Fitness Tracker: Safety Device for Real Time Depression Monitoring- A Survey

Mayur Deshmukh [1], Shivani Waghchoure[2], Abhijeet Khyale[3], Suraj Chavan[4]
[1234](Students, Department of Computer Engineering, Sinhgad Academy of Engineering, Pune, Maharashtra, India)

Abstract: ***Now a day's depression is considered as crucial and commonly occurring public health concern in India. 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. Sometimes mental stress needs to be control as it results in different dangerous suffering. Timely mental stress detection can help to prevent stress related health problems.***

IoT plays a role in sensing, analyzing and processing the data in the cloud. 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 is the unwavering feeling of sadness, exhaustion and anxiety 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[1,2,3], ECG sensor[1,2,3], heart rate(HR) sensor[4], acceleration (ACC) sensor[5,6], electro dermal activity (EDA) sensor[1,2,3,4,5], 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.

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.

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.

III. PROPOSED SYSTEM

A. SYSTEM ARCHITECTURE AND FLOW

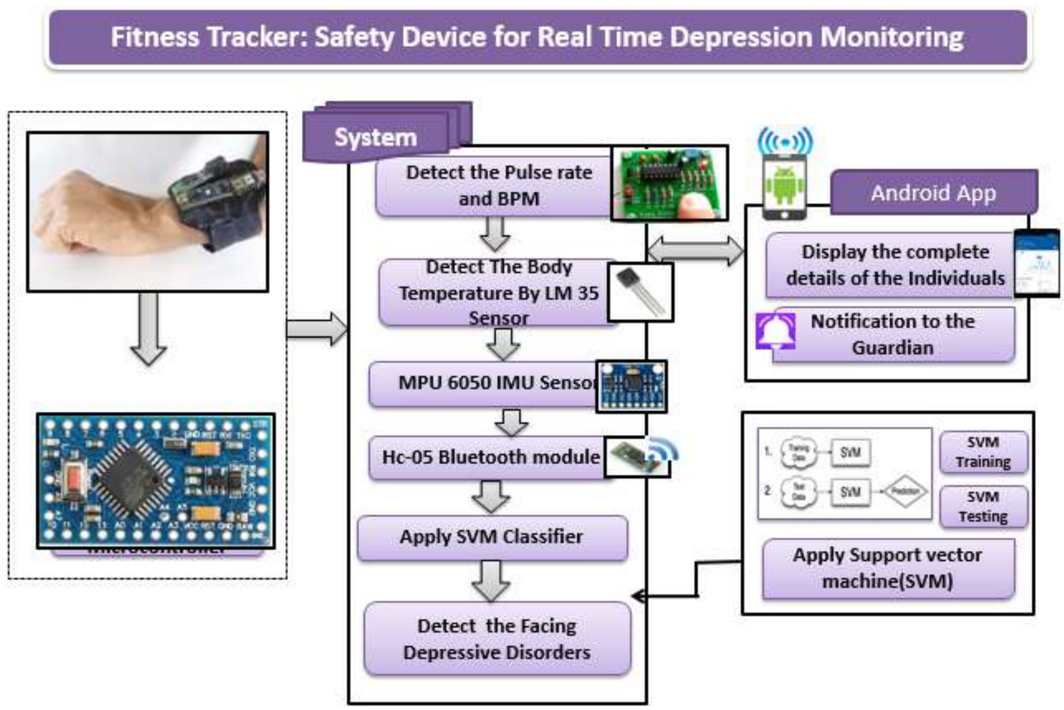

Figure: - System Architecture

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. MQ135 is used for monitoring air quality. It can detect a wide range of hazards gases, including NH_3, NO_x, alcohol, benzene, smoke and CO_2 in the surrounding environment. 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 UNO
  2. Temperature Sensor
  3. BPM sensor
  4. MPU 6050 Sensor
  5. HC-05 Bluetooth module

Some are elaborated as follows;

1) Temperature Sensor:-

The main purpose of the temperature Sensors is to 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 4: - Temperature Sensor

2) BPM sensor

The output in the form of the digital 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 5: - BPM Sensor

3) HC-05 Bluetooth module

The HC-05 Bluetooth module is considered as efficient to apply on Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. To send the data from wearable band to the smartphone

Bluetooth Sensor Module

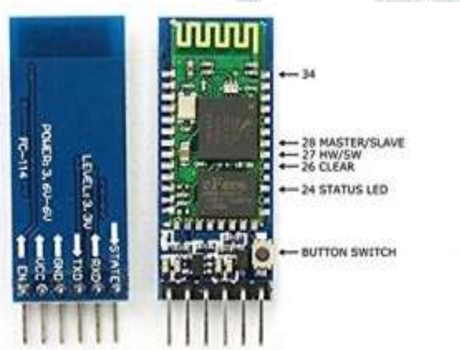

Figure 6: - HC-05 Bluetooth Sensor

Technical specifications of HC-05 Bluetooth

Specification	Values
Bluetooth protocol	Bluetooth Specification v2.0+EDR
Frequency	2.4GHz ISM band
Modulation	GFSK(Gaussian Frequency Shift Keying)
Asynchronous Speed	2.1Mbps(Max) / 160 kbps
Synchronous Speed	1Mbps/1Mbps
Security	Authentication and encryption
Power supply	+3.3VDC 50mA

Table 1: - Technical specifications of HC-05 Bluetooth

4) 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 that relies on MEMS (micro electro mechanical systems) technology. To return sedentary, Idle and sitting positions.

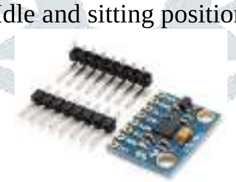

Figure 7: - MPU 6050 Sensor

5) MQ135 Air Quality Sensor

MQ135 is used for monitoring air quality. It can detect a wide range of gases, including NH3, NOx, alcohol, benzene, smoke and CO2.

Figure 8: - MQ135 Air Quality Sensor

IV. CONCLUSION

Wearable IoT can offer endless new opportunities in many real-life applications. This paper provided a survey on the most important efforts of the research community in the area of wearable and IoT. 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.

REFERENCES

[1] K. Hovsepian, M. Absi, T. Kamarck, M. Nakajima, cStress: towards a gold standard for continuous stress assessment in the mobile environment, in: ACM Conf. Ubiquitous Computing, 2015.

[2] H. Sarker et al., Finding significant stress episodes in a discontinuous time series of rapidly varying mobile sensor data, Hum.-Comput. Interact. (2016).

[3] J.A. Healey, R.W. Picard, Detecting stress during real-world driving tasks using physiological sensors, IEEE Trans. Intell. Transp. Syst. 6 (2) (2005) 156–166.

[4] A. Muaremi, A. Bexheti, F. Gravenhorst, B. Arnrich, G. Tröster, Monitoring theimpact of stress on the sleep patterns of pilgrims using wearable sensors, in:IEEE-EMBS Int. Conf. Biomed. Heal. Informatics, 2014, pp. 3–6.

[5] A.D.S. Sierra, C. Ávila, Real-time stress detection by means of physiological signals, Gr. Biometrics (2013).

[6] J. Ramos, J. Hong, A.K. Dey, Stress recognition – a step outside the lab, in: Proc.Int. Conf. Physiol. Comput. Syst., 2014, pp. 107–118.[14] A. Sano, R.W. Picard, Stress recognition using wearable sensors and mobile phones, in: Hum. Assoc. Conf. Affect. Comput. Intell. Interact, 2013, pp. 671–676.

[7] W. Handouzi, C. Maaoui, A. Pruski, A. Moussaoui, Short-term anxietyrecognition from blood volume pulse signal, in: IEEE 11th Int. Multi-Conference Syst. Signals Devices, SSD 2014, 2014.

[8] J. Wijsman, B. Grundlehner, Wearable physiological sensors reflect mentalstress state in office-like situations, in: Affective Computing and IntelligentInteraction (ACII), Humaine Conference on, Sep. 2013, pp. 600–605.

[9] Z. Dharmawan, Analysis of computer games player stress level using EEG data,(Master of Science Thesis Report), Faculty of Electrical Engineering,Mathematics and Computer Science, Delft University of Technology,Netherlands, 2007.

[10] P. Adams, M. Rabbi, T. Rahman, M. Matthews, Towards Personal StressInformatics: Comparing Minimally Invasive Techniques for Measuring DailyStress in the Wild, 2011. pac.cs.cornell.edu.

[11] Dey, Nilanjan, et al., eds. Internet of Things and big data analytics toward next-generation intelligence. Springer International Publishing, 2018.

[12] Hiremath, Shivayogi, Geng Yang, and Kunal Mankodiya. "Wearable Internet of Things: Concept, architectural components and promises for person-centered healthcare." Wireless Mobile Communication and Healthcare (Mobihealth), 2014 EAI 4th International Conference on. IEEE, 2014

[13] Saha, Jayita, et al. "A framework for monitoring of depression patient using WBAN." Wireless Communications, Signal Processing and Networking (WiSPNET), International Conference on. IEEE, 2016.

[14] Jena, Lambodar, and Narendra K. Kamila. "A Model for Prediction of Human Depression Using Apriori Algorithm." Information Technology (ICIT), 2014 International Conference on. IEEE, 2014.

[15] Rajeswari, A., et al. "Improved emotional speech recognition algorithms." Wireless Communications, Signal Processing and Networking (WiSPNET), International Conference on. IEEE, 2016.

[16] Mallikarjun, H. M., and H. N. Suresh. "Depression level prediction using EEG signal processing." 2014 International Conference on Contemporary Computing and Informatics (IC3I). IEEE, 2014.

[17] Rani, Barkha. "Detecting depression: A comparison between I-Vector technique and fuzzy membership functions." 2016 International Conference on Inventive Computation Technologies (ICICT). Vol. 1. IEEE, 2016.

[18] Katyal, Yashika, et al. "EEG signal and video analysis based depression indication." 2014 IEEE International Conference on Advanced Communications, Control and Computing Technologies. IEEE, 2014.