A Survey on IOT Powered Wearable Health Band

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Abstract: Depression is a common and crucial public health concern in India expanding at a very fast pace. It is affecting people of all age groups, male or female, urban or rural, educated or uneducated and even employed or unemployed. In India, a large number of people are committing suicides due to depression each year. With the advancement of technology, sensors become an extensive part of everyday life. Various researchers are trying to detect and treat depression with the use of sensors, IOT and other technology. In this paper, we are inspecting multiple ways in which the researchers are trying to help people by detecting depression.

Keywords: **Internet of Things, Depressive Disorders, Depression detection, Real life, Wrist device, wearable sensors, Machine learning.**

I. INTRODUCTION

Daily life depression is an important problem of our modern society. It is a growing issue and it has become an unavoidable part of our daily lives. Depression [1] is the unwavering feeling of sadness, exhaustion and anxiety[1] along with various physical complaints. Depression is a non-communicable disease and can be cured with the correct dosage of medicines and sometimes lifestyle changes.

Internet of Medical Things (IoMT) is becoming a common paradigm with so many advancements in the medical industry. This has increased the life expectancy of people especially in the developed countries [10]. The Internet of Health Things [11] or Internet of Medical Things [12] or Smart Healthcare [13] as it being called is combining the reliability and safety of conventional medical devices used for the treatment of chronic illnesses with the dynamicity and generality of Internet of Things. IoMT is providing solutions for addressing the requirements of both the ageing population as well as patients with chronic diseases and providing patients mobility in contrast to the telemedicine systems.

Figure: - IOT Wearable Health Band

The paper is structured into four sections. Section I contains entire introduction of what is depression? And how the depression is detected. Section II provides the technological advancements executed by various researchers in detecting depression or treating it. The major works have been depicted in this section. Section III provides the overall architecture of the proposed system along with the detailed description of the sensors used in the proposed system. The conclusion of the survey has been summarized in Section IV.

II. LITERATURE REVIEW

In the period 2005–2016, various studies were conducted to implement depression detection using a combination of signal processing and machine learning (ML). Most of them used data from a sensors like[2,3,18], ECG sensor[2,3,18], heart rate(HR) sensor[4], acceleration (ACC) sensor[5,6], electro dermal activity (EDA) sensor[2,3,4,5,18], blood volume pulse (BVP)sensor and electromyogram (EMG) sensor[2,8]. Some are more constrained, either physically (e.g., brain activity analysis [9]) or with respect to privacy.

Huijie Lin et al.[1] find that users stress state is closely related to that of his/her friends in social media. Here a novel hybrid model - a factor graph model combined with Convolutional Neural Network is used to study the correlation of users' stress states and social interactions.

Wrist-worn EDA Sensor
Adams et al. [10] collected data from seven participants as they carried out their everyday activities over a ten-day period. They used smartphone audio-sensing and a wrist-worn EDA sensor. They analyzed correlations between stress self-reports and smart-phone audio-sensing. They did not use machine learning to detect stress. They concluded that context information is needed to distinguish between pleasant and negative experiences. Our proposed machine-learning method exploits context information to detect stress.

Wearable IOT (WIOT)
Wearable IOT (WIOT) can be described as the infrastructure that connects various sensors for tracking human factors such as behavior, health, wellbeing and other data. With the help of various tiny wearable body area sensors (WBAS) and internet connected gateways, medical information can reach to physicians where data is collected, managed and monitored. The authors in [11] have extended the concept of WIOT and identified its architectural components along with the support of cloud and big data. WIOT has the power to transform the healthcare by early detection of diseases, lower cost of treatment and efficient means to monitor the treatment and the patient remotely.

In [12], authors have proposed a layout to monitor a depressed patient's health using three tri-axial accelerometers, a barometric pressure sensor for sensing in the foot and a smart phone in a remote health care system. The nodes are mobile and communication is reliable. The location of the patient will be extracted in the form of coordinates from the android application (to be developed) installed on the patients phone. An alarm is triggered as soon as the patient is found to be in the danger zone for more than a stipulated threshold time.

Apriori Algorithm and Association Rule Mining

Predicting depression accurately is a major concern till date and hence in [13], the authors propose a model for depression prediction considering Apriori algorithm and association rule mining and 500 individuals with diverse factors of depression.

EEG signal processing

Authors in [14] used EEG signal processing for depression level prediction. They used the links between sleep and depression to process a model. Insomnia is extremely common in depressed people. Three quarters of depressed patients have sleep disorders, including insomnia and hypersomnia. The symptoms of sleep disorders and alcoholism cause a major impact on quality of life, thus increasing the risk of suicides. The results they acquired through ANFIS were slightly better than the results of classifier.

Linear Predictive Coding (LPC)

Depression and suicides are becoming a major health concern. With the help of Linear Predictive Coding (LPC) and Parameters based method, the authors in [18] have prepared a model of emotional speech recognition algorithm using Tamil language. The best recognition rate obtained was 90% with the help of LPC algorithms.

Electroencephalogram Gram (EEG) signals through MATLAB

The authors in [15] have used Electroencephalogram Gram (EEG) signals and processed these signals through MATLAB. They suggested a depression detection system which extracted EEG signals from the database, converted the signals into ASCII or text file, extricated the EEG bands by Welch method and hence passed on the result to ANFIS and nprtool after applying Log PSD Mean and standard deviation. After the process of training and testing the data, the sleep disorders and alcoholic disorders are classified within the depression domain. ANFIS was found to provide better results than nprtool.

I-Vector Technique and Fuzzy Membership Functions

In [17], I-Vector technique and fuzzy membership functions have been selected to uncover depression level in twenty patients. For simulation MATLAB 2013A with a toolbox for signal processing is used. Comparison between the algorithms is performed based on accuracy, balanced classification rate, peak signal to noise ratio, F-Measure and specificity. Before processing, is becomes necessary to remove silence present in the audio signals for increasing the accuracy. Fuzzy membership functions proved to be much better with an accuracy of 97%.

T-bots (Therapy Chatbot)

With the detection of level of depression in an individual, the authors managed to provide a system to suggest remedies for lowering the level of depression in [6]. A therapy chatbot is used in this research which can act as a therapist or a friend or a well-wisher. Depressed people don't wish to visit a therapist; however, they can share their feelings with an appealing virtual therapist instead of having an alone miserable time. T-bots are very useful and can serve as a personal assistant, psychiatrist, brawl depression, can provide feedback, can identify the level of depression, can provide the therapy level etc.

The authors here in [16] focus on distinguishing the level of depression being experienced by the depressed. EEG signals are taken into account and features are extracted to train the neural network. Thereafter, emotion recognition is implemented to identify depression levels through facial analysis. At the end, they conclude that the combination of EEG signals and facial expressions produce a better result as compared to the individual algorithms in differentiating the depressed from the control patients.

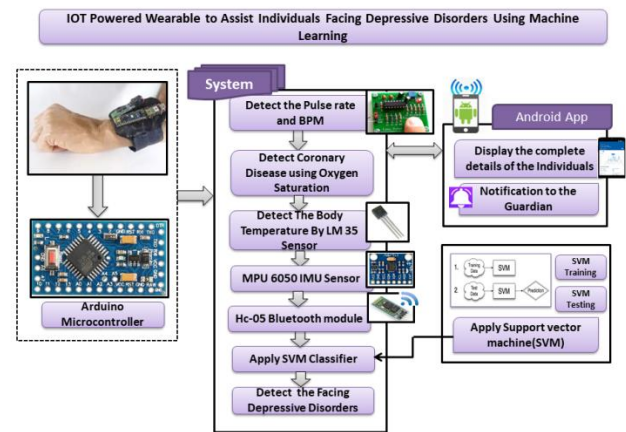## III. PROPOSED SYSTEM

A. SYSTEM ARCHITECTURE AND FLOW

Figure: - System Architecture

Description: - Initially user will wear the health band and connect it to the android phone. The input in the form of signal data is obtained from the wearable (Health-Band) device. This inputted data is then sent to the smart phone using hc-05 Bluetooth module. The wearable device contains some sensors, like Temperature Sensor, BPM sensor, MPU 6050 Sensor and etc. The user can view the sensor data received from the wearable device through the system. Support Vector Machine (SVM) algorithm is applied on some features to make some decisions that mainly includes user's Position (Sitting, Standing) and detection of depressive disorders. If the individual is facing the depression then the notification is sent to the guardian (caretaker) via android application. The android application is also useful for displaying the entire details of the individual.

B. HARDWARE USED
> List of Hardware required is;
1. Arduino
2. Temperature Sensor
3. BPM sensor
4. MPU 6050 Sensor
5. Hc-05 Bluetooth module

Some are elaborated as follows;

1) Temperature Sensor:-

Temperature Sensors measure the amount of heat energy or even coldness that is generated by an object or system, allowing us to "sense" or detect any physical change to that temperature producing either an analogue or digital output. Get current temperature value.
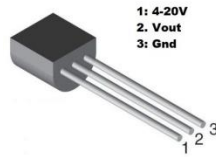
Figure: - TEMPERATURE SENSOR

2) BPM sensor

The digital output can be connected to microcontroller directly to measure the Beats Per Minute BPM) rate.

Get Blood Pressure value and coronary disease detection using block blood flow and oxygen rich level in blood.

Figure: - BPM SENSOR

3) MPU 6050 Sensor

The MPU 6050 is a 6 DOF (degrees of freedom) or a six-axis IMU sensor, which means that it gives six values as output: three values from the accelerometer and three from the gyroscope. The MPU 6050 is a sensor based on MEMS (micro electro mechanical systems) technology. To return sedentary, Idle and sitting positions.

Figure: - MPU 6050 SENSOR

4) Hc-05 Bluetooth module

HC-05 module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. To send the data from wearable band to the smartphone
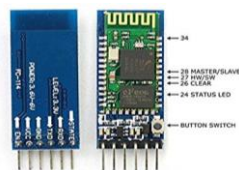

Figure: - HC-05 BLUETOOTH SENSORE

IV. CONCLUSION

In this paper we have analyze the different techniques used by the different researchers till now. Based on this analysis, some technologies and sensors can be combined together to detect depression. Sensors with android applications are more of the new IOT can be utilized for creating a model that could help the people to detect depression and can hence visit the doctors and psychiatrists respectively.

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