Ilkogretim Online - Elementary Education Online, 2021; Vol 20 (Issue 1): pp. 5188-5199
http://ilkogretim-online.org
doi: 10.17051/ilkonline.2021.01.554

Wearable Monitoring Device With Privacy Preserving For Mental And Physical Well Being Based On Iota

[1]Shali A , [2]Gayathri S , [3]Keerthana N , [4]Samson Britto X

[1]Assistant Professor, Department of Computer Science and Engineering, Sri Sairam EngineeringCollege, Chennai

[2,3]Student, Department of Computer Science and Engineering, Sri Sairam Engineering College, Chennai

[4]Senior Software Engineer, Agilisium, Chennai

Abstract: The evolution of man-kind is a process that began decades ago. Along with this development the world was being stripped of its exquisite resources that ultimately led to pollution, global-warming, etc. These factors in turn critically affected the health and well-being of all living beings, from a new born child to a senile person due to which half of the worlds' population are born with some disability. Heart attacks and seizures (or fits) are the two most common medical problems that majority of people experience be it an abled or a disabled person. Long-term well-being monitoring is an underlying theme for evaluating health status by collecting physiological signs through behavioral traits. A wearable social sensing technology which is non-intrusive and trustworthy also in alignment with internet of things (IOT) paves way for researchers to find and establish the inter-relationships between unobtrusive social cues and physical mental health (PMH). This project aims at implementing an IOT structured wearable social sensing device with the integration of behaviour monitoring for a disabled person. This device checks for any abrupt changes in patient heartbeat, body position, body temperature. If there is an abrupt change, the device automatically alerts the doctor and the patient's relatives about his or her status through IOT. The added advantage of this device is that it includes an electric pulse simulator that generates electric pulses to the whole body in case of seizures or heart attacks which helps in stabilizing the heartbeat of the patient to a normal level until the patient is tended to.

Index terms: Physical mental health (PMH), Electric pulse simulator, Heart attacks.

I. INTRODUCTION

The size and composition of the world population has changed over the last couple of decades, and these trends are projected to continue. Such demographic trends have significant implications for almost all areas of the society, particularly in health and healthcare. Life expectancy has increased dramatically, especially in the more affluent nations, which is set to be celebrated and should be viewed as an opportunity for people to live longer and better.

However, this requires substantial improvement in both the healthcare service and the living environment, as physically and mentally disabled people generally require more healthcare than their abled ones. To move forward, embedding modern information and communication technologies (ICT) in healthcare system is expected to deliver more effective and efficient healthcare services to patients. Along with this development the world was being stripped of its exquisite resources that ultimately led to pollution, global-warming, etc.

These factors in turn critically affected the health and well-being of all living beings, from a newborn child to a senile person due to which half of the worlds' population are born with some disability. Heart attacks and seizures (or fits) are the two most common medical problems that majority of people experience be it an abled or a disabled person. Long-term well-being monitoring is an underlying theme for evaluating health status by collecting physiological signs through behavioral traits. A wearable social sensing technology which is non- intrusive and trustworthy also in alignment with internet of things (IOT) paves way for researchers to find and establish the inter-relationships between unobtrusive social cues and physical mental health (PMH).

II. LITERATUREREVIEW

Continuous EEG Decoding of Pilots' Mental States Using Multiple Feature Block-Based Convolution al Neural Network[1]they proposed MFB-CNN for classifying mental states with high accuracy and Machine learning methods are used for classification.
Heart Rate Monitoring System [2] pulse oximetry logic is proposed.
A convolutional neural network for steady state visual evoked potential classification under ambulatory environment [3] to check the factors that affect the mental and physical health condition of the person.
Effect of higher frequency on the classification of steady-state visual evoked potentials [4] to achieve a higher efficient output.
Making sense of spatiotemporal preserving representations for EEG-based human intention recognition [5] ECG electrodes are used to produce desired output.
A reliable IOT system for personal healthcare devices [6] they proposed a reliable one, M2Mbased IoT system for Personal Healthcare Devices.
Cluster-based real-time analysis of mobile application for prediction of physiological data [7] they proposed Online Distribution Resource Aware (ODRA) algorithm.
Wearable sensor device for early detection of Alzheimer disease using dynamic time wrapping algorithm [8] they proposed dynamic time wrapping (DTW) algorithm.
Smart Wearable IoT Based Health Monitoring System (HMS) Using BSN [9] BSN (body sensor network) technology is proposed.

III. SYSTEMANALYSIS

1) EXISTINGSYSTEM

Research on mental health evaluation has attracted a lot of attention. In the existing systems, human or environmental social signals can be used to assess a person's activity level, improve

work efficiency, and understand Human Networks (HN). It is possible to predict the results with a high accuracy by collecting social signals from just 5 minutes of negotiation. The project demonstrates that it is possible to help individuals to regulate emotions with mobile interventions that leverage the way human beings naturally react to body signals.

The existing devices monitors only the mental well-being through EEG sensors. These sensors record the person's workload, mental fatigue, distractions, if the person is in a normal state or not, etc. through the brain activity at a time interval of one hour. It is difficult to objectively evaluate a person's psychological state by using common questionnaire-based methods.

The drawbacks of the existing system is that it doesn't give any alert message during abnormal condition of the person, doesn't provide any first aid in abnormal condition to the person and also the efficiency of algorithm is low.

2) PROPOSEDSYSTEM

The proposes system is a wearable social sensing device that can monitor the mentally handicapped patients periodically for any abrupt change in the physical and mental well-being like, their heartbeat, body position, body temperature, etc. It also helps to keep the patient's family informed about their health status from time to time. If the device detects any abrupt changes in the patient's heartbeat, body position or in the body temperature, the device automatically alerts the doctor and the relatives of the patient about his/her status over IOT. In addition to that, until medical attention is given to the patient, an electric pulse simulator is present that generates electric pulses to the whole body which helps to try and stabilize the heartbeat of the patient to a normal level. The patient's workload will thus be reduced when his/her details are being checked at home rather than in a hospital. This system is able to provide the perfect solution for the problems faced in real time.

A. ARCHITECTUREDIAGRAM

It is a pictorial representation of the concepts, their principles, elements and components that are part of architecture. An architecture description is a formal description and representation of a system, organized in a way that supports reasoning about the structures and behaviours of the system. System architecture can comprise system components, the externally visible properties of those components, the relationships (e.g., the behaviour) between them. It can provide a plan from which products can be procured, and systems developed, that will work together to implement the overall system. From the implementation perspective it is important to have an abstract view of the project under progress to visualize the modules. More over any changes must also be documented in the architecture diagram for an efficient project management.

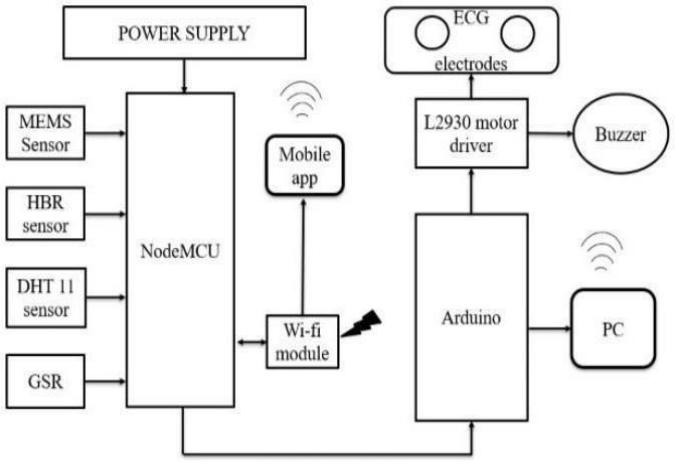


FIGURE 1: ARCHITECTURE OF THEPROPOSED SYSTEM

B. COMPONENTS

The prototype uses the following components:-

1)ARDUINO IDE: The Arduino Integrated Development Environment (IDE) is a cross platform application (for Windows, macOS, Linux) that is written in functions from C and C++. It is used to write and upload programs to Arduino compatible boards, but also, with the help of third-party cores, other vendor development boards. The source code for the IDE is released under the GNU General Public License, version 2. The Arduino IDE supports the languages C and C++ using special rules of code structuring.

2)EMBEDDED C: Embedded C is a set of language extensions for the C programming language by the C Standards Committee to address commonality issues that exist between C extensions for different embedded systems.

3)JAVA: Java is a class-based, object-oriented programming language that is designed to have as few implementation dependencies as possible. It is a general-purpose programming language intended to let application developers write once, run anywhere (WORA), meaning that compiled Java code can run on all platforms that support Java without the need for recompilation. Java applications are typically compiled to bytecode that can run on any Java virtual machine (JVM) regardless of the underlying computer architecture. The syntax of Java is similar to C and C++, but has fewer low-level facilities than either of them. The Java runtime provides dynamic capabilities (such as reflection and runtime code modification) that are typically not available in traditional compiled languages.

4) HBR SENSOR: Heartbeat Sensor is an electronic device that is used to measure the heart rate i.e. speed of the heartbeat. Monitoring body temperature, heart rate and blood pressure are the basic things that we do in order to keep us healthy.

5) MEMS SENSOR: Microelectromechanical systems (MEMS), also written as micro-electromechanical systems (or microelectronic and microelectromechanical systems) and the related micro mechatronics and microsystems constitute the technology of microscopic devices,

particularly those with moving parts. They merge at the nanoscale into nanoelectromechanical systems (NEMS) and nanotechnology. MEMS are also referred to as micromachines in Japan and microsystem technology (MST) in Europe.

FIGURE 2: MEMSSENSOR

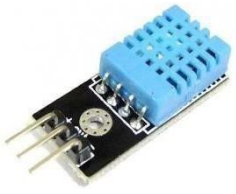


FIGURE3: DHT11 SENSOR

6) DHT 11 SENSOR: The DHT11 is a basic, ultra- low-cost digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air, and spits out a digital signal on the data pin (no analog input pins needed). It's fairly simple to use, but requires careful timing to grab data. The DHT11 calculates relative humidity by measuring the electrical resistance between two electrodes. The humidity sensing component of the DHT11 is a moisture holding substrate with the electrodes applied to the surface. The change in resistance between the two electrodes is proportional to the relative humidity.

7) L293D MOTOR DRIVER: The L293D is a popular 16-Pin Motor Driver IC which can control a set of two DC motors simultaneously in any direction. As the name suggests it is mainly used to drive motors. The L293D is designed to provide bidirectional drive currents of up to 600 mA (per channel) at voltages from
4.5 V to 36 V (at pin 8!). You can use it to controlsmall dc motors - toy motors.

8) ARDUINO: Arduino is an open-source hardware and software company, project and user community that designs and manufactures single-board microcontrollers and microcontroller kits for building digital devices.Arduino board designs use a variety of microprocessors and controllers. The boards are equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards ('shields') or breadboards (For prototyping) and other circuits. The boards feature serial communications interfaces, including Universal Serial Bus (USB) on some models, which are also used for loading programs from personal computers. The microcontrollers can be programmed using C and C++ programming languages. In addition to using

traditional compiler toolchains, the Arduino project provides an integrated development environment (IDE) based on the Processing language project.

9)ECG ELECTRODES: Electrical activity going through the heart can be measured by external (skin)electrodes. The electrocardiogram (ECG) registers these activities from electrodes which havebeen attached onto different places on the body. In total, twelve leads are calculated using ten electrodes. Two types of electrodes in common use are a flat paper-thin sticker and a self-adhesive circular pad. The former is typically used in a single ECG recording while the latter are for continuous recordings as they stick longer.

FIGURE4:ECG ELECTRODES

FIGURE5:BUZZER

10) POWER SUPPLY BOARD: The power supply board is a basic essential interface for regulating and supplying power to the connected components. The female barrel jack connector on the power supply boardacts as the input terminal and the terminal blocks on theboard enables you to connect to the components using the male bread board wires.

11) GSR SENSOR:A GSR sensor allows us to measure sweat gland activity, which is related to emotional arousal. To measure GSR, we take advantage of the electrical properties of the skin. Specifically, how the skin resistance varies with sweat gland activity, i.e., the greater sweat gland activity, the more perspiration, and thus, less skin resistance. The most common measure of a GSR signal is notresistance, but conductance. The conductance makes the signal interpretation easier, since the greater thesweat gland activity, the higher the skin conductance.

12) MULTIMETER: A digital multimeter is a test tool used to measure two or more electrical values— principally voltage (volts), current (amps) and resistance (ohms). It is a standard diagnostic tool fortechnicians in the electrical/electronic industries.

13) Buzzer:A buzzer or beeper is an audio signaling device which may be mechanical, electromechanical, or piezoelectric (piezo for short).

14) NODE MCU: NodeMCU is an open-source firmware for which open-source prototyping board designs are available. The name "NodeMCU" combines "node" and "MCU" (microcontroller unit). The term "NodeMCU" strictly speaking refers to the firmware rather than the associated development kits. Both the firmware and prototyping board designs are open source.

15) Wi-Fi MODULE: The ESP8266 Wi-Fi Module is a self-contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your Wi-Fi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor.

16) SPI PROTOCOL: The Serial Peripheral Interface (SPI) is a synchronous serial communication interface specification used for short-distance communication, primarily in embedded systems.SPI devices communicate in full duplex mode using a master-slave architecture with a single master. The master device originates the frame for reading and writing. Multiple slave-devices are supported throughselection with individual slave select (SS), sometimes called chip select (CS), lines. Sometimes SPI is called a four-wire serial bus, contrasting with three-, two-, and one-wire serial buses.

IV. METHODOLOGY

A modular design reduces complexity, facilities change (a critical aspect of software maintainability), and results in easier implementation by encouraging parallel development of different part of system. Software with effective modularity is easier to develop because function may be compartmentalized and interfaces are simplified. Software architecture embodies modularity that is software is divided into separately named and addressable components called modules that are integrated to satisfy problem requirements. Modularity is the single attribute of software that allows a program to be intellectually manageable. The five important criteria that enable us to evaluate a design method with respect to its ability to define an effective modular design are: Modular decomposability, Modular Comps ability, Modular Understandability, Modular continuity, Modular Protection. The following are the modules of the project, which is planned in aid to complete the project with respect to the proposed system, while overcoming existing system and also providing the support for the future enhancement.

The flowchart of various steps involved in the proposed system is described into four modules:

i. SENSORS DETECTION

In this module, we use various types of sensors like DHT11 to detect the temperature and humidity, HBR to sense the heartbeat, MEMS to detect body position and GSR amplifier to sense the skin conductance of the person. The

Node MCU reads the data or output of these sensors and the same is displayed in the mobile application.

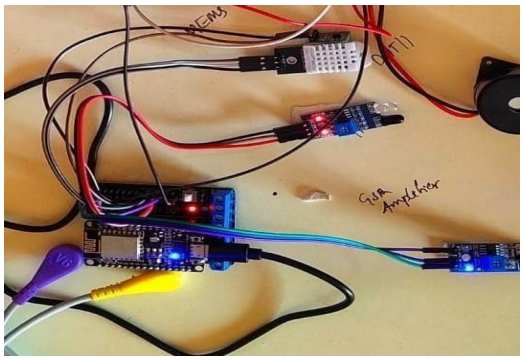


FIGURE6: SENSORS DETECTING THE PERSON'SHEALTH STATE.

FIGURE7:HEALTH STATUS IS DISPLAYED INMOBILE PHONE

ii. ELECTRICAL SIMULATOR

When the person's health condition reaches an abnormal state, the device senses the abnormality. It activates the electrical simulator which generates an electric pulse of 5 volts. This electric pulse is passed to the person's body withthe help of electrodes, to stabilize the person's abnormality.

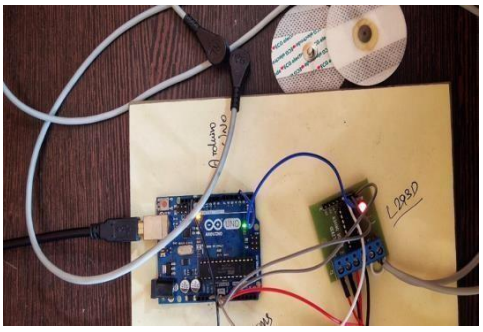
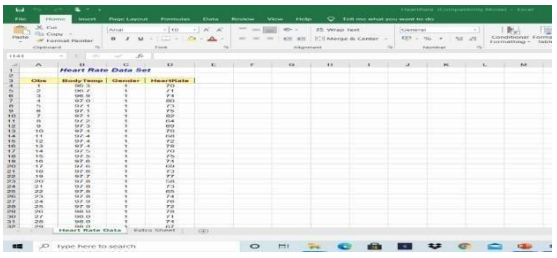


FIGURE8: ELECTRICAL SIMULATOR

FIGURE9: ELECTRIC PULSE GENERATION

iii. FL BASED ALGORITHM

Federated learning (also known as collaborative learning) is a machine learning technique that trains an algorithm across multiple decentralized edge devices or servers holding local data samples, without exchanging them. This approach stands in contrast to traditional centralized machine learning techniques where all the local datasets are uploaded to one server, as well as to more classical decentralized approaches which often assume that local data samples are identically distributed. Here the algorithm is trained with datasets based on FL technique. This algorithm produces higher efficient output. It is the technique in which the output produced is again given as input to system and verifies the output.



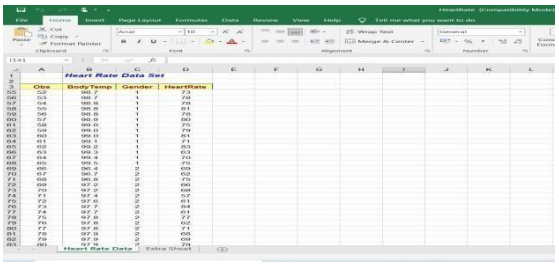


FIGURE10:DATA SETS COLLECTED

iv. BUZZER AND COMBINING ELECTRODES

When the patient's condition reaches abnormal state, the device detects the abnormality and gives buzzer sound to alert the persons around him/her for help. • To get accurate readings of the sensors output the electrodes are combined in one band.

FIGURE11: IMPLEMENTING BUZZER ANDCOMBINING ELECTRODES

V. RESULT

A wearable social sensing device will monitor the mentally handicapped patients periodically for any abrupt change in the physical and mental well-being like, their heartbeat, body position, body temperature, etc. It also helps to keep the patient's family informed about their health status from time to time. If the device detects any abrupt changes in the patient's heartbeat, body position or in the body temperature, the device automatically alerts the doctor and the relatives of the patient about his/her status over IOT. As the heartbeat pulse rate increases beyond the stable condition, an electric pulse is generated which stabilizes theperson's heartbeat pulse rate.

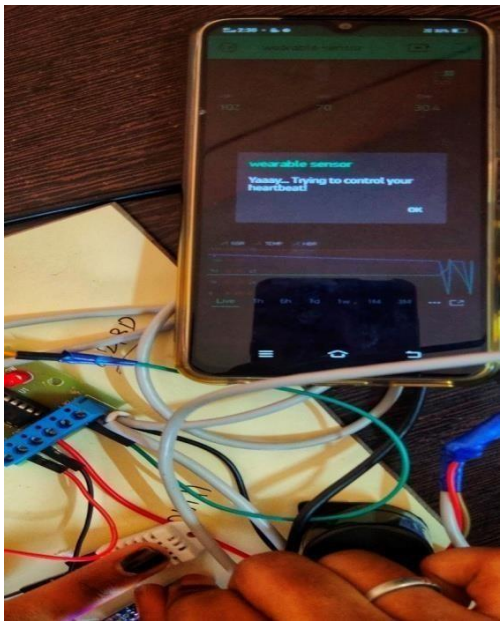


FIGURE12: OUTPUT

VI. CONCLUSION

A wearable social sensing device will monitor the mentally handicapped patients periodically for any abrupt change in the physical and mental well-being like, their heartbeat, body position, body temperature, etc. It also helps to keep the patient's family informed about their health status from time to time. If the device detects any abrupt changes in the patient's heartbeat, body position or in the body temperature, the device automatically alerts the doctor and the relatives of the patient about his/her status over IOT. until medical attention is given to the patient, an electric pulse simulator is present that generates electric pulses to the whole body which helps to try and stabilize the heartbeat of the patient to a normal level.

VII. FUTURE ENHANCEMENT

It can reasonably justifiable that this application can further be improved in several aspects. More parameters can be considered to evaluate the patient's health status. Advanced sensors can be used to get more accurate results. Upcoming technology can be used to function the device more efficiently

REFERENCES

[1]D. Lee, J. Jeong, K. Kim, B. Yu and S. Lee, "Continuous EEG Decoding of Pilots' Mental States Using Multiple Feature Block-Based Convolutional Neural Network," in IEEE Access, vol. 8, pp. 121929-121941, 2020, doi: 10.1109/ACCESS.2020.3006907.

[2]D. Zhang, L. Yao, K. Chen, S. Wang, X. Chang, and Y. Liu, ''Making sense of spatio-temporal preserving representations for EEG-based human intentionrecognition,'' IEEE Trans. Cybern., vol. 50, no. 7, pp. 3033– 3044, Jul. 2020.

[3]P. Kabilan1 , P. Sakthivel2, S. Karthi3 , Dr. G. Mahesh Manivanna Kumar M.E.,PH.D4 ,"Smart Wearable Iot Based Health Monitoring System (HMS) Using BSN", International Research Journal of Engineering and Technology (IRJET) Volume: 06 Issue: 02 | Feb 2019.

[4]J.-H. Jeong, B.W. Yu, D.H. Lee, and S.W. Lee, ''Classification of drowsiness levels based on a deep spatio- temporal convolutional bidirectional LSTM network using electroencephalography signals,'' Brain Sci., vol. 9, no. 12, p. 348, Nov. 2019.

[5] Min Woo Woo, JongWhi Lee, KeeHyun Park, "A reliable IoT system for Personal Healthcare Devices", Future Generation Computer Systems, Volume 78, Part 2,2018.

[6] Tambe, S.B., Gajre, S.S. Cluster-based real-time analysis of mobile healthcare application for prediction of physiological data. J Ambient Intell Human Comput 9, 429–445 (2018). 64

[7] Varatharajan, R., Manogaran, G., Priyan, M.K. et al. Wearable sensor devices for early detection of Alzheimer disease using dynamic time warping algorithm. Cluster Comput 21, 681–690 (2018).

[8]N.S. Kwak, K.R. Müller, and S.W. Lee, ''A convolutional neural network for steady state visual evoked potential classification under ambulatory environment,'' PLoS ONE, vol. 12, no. 2, Feb. 2017, Art. no. e0172578.

[9]D.O. Won, H.J. Hwang, S. Dähne, K.R. Müller, and S.W. Lee, ''Effect of higher frequency on the classification of steady-state visual evoked potentials,'' J. Neural Eng., vol. 13, no. 1, Feb. 2016, Art. no. 016014.