PREDICTION OF DISEASES USING EMOTION RECOGNIZED THROUGH FACIAL EXPRESSIONS

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ABSTRACT

Mental disorders are prevalent in the society which remains undiagnosed due to the social stigma that results in drastic reduction of productivity in the workforce and mental stability of the individual. We developed a system for detecting emotions through facial expressions and use them to predict diseases. This was achieved with the help of trained and tested neural networks. A real-time application was developed which gives out the emotion of the individual and the probable disease. The design of the system is explained in this paper along with the applicability of the model.

Keywords – *emotions; facial expressions; neural networks; convolution neural network; disease*.

I. INTRODUCTION

Prediction of diseases using emotions is a recent concept in the field of neuropsychology, medicine, and mental health. The diseases predicted in this paper include a mood disorder - depression and a mental disorder - bipolar.

1.1. Depression

A recurrent mental disorder, depression is a contributor to the global cause of burden. In this disorder, an individual suffers from lack of interest and enjoyment, decreased energy and feelings of unworthiness and guilt for a period of at least two weeks. Extreme depression can also lead to suicide. The individual will function in the society but he/she may also hide the mental struggle.

Depending on the criticality of the condition, depression is categorized as mild, moderate and severe. This disorder mainly becomes ignored in the society due to lack of medical resources and the social stigma around it. Around 800,000 people die every year due to this condition. Depression can be treated by timely intervening of professionals. Depression can be caused by various reasons and emotional factors play a major role.

1.2. Bipolar Disorder

Bipolar disorder is characterized by long episodes of either positive or negative emotion. It is considered to be a neurological disorder. The episodes have an adverse effect on the individual and the environment. These episodes come(occur) in cycles and are identified by their high intensity that may or may not have environmental

factors. The individual suffers through drastic changes in the pattern of emotions, i.e, has cycles of varying emotions. The affected patients find it hard to regulate their mood and have manic episodes.51 million people worldwide suffer from bipolar disorder.

1.3. Neural Network

Artificial Neural networks have existed in concept for decades but with the recent advancements in processing a large amount of data and computing power of computers, it has become practical to design complex neural nets and train and test with large datasets. Neural nets provide a solution to many problems such as image recognition, speech recognition, natural language processing, pattern recognition etc. Neural networks for image recognition have proven to be very successful and efficient. Among the architectures available, CNN, that was modeled on the visual cortex of the human being is a good choice.

1.4. Human Emotions

Happiness, fear, sadness, anger, surprise and disgust are the emotions that are categorized as the Big six emotions. The major approaches that affect modeling are distinguished as dimensional and categorical. Two orthogonal dimensions: arousal and valence are used in the dimensional approach. IT models the emotional properties based on the emotion dimensions.

II. EXISTING SYSTEM

A system using Japanese Female Facial Expression (JAFFE) was proposed which was trained on Cohn-Kanade(CK+) dataset. This system was efficient as it passed the images several times through the networks. But the downfall was that the same accuracy could be obtained with Support Vector Machine (SVM) or Learning Vector Quantization(LVQ). The system for predicting depression or any mental disorder usually existed as ques for the professional. One such system [1], used multimodal emotion recognition for sending alert to the doctor. This was not a fully automated system.

In the system, the emotions for a day were recognized and the number of times negative emotions occurred was counted and the number of times the positive emotions used were counted. If the negative emotions were more, the system alerted a professional otherwise the person was considered to be stable. The drawback of this system was that it wasn't automated hence if professionals were not available or if the person was uncomfortable about discussing his mood, then it would remain undiagnosed. We propose a model that circumvents this and also additionally gives other factors that could play a role in identifying the disease from the existing data thereby eliminating the need for taking in other factors.

III. PROPOSED SYSTEM

We propose a system for detecting facial expressions with which we can predict the probable diseases of the individuals. The existing system could achieve full automation and increased efficiency. The novel concept that we propose includes a disease mapper that predicts disease. Here we are dealing with mainly two diseases - Depression and Bipolar Disorder. These diseases are known to affect the mental state of an individual. The system could be made possible with the help of advancements in technology, neural networks, and computing power.

The proposed system uses one convolution layer capable of learning the facial expressions of the subject. The proposed system is a continuation of the existing system which predicts the disease by taking the expressive factors into account from which the emotion is realized and the further process is continued. The convolution layer is connected with normalization layer which in turn connected with one max pooling, one fully connected layer and one softmax output layer. OpenCV library detects the various features of the face of the subject. TFLearn library built on top of Tensorflow will be used to train the proposed system.

A minimum of sixty hours is necessary for obtaining a good accuracy. Once the emotions are extracted using the facial expressions, they are stored in an updatable database. The data is used for disease mapper which will

map the diseases. We propose the K-nearest neighbors algorithm for disease mapper for its efficient partitioning including boundary values of data.

IV. ARCHITECTURE

The architecture has been designed to get real-time data and give the disease prediction accordingly. The first module acquires the facial expression of the user and detects the face.

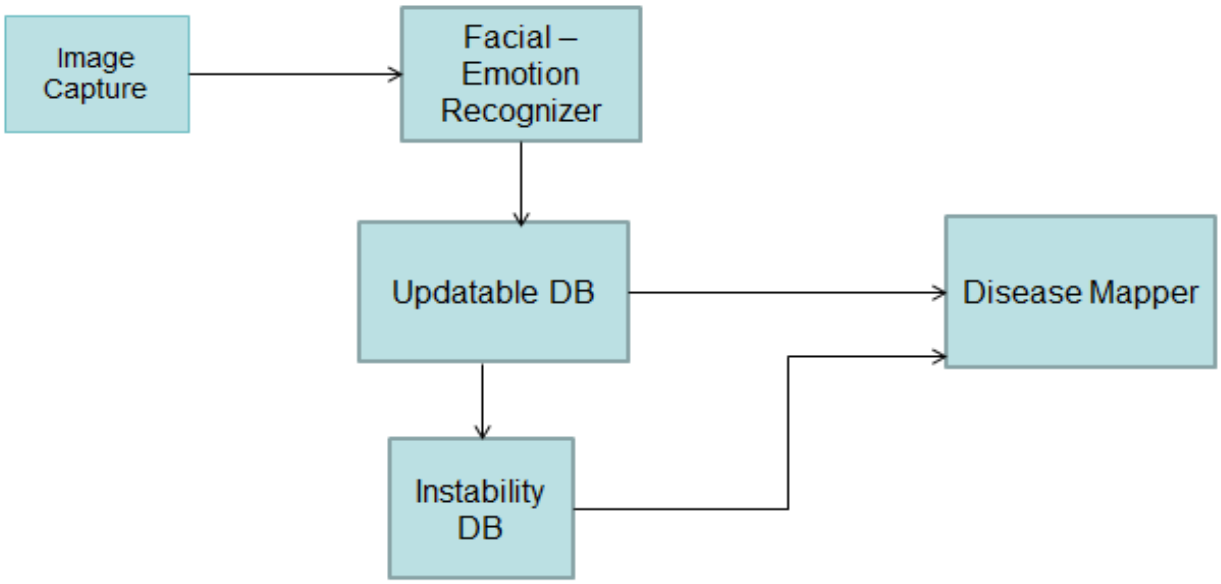

Fig 1 - Architecture

The largest face is taken if multiple faces are in the frame. The accuracy of face detection is pretty high except for low lighting scenarios. The second module is the neural network that is trained with the FER dataset, that consists of 28,709 images of 48*48 resolution. The neural network is trained and the weights are saved in a checkpoint. This is done for detecting the emotion of the person. The output is obtained and is susceptible to change based on the real-time emotions. The data based on emotions are stored in a database. This data can be collected for a larger time frame to detect the mood of the person. Features are extracted from this database which will be then used as an input for the disease mapper.

The disease mapper is used to predict the diseases based on the data obtained from emotions and the extracted features from the database. This is done using the k-nearest neighbors algorithm which is useful for the functionality of disease mapper. It maps the features to the probable diseases. This provides a good system with a fairly high accuracy.

V. ALGORITHM

The input for the system is the real time facial data that is used by the face detection module. It resizes the image, i.e., the face detected. When more than one face is in the frame, the algorithm takes the largest face and extracts its features. The output is then fed to the neural network. The neural network used here is CNN, i.e., Convolution Neural Network. CNN is used for its unique capability of recognizing images. The first layer is the input layer, that has 48*48 nodes. The next layer is a convolutional layer which is followed by a local contrast normalization layer. Additionally, two convolution layers are added.

Another layer is added which finally is connected to a softmax layer. The softmax layer is the output layer. The network is trained on FER dataset that has images labeled with the type of emotion the picture represents. This dataset is a labeled dataset and the network goes through supervised training. The emotions detected by the network include 6 types: happy, sad, angry, disgusted, surprised, fearful and neutral. The network gives the emotion as the output, i.e., it gives a vector of seven dimensions where the emotion is a combination of them all. The network is tested with the real-time data.

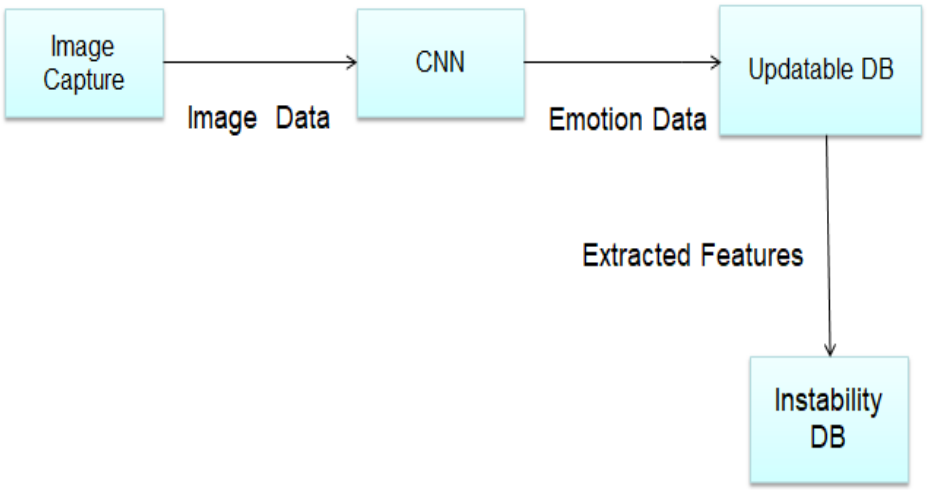

Fig 2 - Workflow

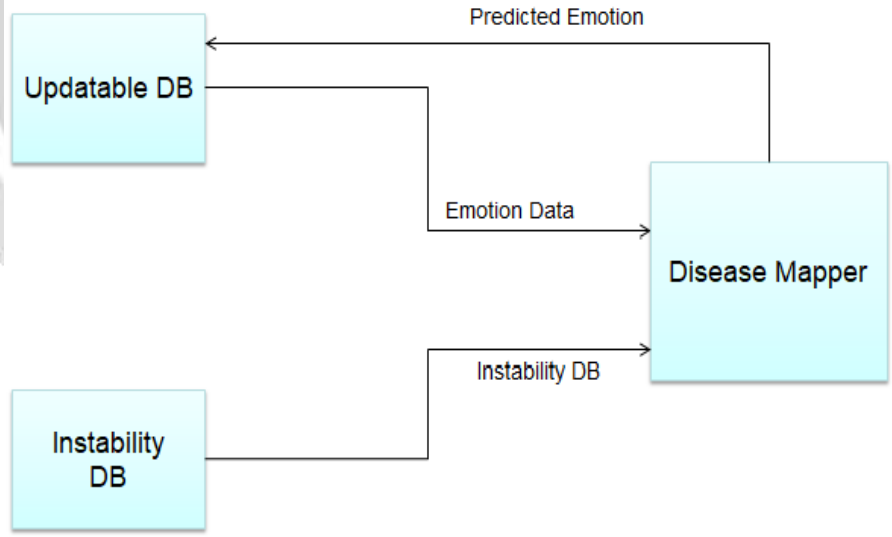

Fig 3 - Workflow

The emotion data is used for the next module which is the disease mapper. Before predicting diseases the features have to be extracted from the data collected from the user, that is, the emotion data. It could be for varying durations based on the requirement. From the real-time data obtained, the instability database is created and other

features are extracted like the most prominent emotion and for how long. The disease mapper uses k nearest neighbors that take the data and uses it to map it to diseases. It maps it to two diseases depression and bipolar disorder. The features extracted and the emotion data collected are used by the disease mapper to map it to diseases.

VI. CONCLUSIONS

A system for disease deduction based on emotions obtained from facial expressions is proposed and presented. Execution included training the system for sixty hours and testing the system with real-time data. The fully automated system had fairly high accuracy and was able to differentiate even the boundary values. The facial recognition also proved to be good at detection of emotions. The disease mapper was able to successfully map the emotions to diseases based on the features extracted.

VII. REFERENCES

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