iJRASET
International Journal For Research in Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 10 **Issue:** II **Month of publication:** February 2022

DOI: https://doi.org/10.22214/ijraset.2022.40371

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 10 Issue II Feb 2022- Available at www.ijraset.com

Mental Health Prediction Using Deep Learning

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Abstract: Mental health is the aggregation of emotional, social and psychological well-being of a person. These problems at workplace can lead to an increased amount of substance abuse, work errors, workplace accidents, poor decision-making, poor timekeeping and a general deterioration in planning and control of work, which all contribute to an overall reduction in work output. Mental Health Prediction application, a one stop solution for all the employees where they can check their mental health regularly Scope of mental health maintenance isn't solely a requirement of seeing a mental health professional, but rather creating a routine of self-check ins, and proper maintenance of our mental states.

I. INTRODUCTION

A. Overview

Mental health is the aggregation of emotional, social and psychological well-being of a person. It effects on the person's thinking, acting and feeling capability. Mental health is a measure of handling stress and decision making with every step-in life. Mental Health is very important factor in every stage in life whether it be childhood or an adult. Mostly mental health is something which never discussed publicly, and no proper awareness is there in society. People would generally not talk about it in public. Mental health could affect one's thinking and behavior. Some common reasons of instable mental health could be:

1) Past life experiences, such as ragging or bullying
2) Biological factors, such as genes
3) Hereditary problem from family

B. Methodologies

Artificial neural networks are computing that were inspired by biological neural networks of the animals' brains (though many scientists believe that actual brains are much more complex systems than artificial neural networks it has much more units, signals are transferred differently etc). The artificial neural networks consist of units (generally grouped by layers) and connections between them. Each of these connections has a corresponding weight, which are modified during learning process as per Figure 1. There is no formal definition of deep neural network, but usually it is assumed that neural network is deep if it has more than one hidden layer (not input or output layer).

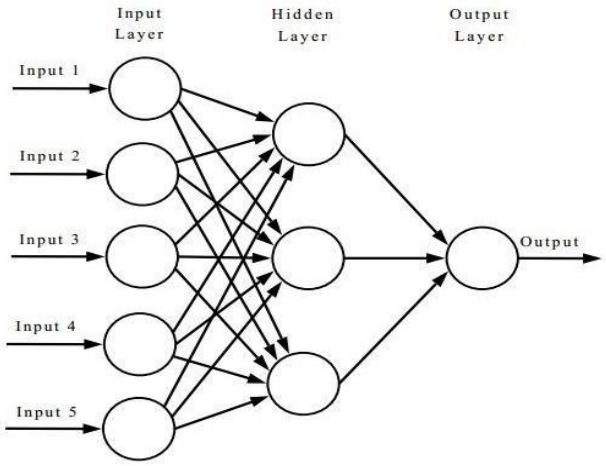


Figure 1 Flow Diagram of Convolution Neural Network

Deep learning is a set of learning methods attempting to model data with complex architectures combining different non-linear transformations. The elementary bricks of deep learning are the neural networks, that are combined to form the deep neural networks.

These techniques have enabled significant progress in the fields of sound and image processing, including facial recognition, speech recognition, computer vision, automated language processing, text classification (for example spam recognition). Potential applications are very numerous. A spectacularly example is the AlphaGo program, which learned to play the go game by the deep learning method, and beat the world champion in 2016. There exist several types of architectures for neural networks:

1) The multilayer perceptron's, that are the oldest and simplest ones
2) The Convolutional Neural Networks (CNN), particularly adapted for image processing
3) The recurrent neural networks, used for sequential data such as text or times series

C. Problem Statement

Scope of mental health maintenance isn't solely a requirement of seeing a mental health professional, but rather creating a routine of self-check ins, and proper maintenance of our mental states. (BUT seeing a mental health professional is still a wholesome experience that doesn't require being diagnosed with a specific condition. I still highly recommend it.) Classification Accuracy: it is a measure of correct predictions in percentage and Confusion Matrix which display Tabular format to describe performance of model

II. LITERATURE SURVEY

Age, sex, marital status, socio-economic conditions, family environment, literacy, job security, past history of depression, chronic medical conditions are strongly associated with the anxiety and depression among the older people [1-3]. Those factors can be used as predictors for the development of an automated anxiety and depression prediction system. Predictor variables can be put into the automated system by any one, not necessarily to be a medical or paramedical person including patient himself and based on its prediction can be made within seconds. This is a binary class classification problem. Different machine learning algorithms can handle this kind of health-related classification issues very efficiently [4]. Ten different classifiers were employed and evaluated to select the optimal one with the selected set of features. These are Bayesian Network (BN), logistic, multiple layer perceptron (MLP), Naïve Bayes (NB), random forest (RF), random tree (RT), J48, sequential minimal optimisation (SMO), random sub-space (RS), and K Star (KS). Those ten different classifiers represent different principles applied in machine learning. Such as BN and NB are based on Bayesian principle, logistic based on regression principle, MLP follows feed forward artificial neural network modelling, RT, and J48 are decision tree-based classifiers, whereas RF is an ensemble learning method, SMO used for training of support vector machine (SVM), KS is an instance-based classifier which uses entropy-based distance function and RS is a meta classifier based on bagging**.** The prediction of model is based on small number of sample size and is hardly generalizable.

The proposed model predicts depression risk context in the combination with DNN and context information. It is used to predict the potential context influencing the risk of depression. In this way, the risk of depression is predicted. Regression analysis, which is often used in statistics, mathematically estimates linear correlations between data with the use of regression [5]. As variables, independent variables (cause) and dependent variables (result) are used [6]. Regression analysis is distinguished into simple regression analysis and multiple regression analysis according to the number of independent variables. Depression can incur in diverse context so that independent variables are multiple. In multiple regression analyses, the variables for predicting the risk of depression are extracted. At this time, a significance level is applied. In addition, a regression equation is extracted. The risk of depression is set as a target variable, and a context variable for predicting depression is set as an independent variable. A significance level represents the stochastic precision of judgment in the hypothesis test.

DNN (Deep Neural Network) has the structure of multiple hidden layers between the input layer and the output layer [7]. In this case, the number of nodes in the input layer is determined by the feature of sample data. In the hidden layer, it is possible to learn relations of a variety of nonlinear data. Also, complex nonlinear problems can be solved, and a variety of information can be extracted from high-dimensional data. In the hidden layer connected with the input layer, it is possible to combine with a value of input variable, give a weight, extract a new value, and deliver it to the output layer. The drawback of these paper is Discovery for relation using regression analysis is difficult. This paper aims to synthesise the literature on machine learning (ML) and big data applications [8] for mental health, highlighting current research and applications in practice. Methods We employed a scoping review methodology to rapidly map the field of ML in mental health. Eight health and information technology research databases were searched for papers covering this domain. Articles were assessed by two reviewers, and data was extracted on the article's mental health application, ML technique, data type, and study results. Articles were then synthesised via a narrative review.

Results Three hundred papers focusing on the application of ML to mental health were identified. Four main application domains emerged in the literature, including: (i) detection and diagnosis; (ii) prognosis, treatment and support; (iii) public health, and; (iv) research and clinical administration.

The most common mental health conditions addressed include depression, schizophrenia, and Alzheimer's disease. ML techniques used include support vector machines, decision trees, neural networks, latent Dirichlet allocation, and clustering. Conclusions Overall, the application of ML to mental health has demonstrated a range of benefits across the areas of diagnosis, treatment and support, research, and clinical administration. With the majority of studies identified focusing on the detection and diagnosis of mental health conditions, it is evident that there is significant room for the application of ML to other areas of psychology and mental health. The challenges of using ML techniques are discussed, as well as opportunities to improve and advance the field. No in-depth details about actual algorithms are discussed in the paper. Although many papers and application created AI in healthcare with one basic function, this paper [8] found that rarely findings allow the patients to read their own diseases, particularly supporting both patients and doctors in payment. Mostly AI has been using for doctors to analyse the disease ‘s symptom. Besides that, we are building the AI model in order to create a mobile application which helps patients know more about their health problems. Moreover, [9] with the combination of AI and Blockchain to have the function of payment on the application, AI as a virtual nurse could communicate to doctors, insurance companies, drug companies, hospitals to let them know how much they have to pay for the patients, what kind of medicine the patients take. Hence, the target reader is the relevant stakeholders such as doctors, patients, drug companies, hospitals, insurance companies. From the gap of previous findings and model of Blockchain in healthcare by author (2018)3, this paper will build three 2Researchers from NYU Langine Health found that AI could find and match specific lung nodes (on chest CT images) between 62% to 97% faster than a panel of radiologists. In Blockchain in healthcare: a new technology benefit for both patients and doctors, (Tran Le Nguyen, PICMET 2018), [10] author created model using Blockchain to store and manage data of surgery more effectively and facilitate many related parties access data quickly and safely. Models of AI with three main functions of AI: booking an appointment, analysing the results of surgery, announcing patients and stakeholders know how much they have to pay the fee of surgery. There was a high computational complexity observed in the system. Mental health problems affect many employees — a fact that is usually overlooked because these disorders tend to be hidden at work. Researchers analysing results from the U.S. National Comorbidity Survey, a nationally representative study of Americans ages 15 to 54, reported that 18% of those who were employed said they experienced symptoms of a mental health disorder in the previous month. [11] But the stigma attached to having a psychiatric disorder is such that employees may be reluctant to seek treatment — especially in the current economic climate — out of fear that they might jeopardize their jobs. At the same time, managers may want to help but aren't sure how to do so. And clinicians may find themselves in unfamiliar territory, simultaneously trying to treat a patient while providing advice about dealing with the illness at work. [12] As a result, mental health disorders often go unrecognized and untreated — not only damaging an individual's health and career, but also reducing productivity at work. Adequate treatment, on the other hand, can alleviate symptoms for the employee and improve job performance. But accomplishing these aims requires a shift in attitudes about the nature of mental disorders and the recognition that such a worthwhile achievement takes effort and time. [13] The most common mental health problems in the workplace, and how they affect both employees and employers. But in this Software approach is not discussed.

III. PROPOSED METHODOLOGY

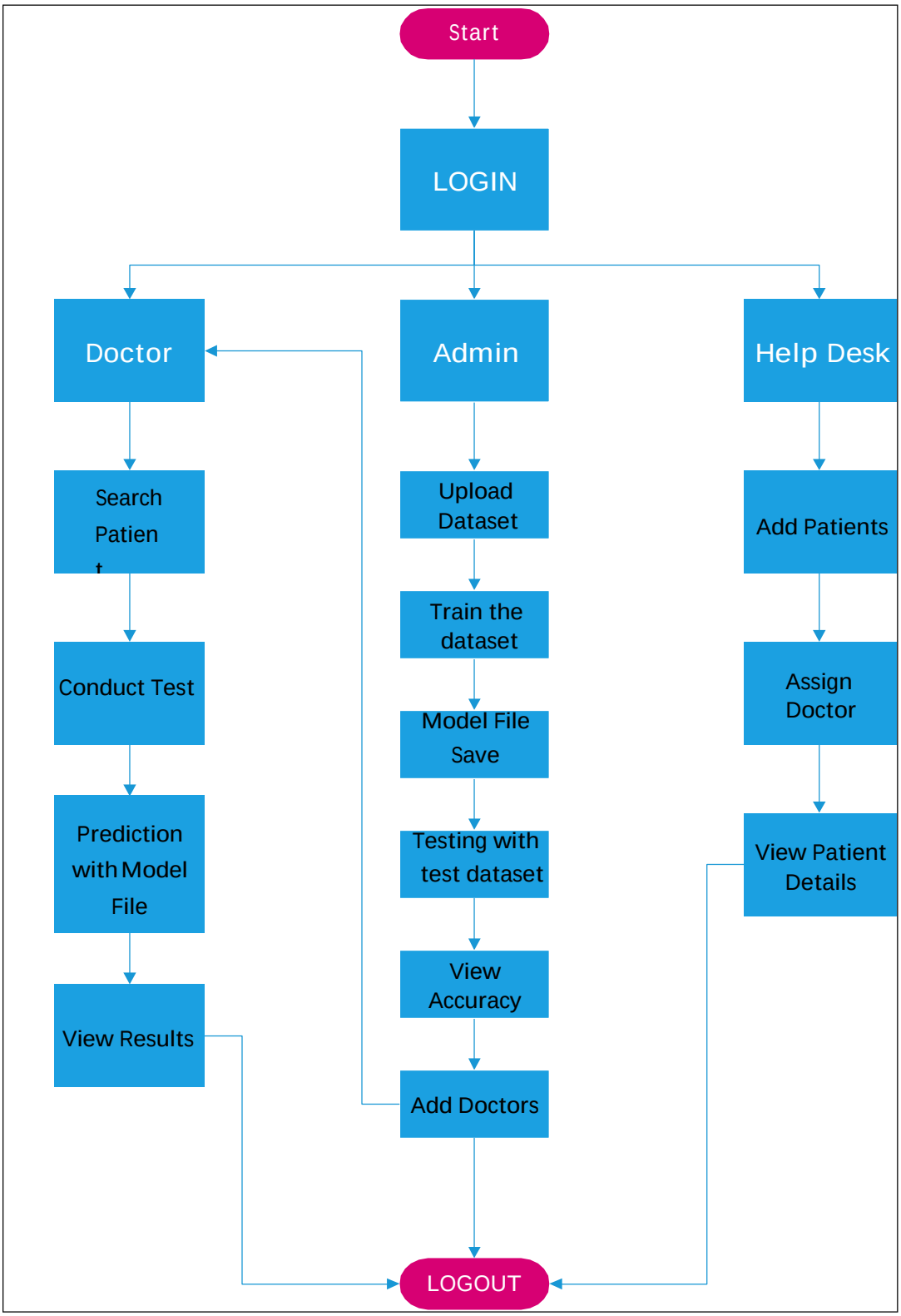
A. Existing Solutions

In Existing system doctors take the information from the patients manually and then have to study the characteristics for days in order to come to the conclusion regarding his/her Mental condition. This takes large amount of time and requires large labor to perform the task. Inappropriate diagnosis of the mental health could lead to incorrect treatment. This could in long run prove to be as fatal as premature death. Hence this paper introduces a new approach as semi-automated system. This system will diagnose psychological disorder in patient. This is achieved by comparing patient’s mental health with the DSM-IV-TR, fourth edition revision.[14] Here they are using genetic algorithm, classification and machine learning techniques to build semi-automated system. The final future goal is to fully automate the system unless it meets the required standards of identifying patient’s mental illness. The classifier had an assessment of a patient as accurate as possible. The final call will be of analyst for treatment of patient.

People with mental disorder often face other anxiety disorder which eventually develops into depression. Hence authors are interested in online communities for data. They have crawled data from 247 online communities of 80,000 users. Then they have extracted the psycho- linguistic posts based on topics, which served as input to model. Machine learning techniques are applied to generate joint model for identifying mental health related features. At last, they performed empirical validation of model on dataset where model performs best in recent techniques and the flow chart is mentioned in Figure 2. With outburst of social media usage [15], health scientists have become more active, particularly for data related to disease epidemics and analyze warning signals of mental health issues. In this paper also, they have focused on precursor, cognitive distortion and symptoms of psychological behavior like anorexia, anxiety and depression.

B. Flow chart of the proposed methodology

Figure 2 Flow Chart of Proposed Neural System



IV. IMPLEMENTATION

SQLite is an in-process library that implements a self-contained, serverless, zero-configuration, transactional SQL database engine shown in Fig 3. The code for SQLite is in the public domain and is thus free for use for any purpose, commercial or private. SQLite is the most widely deployed database in the world with more applications than we can count, including several high-profile projects as per Figure 4 -8.

```
class doctor(models.Model):
    email=models.CharField(max_length=100);
    pwd=models.CharField(max_length=100);
    prof=models.CharField(max_length=100);
    name=models.CharField(max_length=100);
    desg=models.CharField(max_length=100);
    adde=models.CharField(max_length=100);
```

Figure: 3 Model of Doctor

```
class patient(models.Model):
    name = models.CharField(max_length=100);
    email = models.CharField(max_length=100);
    zip = models.CharField(max_length=100);
    gender = models.CharField(max_length=100);
    age = models.CharField(max_length=100);
    demail = models.CharField(max_length=100);
    dname = models.CharField(max_length=100);
```

Figure: 4 Model of Patient

In these given a flexibility to the user to interact with the system using GUI manner for easy access of the developed project.

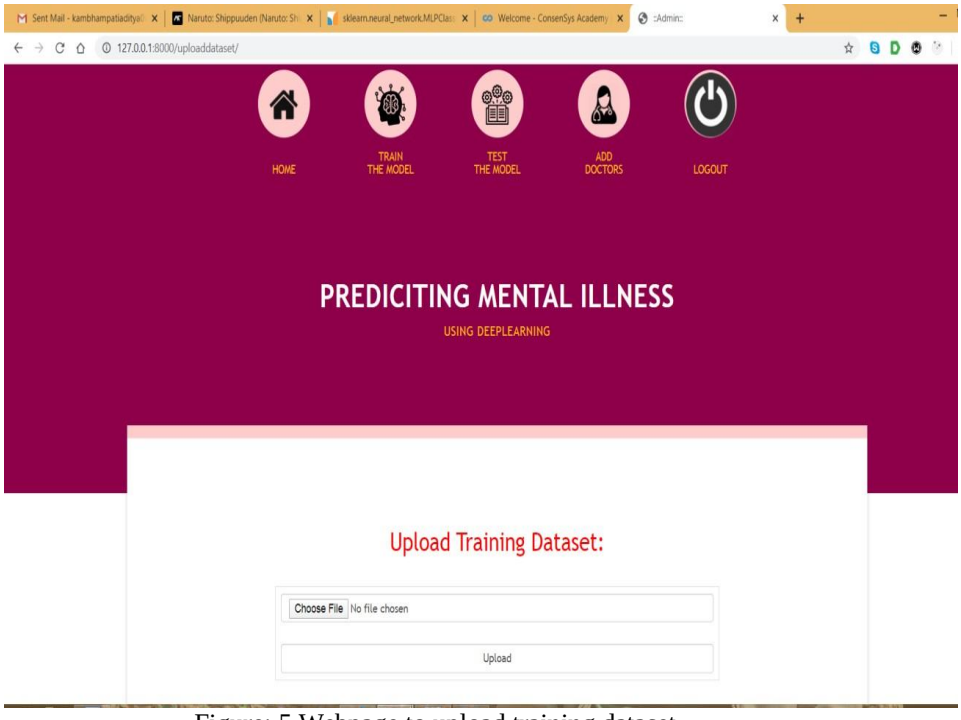


Figure: 5 Webpage to upload training dataset

Once the uploading of data is done then the client side the user can make a registration to the doctor by filling of his details as well as the doctor can do make registration by providing the details of his specialization. After successful login to the portal the doctor can search for the patient based on the details like id or name etc.

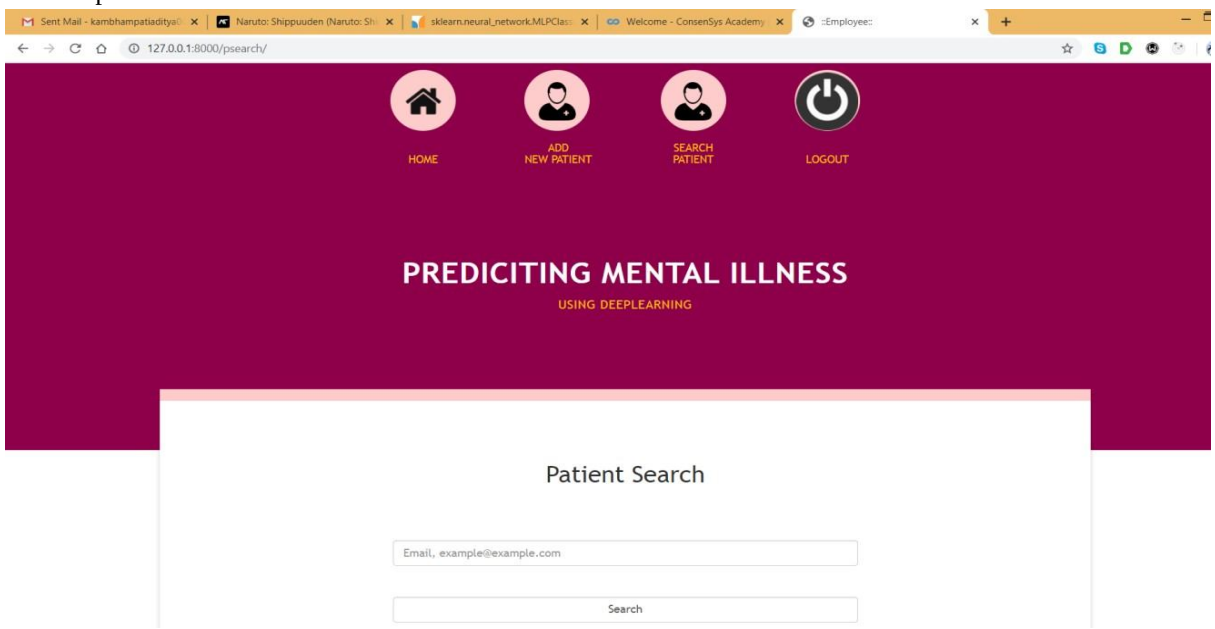


Figure: 6 Patient search pages

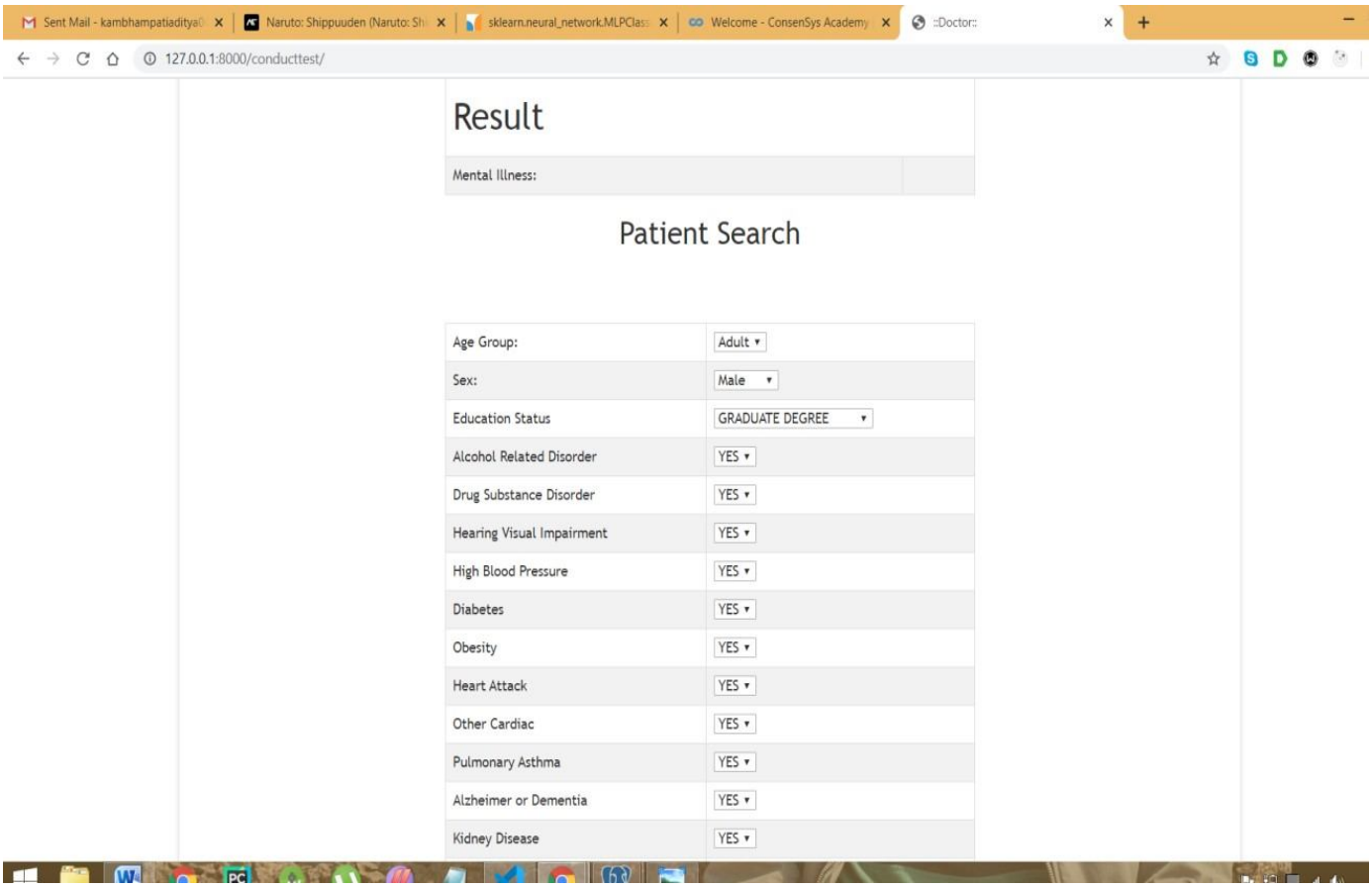


Figure: 7 Patients search result page

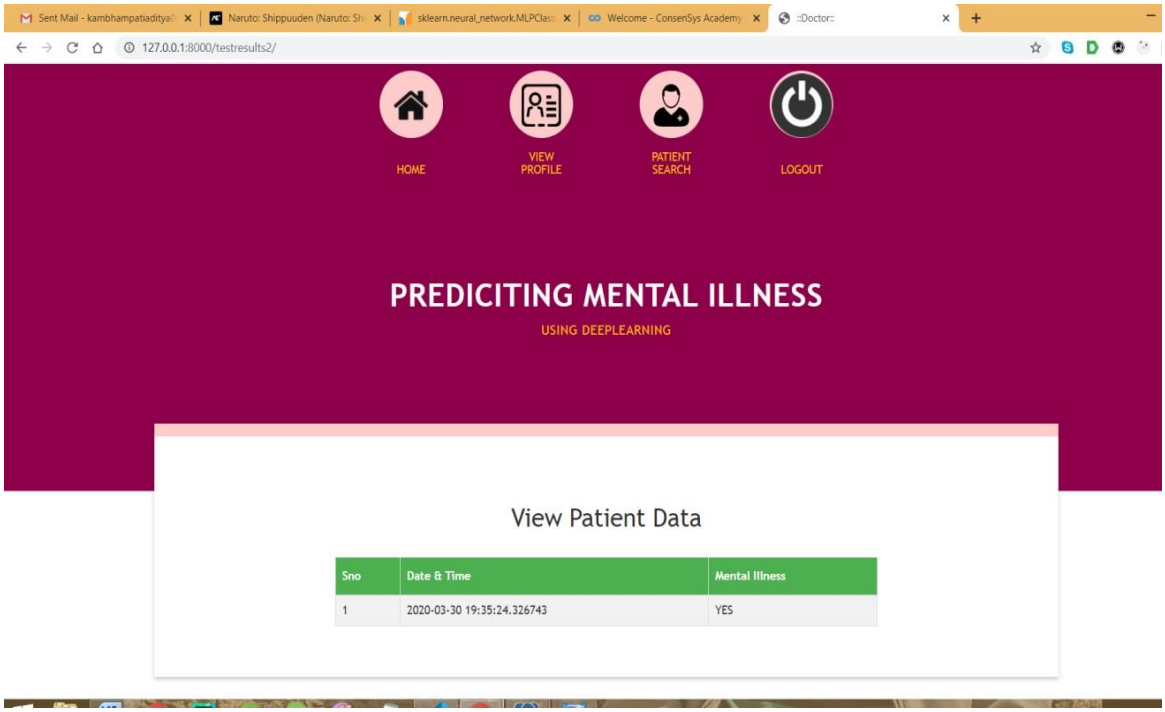


Figure: 8 Patients data page

As the details of illness of a patient are detected in the backend the prediction done using 3 algorithms and maximum shown accuracy algorithm results are considered as final prediction.

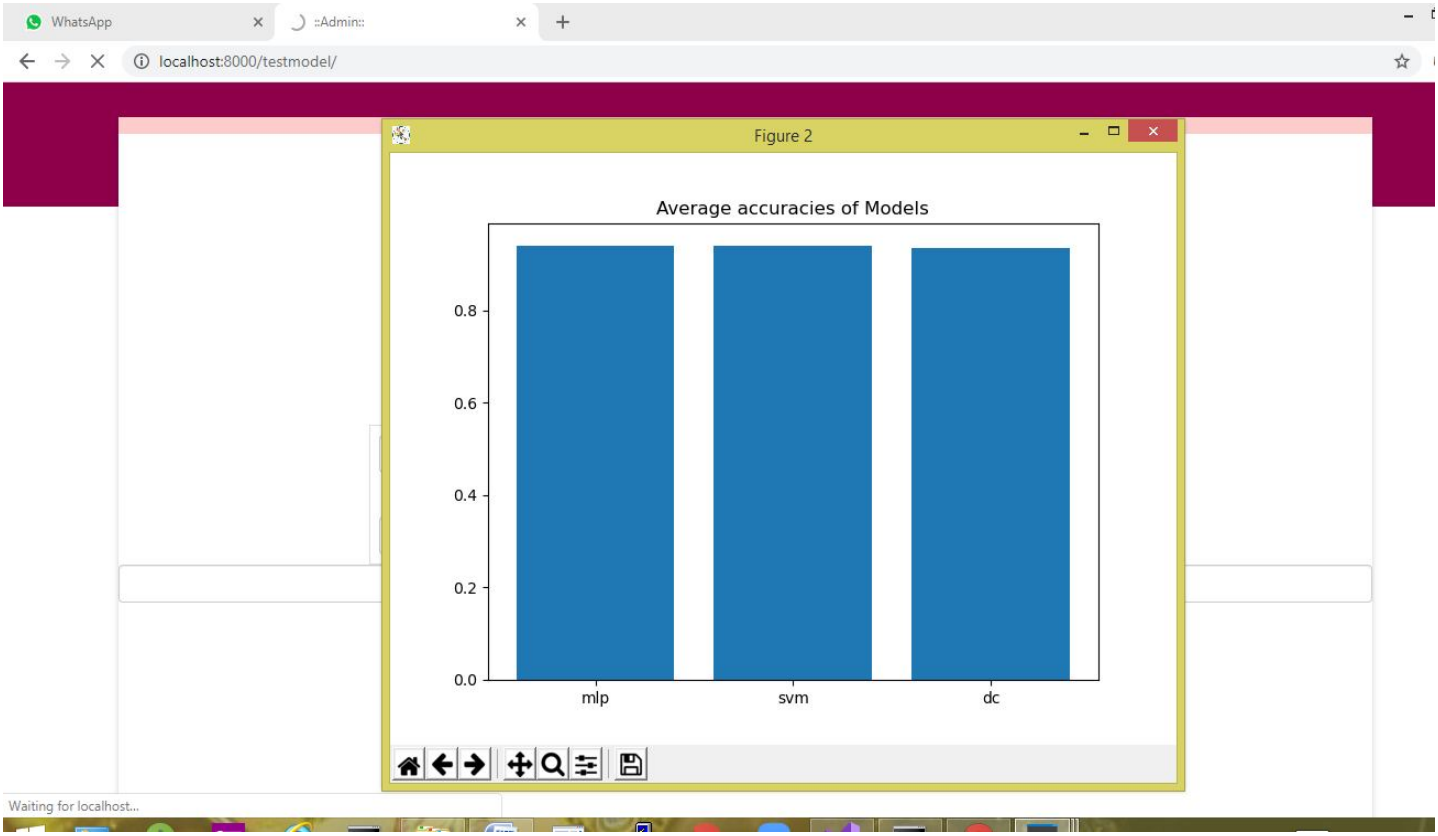


Figure: 9 Model display page

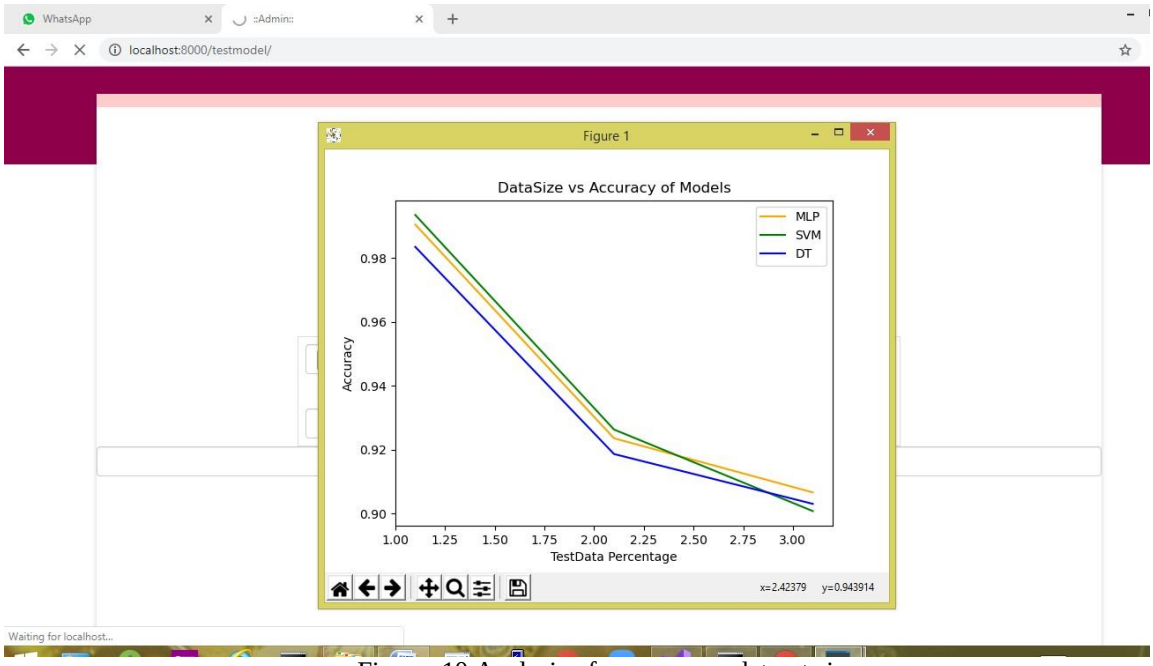


Figure: 10 Analysis of accuracy vs dataset size

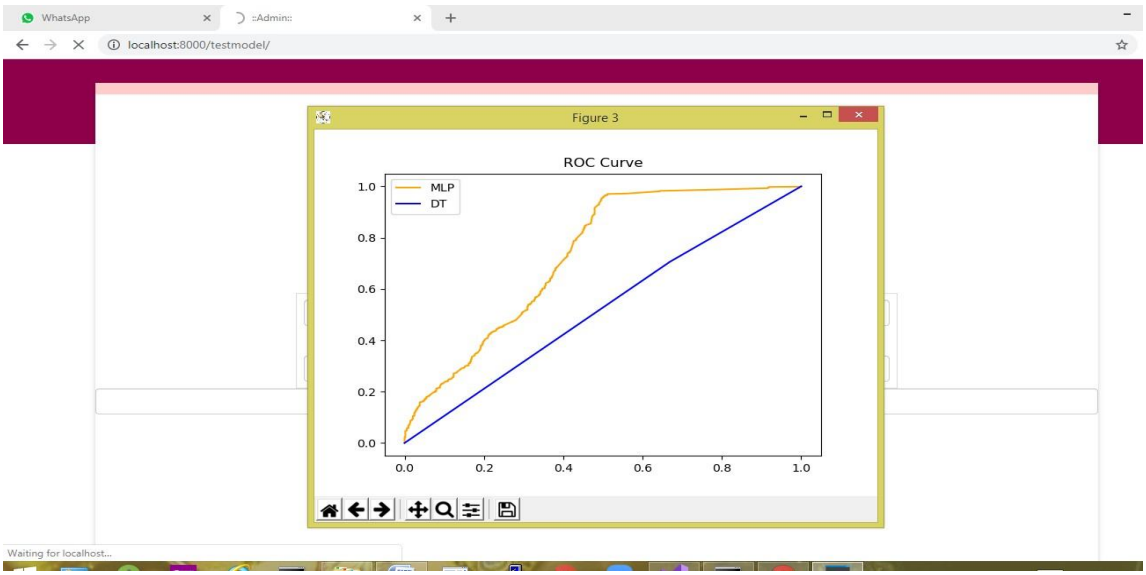


Fig: 11 ROC curve

An ROC curve (receiver operating characteristic curve) is a graph [Figure 10-11] showing the performance of a classification model at all classification thresholds. This curve plots two parameters: True Positive Rate. False Positive Rate.

V. CONCLUSIONS

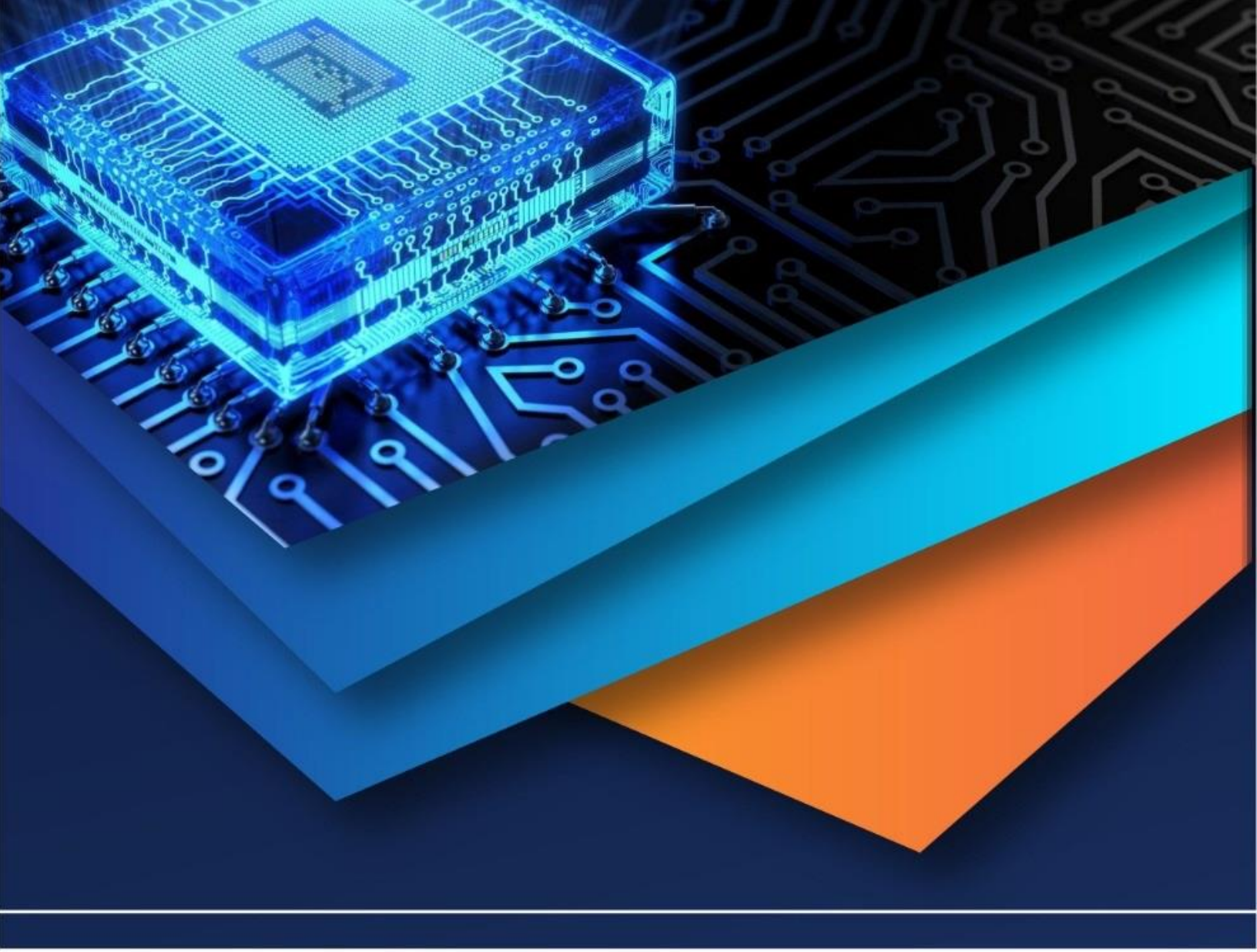
There are many suggestions that employers and employees could keep in mind. Employers need to keep track of number of their employees having mental disorder. Employers should allow flexible work environment with flexible work scheduling and break timings. They should allow employees to work from home or have flexible place of work. They should give day-to- day feedback and guidance for nurturing employees' health. This type of model could be used to detect metal health progress among employees and also could lead to policy changes. Employees could talk to colleagues and their managers about their problem freely.

Hence upper management could help them to get correct aid with beneficiaries like work from home, flexible timings, more leaves, many more. Employees should know health benefits provided by their organization participate in any wellness programs. Proper feedback should be provided to employee when they resign from their job. This could help them to improve their health.

At every interval of months, the survey should be taken in IT companies to know how well their employees are. It should be a rule that should be embedded in their policy book. This project could further be developed with beautification and could potentially be attached to stack of default software in an organization.

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