IoT based smart system to detect mental health emergencies: A proposed model

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***Abstract*— Health is one of the major point of concern that every individual is worried about. There are different aspects of health. Slight variations in any of the aspects can be unpleasant at any point of time. Amidst this pandemic there has been quite a many incidents of dramatic loss of lives due to severe issues in mental health. It's obvious that there might be certain level of stress during our daily lives. If the levels of this stress factor maximizes then it would bring many unfavorable health problems such as anxiety, sadness, depression and other physical health problems too. So our main aim is to develop an efficient system which can be quite favorable to large no of patients in early detection of any mental health issues. This project gets hold of most of the constraints that lead to stress, anxiety, and several other mental health problems. We have proposed the design of an efficient mental health monitoring system which will be able to measure stress levels based on sensing various physical parameters, such as heart rate, Spo2, body temperature and pressure. It also involves a GPS sensor to locate and rescue a patient in case of emergencies like panic attack.**

Keywords*— *Internet of Things, Mental Health, sensor, panic attack, SpO2.

I. INTRODUCTION

Mental health problem is one of the fast growing health problem which is common across the globe. Mental health problems due to anxiety, stress are at a stake worldwide. The WORLD HEATH ORGANIZATION considers depression as one of the global crisis. It includes change in our emotional, psychological, social well-being. According to WHO: Mental Health is a state of well-being in which an individual realizes his or her own abilities, can cope with normal stresses of life, can work productively, and is able to make a contribution to his or her community. The mental health is a point of concern at every stages of life right from childhood to adolescence. Modern city life cultures do not enables a person to focus much on their healthy lifestyle which in turn can be a dominating factor in deteriorating a person's mental health also. IoT and embedded systems are the blooming technologies which have a great role in different research domains including Telemedicine.

Internet of things are the systems of physical devices that are embedded with sensors, software and other technologies for the purpose of connecting and exchanging data with other compatible devices and systems through internet. IoT in health care is found to be beneficial because of it's smarter way of remotely monitoring a patient. With increasing use of smart wearable sensors and smart phones, there already exists a lot more applications to remotely monitor patients of diabetes, heart disease etc. The body sensor network technology is one of the important technology in IoT which is used in studying heath care systems. It uses a combination of very low power and wireless nodes of a sensor that are used to analyse various human body parameters and the environment which is surrounding the patient.

It is quite harder to detect a person's actual emotion but there are lots of body sensors such as heart rate sensors, SpO2 sensors, body temperature sensors and many more which can be used in collecting data of various body parameters and can be used in analysing various types of mental health issues.

Rest of the paper is structured as follows. Section II is about the study of existing works. Section III gives the overview of the components used in the model. Section IV describes the main working principle. Section V and VI explains about the results and the problems faced during the simulation. Section VII contains the future proposals on this topic. Section VIII is about the brief conclusion.

II. LITERATURE SURVEY

Modern health care uses various types of smart systems in the form of wearable devices for monitoring. In case of the mental health of a person, collecting real time patient data is quite necessary followed by processing and analysing of the collected data. Advancements in the field of IoT and electronic sensors help to achieve the competency to build these types of systems.

Authors in [1] used heart rate sensors, temperature sensor and respiratory sensors to determine the level of stress by using the signal response of these sensors. In [2] mainly two types of sensors; heart rate sensor and brain wave sensor were used to identify various brain waves and analyses the stress levels which also includes attention and meditation levels. Authors in [3] worked on the importance of body temperature, blood oxygen saturation, as well as blood pressure. Since mental state of a person is also dependent on various types of stress hormones which affect respiratory and cardiovascular systems and related with skin temperature which are related to sleep, hence it depends on heat loss of the body to the environment and a fall in core body temperature. Authors of

this paper identified the key phases of mental state of a patient by collecting different parameters followed by data analysis, model training and evaluation. Some researches also worked on employing mechanical sensors such as vibration sensors, accelerometers and gyroscope which are generally used to monitor regular activities such as walking, exercise which also plays an integral role in maintaining the mental state of a person. Authors in [4] employed both IoT and machine learning which at first collects several body parameters details and then uses predictive analysing methodology to predict mental health related issues at a very early stage as possible. It is also capable of automated scheduling of doctors and has an automated suggestion procedure involving necessary actions need to be taken based on those collected data. Another paper [5], used the principle of indoor environmental quality and indoor lightning quality. The authors suggested the importance of proper indoor quality and poor lighting quality in regard to good mental health and an AI based methodology for recognizing daily activities. Principle of Galvanic Skin Response in [6] has been used to identify the emotional state of person at an instant of different age groups. Authors in [7] have used Actigraphy devices which is used to monitor human sleep patterns and sleep disorders which are generally useful for mental conditions, such as bipolar disorder. This paper also described on software and social media sensing by using numerous mobile applications which computed time and frequency spent by an user on each category.

III. System Components

The proposed system contains several sensors to monitor different health parameters in real time.

A. *Heart Rate Sensors:*

Heart rate Sensors is an electronic module specifically designed to measure heart rate in beats per minute. It uses an optical LED light source and a LED light sensor.

B. *Temperature Sensor:*

Body temperature is the degree of heat maintained by the body. Temperature sensors such as LM35 is an integrated circuit sensor that can be used to measure temperature with an electrical output proportional to the temperature (in °C). This sensors can measure from -55°C to 150°C.

C. *Pressure Sensor:*

Pressure is being measured using a sensor namely BMP180. It consists of a piezo resistive sensor.

D. *GPS Module:*

GPS stands for Global Positioning System which is a satellite based system that uses satellite and ground stations to measure and compute its position on Earth and it provides position information anywhere in the world.

E. *Blood Oxygen Saturation Sensor:*

It is an electronics module specifically made to measure blood saturation levels. In this module (Fig. 1) there is a red LED light source and an IR light which are used to send light to the photodiode. The photodiode measures the intensity of transmitted light by red and IR led which is used to calculated blood oxygen saturation.

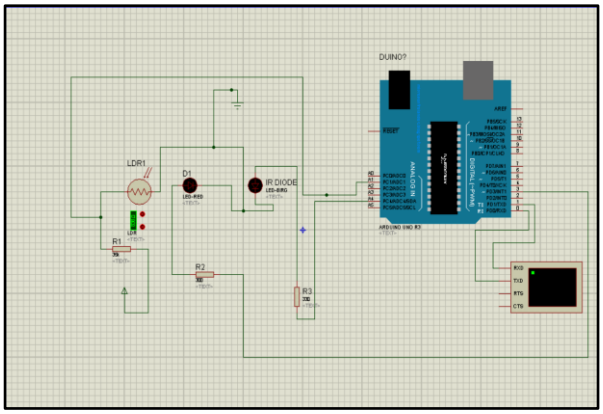

Fig. 1 Circuit diagram for SpO2 detection

The ratio of red and IR signals received by the photodiode with the oxygen saturation value is done to measure blood oxygen saturation levels.

IV. Methodology

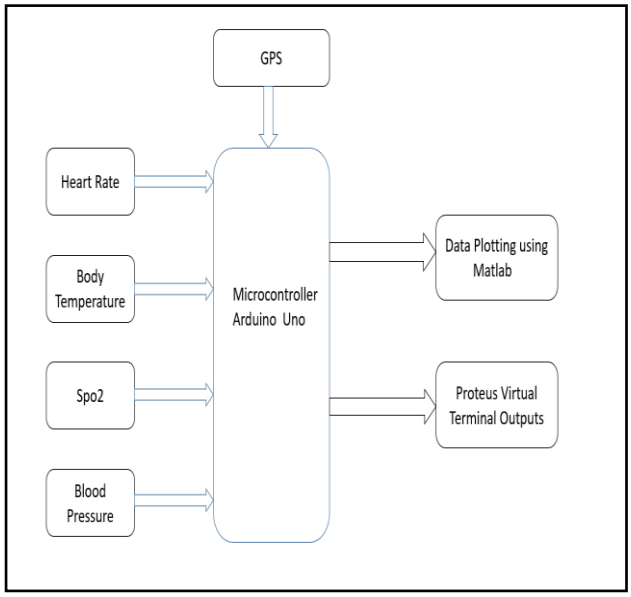

Fig. 2 Block Diagram

The entire process is proposed as below;

Step 1: Various body sensors and environmental sensors are used in the above system which collects various body parameters for monitoring the patient's condition.

Step 2: After the data has been collected from various sensors these data are being processed to a structured dataset.

Step 3: The processed data are plotted in MATLAB to analyse various mental health related emergencies.

Step 4: In the virtual screen it shows the corresponding body health values at a particular instance and based on results the system displays what are the immediate responses that needs to be taken.

Step 5: A GSM module and a GPS module has been used which will be able to notify doctors and other health workers describing the health condition and also the location of that patient in case of emergency.

V. Experimental Result

The entire proposed circuit is simulated and the data produced by each sensors are recorded and plotted respectively.

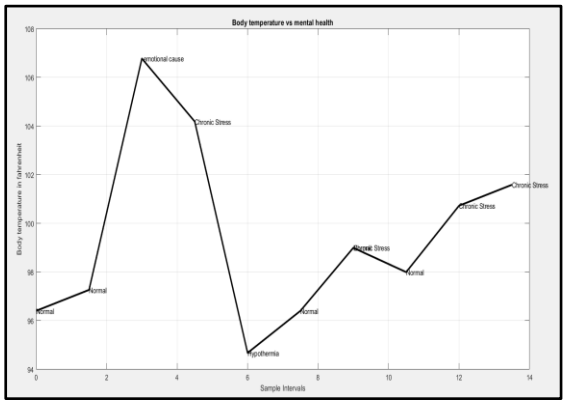

Fig. 3.1 Body temperature vs. Time

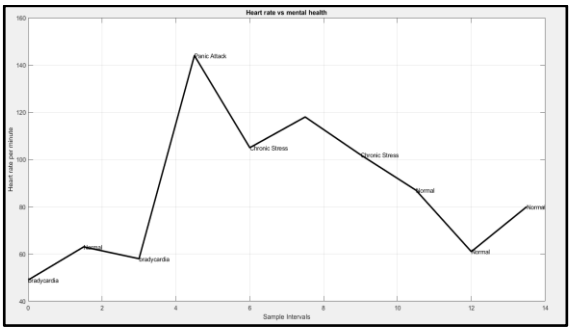

Fig. 3.2 Heart Rate vs. Time

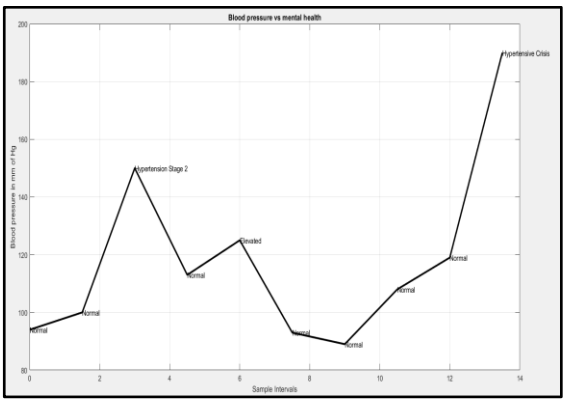

Fig. 3.3 Blood Pressure vs. Time

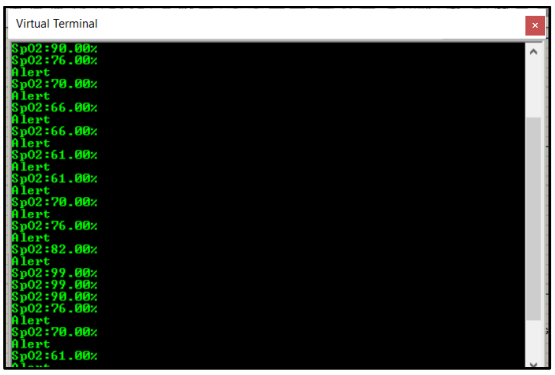

Fig. 3.4 SpO2 Outputs in Virtual Terminal

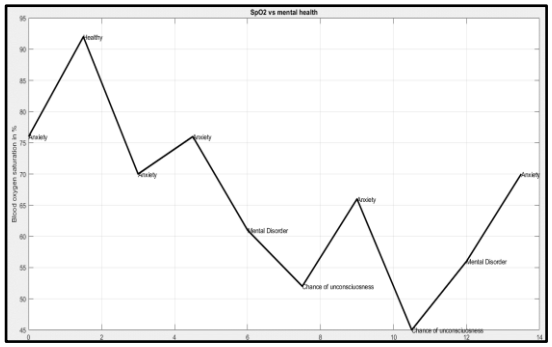

Fig. 3.5 SpO2 vs. Time

Fig. 4 represents the entire circuit of the proposed model. The circuit contains all the necessary sensors and the microcontroller along with the GPS module.

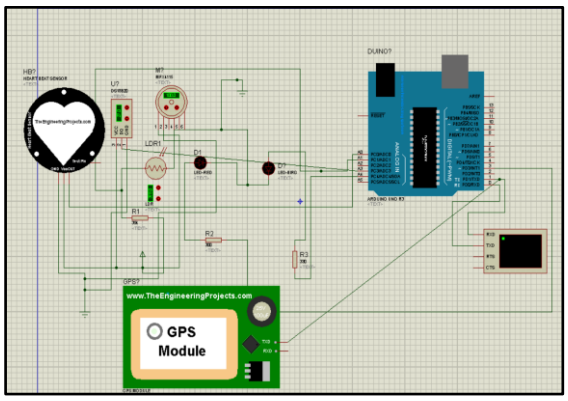

Fig. 4 Circuit diagram of the smart device

VI. Problem Faced

The SpO2 was not available in Proteus library. So it was needed to be designed by maintaining most of the constraints and other parameters. Although the GPS module used can show us latitude and longitude and hence locations but since this is a simulation based project the GPS module is installed with only fixed sets of data.

VII. Future Work

This work will further be implemented using actual hardware kits where all real time data collections can be done. A smart wearable health band can be developed by using the same methodologies. A database needs to be developed containing important medical parameters of a patient. While designing the hardware of this system will be able to send notification to hospitals and doctors as per emergency of a patient.

VIII. Conclusion

Numerous studies and researches were made to choose proper methodologies in determining various mental status of a person based on corresponding signals and their variation. This proposed system will be useful to person in order to manage the emergencies created due to anxiety, stress, depression and hypertension. Hence this system can play an efficient role in order to detect, diagnose and manage the emergencies regarding mental health and in recent future will be a powerful tool to make people more aware of mental health.

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