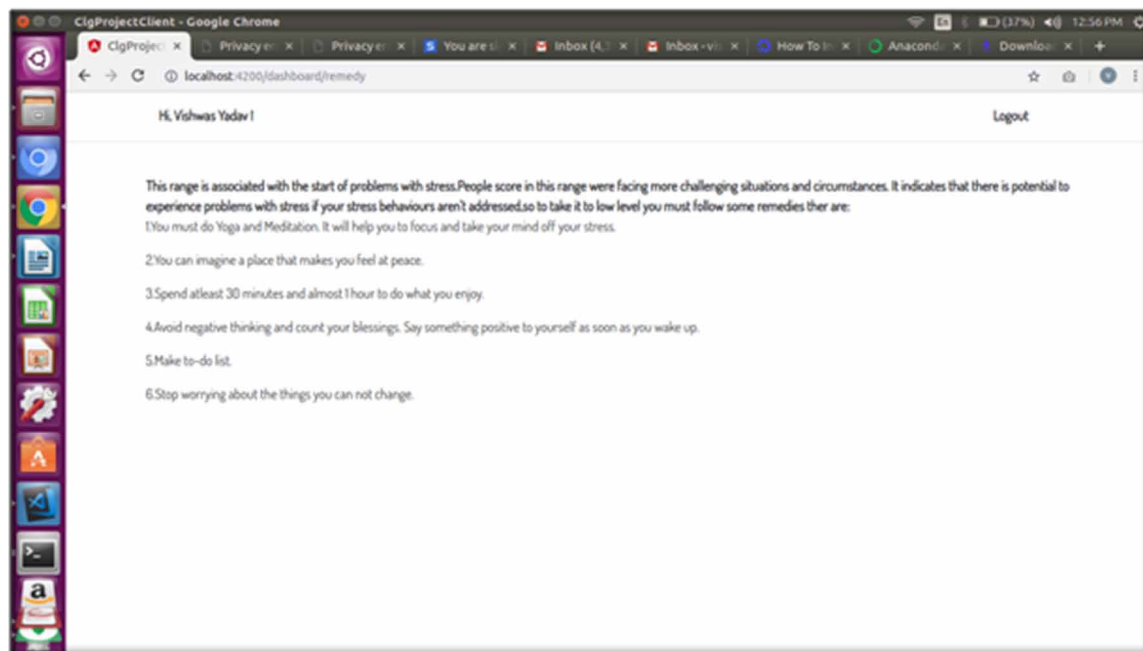
Figure 14. Log of Different responses by a user of MHA app



The screenshot shows a web browser window displaying the dashboard of the MHA app. The user is logged in as 'H. Vishwas Yadav'. The dashboard features a table with the following data:

Sno	Date	Score	Stress Level
1	May 6, 2019	125	High
2	May 6, 2019	25	Low
3	May 6, 2019	60	Medium
4	May 6, 2019	79	High

Figure 15. Remedies proposed of MHA app



The screenshot shows the 'remedy' page of the MHA app. It displays a list of six remedies for stress management:

- 1) You must do Yoga and Meditation. It will help you to focus and take your mind off your stress.
- 2) You can imagine a place that makes you feel at peace.
- 3) Spend at least 30 minutes and almost 1 hour to do what you enjoy.
- 4) Avoid negative thinking and count your blessings. Say something positive to yourself as soon as you wake up.
- 5) Make to-do list.
- 6) Stop worrying about the things you can not change.

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TEST CASES

1. If stress level lies in range of $S \geq 25$ and $S \leq 57$.
2. If stress level lies in range of $S \geq 58$ and $S \leq 68$.
3. If stress level lies in range of $S \geq 68$ and $S \leq 125$.

RESULTS AND DISCUSSION OF OUR RESEARCH WORK

We have found the result that EMG in Audio mode is best among all the other modes of EMG as well as it is also better than GSR in all modes i.e. Audio, Visual and Audio-visual. We have published this results in a book chapter.

RESULTS OF EXPERIMENTS

In the figure 16, mean calculated by the python code is shown. It is the mean of all the questions answered by 399 people as present in the dataset.

1. We have successfully clustered responses from dataset into three clusters i.e. low, medium and high stress level by the help of K-means algorithms and now we classify new user into one of these three classes.

The figure 17 shows the clusters that we have got using k-means algorithm on the dataset of 399 people response of SF-36 questionnaires[5].

Cluster 1 represents Low Stress Level

Cluster 2 represents Medium Stress Level

Cluster 3 represents High Stress Level

2. After making three clusters we have modified the dataset and added the respective clusters in each row and used the new dataset to train various classification algorithms that we have used: Logistic Regression, Naïve Bayes, SVM, Decision Tree algorithm.
3. For training the machines, we used 70% data and for testing and accuracy, 30% data was used for the purposes.
4. Out of all the algorithms Decision tree gives the best accuracy so we have find out the range of each class i.e. low, medium and high using various test cases on Decision tree algorithm and we have got range limits from it that we are using in our website for giving results.

The Figure 18 shows the accuracy of various classification algorithms that are used for classification.

Automated App for Mental Health Analysis*Figure 16. Mean of all questions*

q1	2.967419
q2	2.716792
q3	3.022556
q4	2.832080
q5	2.350877
q6	2.852130
q7	3.225564
q8	2.451128
q9	2.238095
q10	2.832080
q11	2.694236
q12	2.471178
q13	2.696742
q14	2.057644
q15	2.558897
q16	1.822055
q17	2.203008
q18	1.944862
q19	2.203008
q20	2.859649
q21	2.498747
q22	1.794486
q23	2.263158
q24	2.403509
q25	3.035088
Total	62.994987

CONCLUSION**Performance Evaluation**

The time duration for the whole experiment was 6 months which included stress recognition through biofeedback devices and providing its remedy through app. For stress level measurements, Short form of health Survey SF-36 questionnaire was used questionnaire and Biofeedback therapy to know current intensity, duration and frequency of headache of subject and for remedy, we applied meditative techniques and alternative therapies. For backup, we stored the data in Google Drive or Hard Disk to avoid any data loss (Chaturvedi et al., 2014, 2013).

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Figure 17. Clusters of the Analyzed datasets

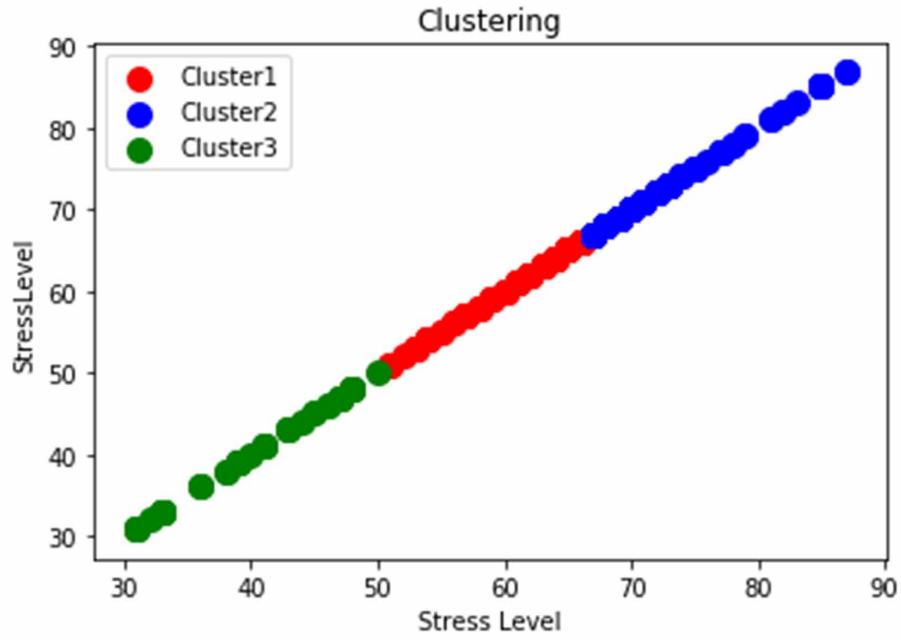
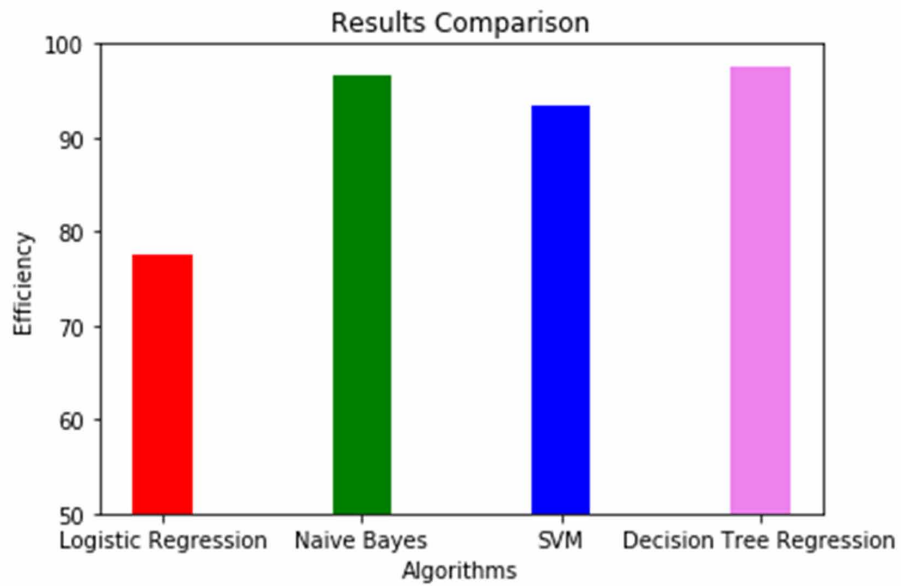


Figure 18. Accuracy of various algorithms applied

77.5 , 96.66666666666667 , 93.33333333333333 , 97.5



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We have used 70% data for training and 30% for testing purposes. The clusters that we have got using k-means algorithm on the dataset of 399 people response of SF-36 questionnaires (Nagai et al., 2019). Low Stress Level represented by Cluster 1, Medium Stress Level represented by Cluster 2 and High Stress Level represented by Cluster 3.

After making three clusters we have modified the dataset and added the respective clusters in each row and used the new dataset to train various classification algorithms that we have used: Logistic Regression, Naïve Bayes, SVM, Decision The logistic Regression algorithm gives the 77.5% accuracy, the Naïve Bayes Classifier gives 96.667% accuracy while SVM gives 93.333%.

We have found the result that EMG in Audio mode is best among all the other modes of EMG as well as it is also better than GSR in all modes i.e. Audio, Visual and Audio-visual. We have published this results in a book chapter.

Out of all the algorithms Decision tree gives the best accuracy as shown in table 1, so we have to find out the range of each class i.e. low, medium and high using various test cases on Decision tree algorithm and we have got range limits from it that we are using in our website for giving results (Chaturvedi et al., 2015, 2019).

Table 1. Accuracy of various Algorithms applied

S.NO	Algorithm Name	Accuracy(%)
1.	Logistic Regression	77.5
2.	Naïve Bayes Classifier	96.667
3.	SVM	93.333
4.	Decision Tree Regression	97.5

EXPERIMENTAL RESEARCH BASED LEARNING

1. Different technologies like: Angular 6, Mongo db, Node js, Express js, Python,
2. Tableau, k-mean clustering, logistic regression algorithm.
3. Practical implementation of tools like: Visual Studio, Tableau and Mongoddb Shell
4. Team Work.
5. Dividing and Managing the work.

FUTURE DIRECTIONS

1. Give suggestion of nearby hospitals or psychiatrists by tacking GPS location of the
2. user's device.
3. Send the result with the remedies to the user through email.
4. Make a team for doing survey among people in our college and offices for getting
5. larger dataset so that we may increase the accuracy.
6. Conducting awareness camps for telling people to use this type of application for
7. getting better stress free lifestyle.

Automated App for Mental Health Analysis**ACKNOWLEDGMENT**

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