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Design and Development of Mental Health Monitoring System using Multiple Sensors Integrated with Arduino Uno

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ABSTRACT

There has been a revolution in the use of mobile health devices for monitoring physical health. There is more recent interest in whether these devices can also be used for monitoring symptoms of mental illness. The paper discusses how mobile based system can be employed for detecting physiological signs of stress. Stress causes deviations in biometrics such as EDA, heart rate etc. measurement of these biometrics using a handheld device can allow patients to self-monitor and clinicians to detect the early warning signs. The system developed is employing Arduino UNO to interface sensors like temperature sensor (LM35), pulse oximeter (MAX30102), pulse sensor, GSR sensor and LCD.

KEYWORDS: *Mental Health, Skin Resistance, SpO2, Heart Rate, Temperature*

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I. INTRODUCTION

Mental health is a vital aspect of overall well-being, and its significance has gained increasing recognition in recent years. However, mental health issues continue to pose significant challenges worldwide. [3,4] The advent of technology has opened up new opportunities to address these challenges and provide effective support to individuals in managing their mental health. One such technological advancement is the development of mental health monitoring systems.

The introduction of mental health monitoring systems marks a significant step forward in promoting mental well-being and addressing the complexities associated with mental health issues. These systems leverage the power of sensors, data analysis algorithms, and user-friendly interfaces to monitor and analyse various physiological and behavioural parameters that are indicative of an individual's mental health status. By continuously collecting and analysing this data, mental health monitoring systems offer personalized insights, early detection of potential issues, and access to timely interventions. [13,14]

This paper aims to explore the concept of mental health monitoring systems and integration of mental health monitoring systems into existing healthcare frameworks.

By examining the potential of mental health monitoring systems, this paper focused on harnessing technology for the betterment of mental well-being, this research endeavours to pave the way for more effective and accessible support systems for individuals facing mental health challenge.

II. Literature Review:

The following papers were studied and analysed in details and hence summarized in the below table:

Table 1: Paper studied

Reference	Main considered devices	Description
Gravenhorst, F. et al.	smartphones	Overview of how mobile phones can support the treatment of mental disorders
Nicholas, J. et al.	smartphones	A systematic review of android and iOS applications for bipolar disorder
Pantelopoulos, A. and Bourbakis, N.G	wearable sensors	Survey's research and developments on wearable biosensor systems for health monitoring.
Donker, T. et al.	smartphones /tablets	A systematic review of research evidence supporting the efficacy of mental health apps for mobile devices.
Bayndr, L.	smartphones	A survey about using smartphones to detect human behaviour including health related activities like physical exercise and sleeping.
Mohr, D.C. et al.	smartphones and other wearable sensors	A review of personal sensing research related to mental health and a framework to convert raw data into knowledge
Stephens, J. and Allen, J.	smartphones	Systematic review of smartphone applications and text messaging in promoting weight reduction and physical activity
Guntuku, S.C. et al.	social media	A review of recent studies that analyse social media to detect depression and mental illness.
Wang, J. et al.	smartphones	A review of smartphone interventions for long-term chronic condition management including mental health problems.
Huguet, A. et al.	smartphones	Systematic review of self-help apps for people with depression and evaluate those that offer cognitive behavioural therapy or behavioural activation.
Alotaiby, T.N. et al.	electroencephalogram	A survey of seizure detection and prediction challenges and algorithms.
Mosenia A. et al.	wearable sensors	A survey of applications and architecture of wearable medical sensors systems.

Study of papers revealed that currently all the techniques used for monitoring devices are either using single sensor with the IOT or are using two to three sensors mostly heart rate and temperature sensor or GSR sensor which limits the parameter to conduct the diagnosis. These mental health monitoring systems are only compatible with certain sensors, limiting the types of data that can be collected and analysed.

III. Materials and Methods:

The system we are developing is able to transmit the monitored parameters at far places. It employs multiple sensors like HR, Temperature, skin conductance and SpO_2 that presents comprehensive data for person's health.

Main objective of this system is to integrate various sensors to collect data, transmit and being observed/analysed by professionals as and when needed.

A. Block Diagram:

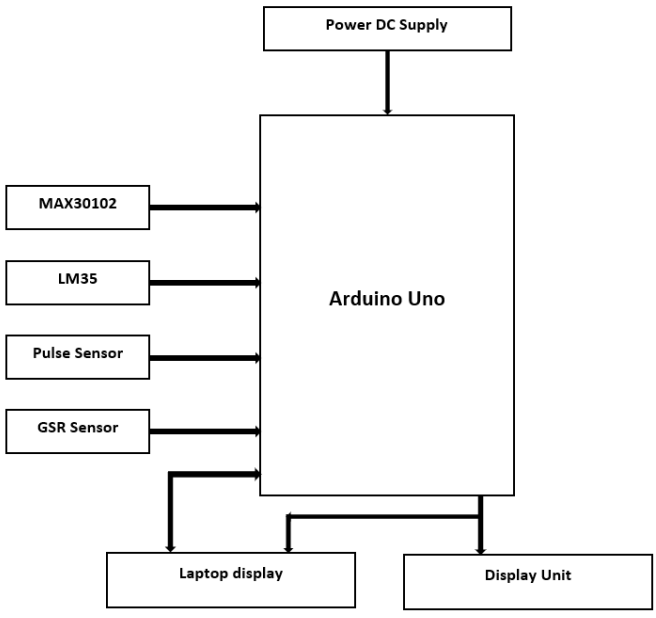

Fig.1: Block diagram

B. Hardware Requirements:

- Arduino Uno
- Temperature Sensor (LM35)

- Pulse Oximeter (MAX30102)
- Pulse Sensor
- Galvanic Skin Resistance Sensor
- Wi-Fi module (ESP8266)
- Liquid Crystal Display (LCD)

C. Hardware Implementation:

Connecting the LM35 Temperature Sensor to an Arduino

Hooking up the LM35 to an Arduino is super simple. You only need to connect three pins: two for power and one for reading the sensor value.

The sensor can be powered from 5V. The positive voltage connects to '+Vs' and ground connects to 'GND'. The middle pin 'Vout' is the analog signal output from the sensor and connects to the A0 analog input of an Arduino.

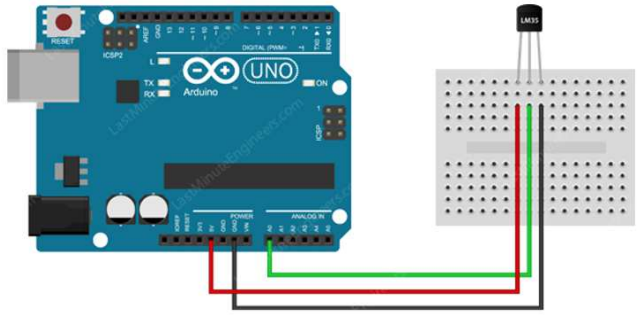

Fig.2: Connection of LM35 with Arduino Uno

Wiring up a MAX30102 Module to an Arduino:

Start by connecting the VCC pin to the power supply, 3V-5V is fine. Use the same voltage that your microcontroller logic is based off of. For most Arduinos, that is

5V. For 3.3V logic devices, use 3.3V. Now connect GND to common ground. Connect the SCL pin to the I2C clock pin and the SDA pin to the I2C data pin on your Arduino. Note that each Arduino Board has different I2C pins which should be connected accordingly. On the Arduino boards with the R3 layout, the SDA (data line) and SCL (clock line) are on the pin headers close to the AREF pin. They are also known as A5 (SCL) and A4 (SDA).

The following illustration shows the wiring:

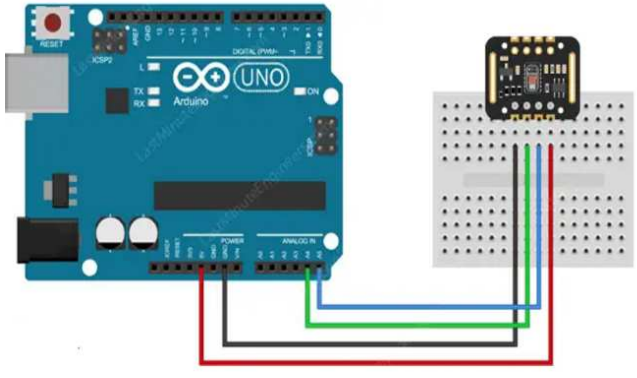

Fig.3: Connection of MAX30102 with Arduino Uno

Wiring a Pulse Sensor to an Arduino:

Connecting the Pulse Sensor to an Arduino is a breeze. You only need to connect three wires: two for power and one for reading the sensor value.

The module can be supplied with either 3.3V or 5V. Positive voltage is connected to '+,' while ground is connected to '-.' The third 'S' wire is the analog signal output from the sensor, which will be connected to the Arduino's A0 analog input.

The following is the wiring diagram for the Pulse Sensor experiments:

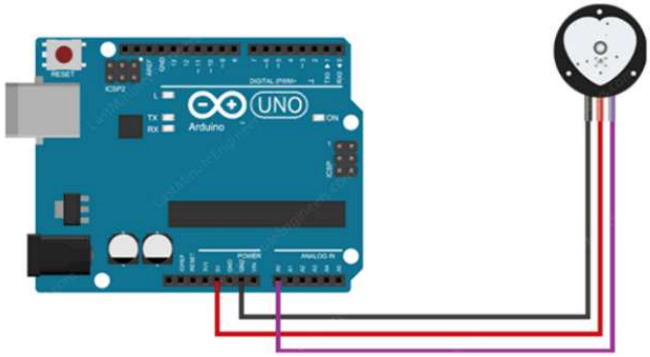

Fig.4: Connection of pulse sensor with Arduino Uno

GSR sensor interfacing:

Following diagram depicts GSR sensor interfacing with Arduino board. Following are the connections between pins of both GSR sensor and arduino board.

Vcc (GSR sensor side) - 5V (Arduino side)

GND – GND

SIG - A0

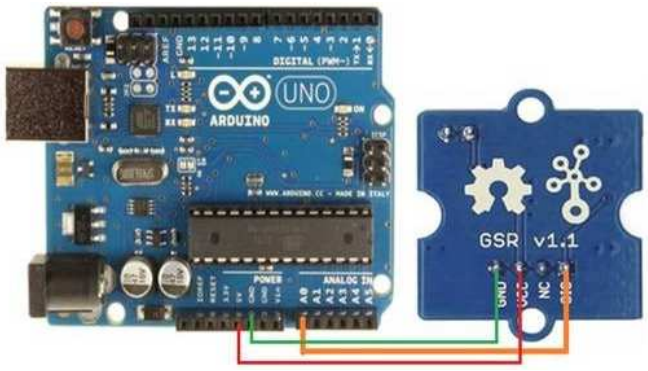

Fig.5: Connection of GSR sensor with Arduino Uno

Wiring a 16×2 Character LCD to an Arduino:

HD44780-based LCDs are designed so that we can communicate with them using only four data pins (in 4-bit mode) rather than eight (in 8-bit mode). This helps us save 4 I/O pins! So, to interface the LCD in 4-bit mode, only six pins are required: RS, EN, D7, D6, D5, and D4. Connect the LCD's four data pins (D4-D7) to digital pins 5 to 2 on the Arduino, the EN pin to digital pin 11, and the RS pin to digital pin 12.

The wiring is shown below.

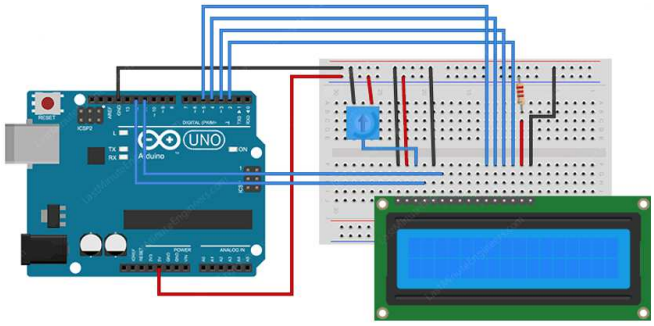

Fig.6: Connection of LCD with Arduino Uno

D. Circuit Design:

In the circuit the signal starts from the sensors which continuously monitors the parameters like heart rate, spO2, temperature, skin resistance and send signal to Arduino through the analog pins of the sensors to Arduino's analog I/O pins which are read by Arduino. Then the monitored data is sent to display through digital Input/output pins of the Arduino. The LCD display's the monitored parameters. Meanwhile all the parameters recorded are also sent to web page through ESP8266 WIFI module so that the mental health professional also check the parameters.

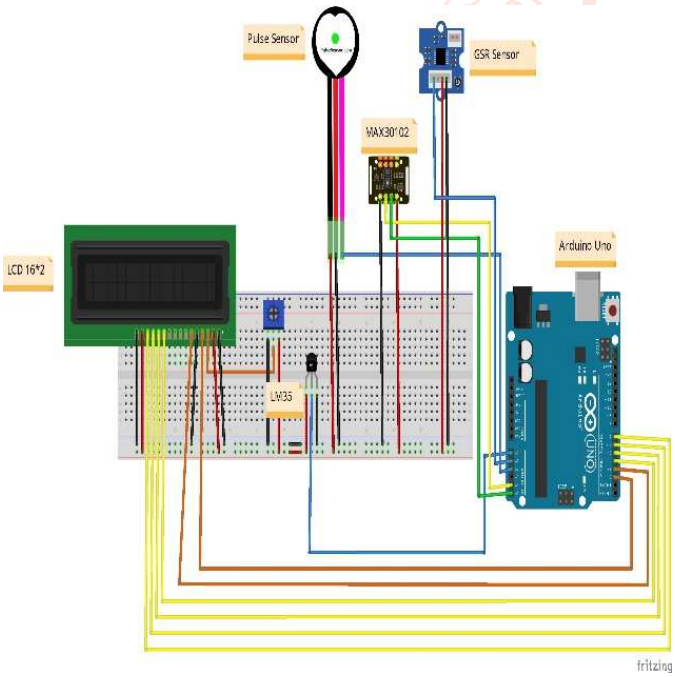

Fig.7: Complete circuit Diagram

E. Flow Chart of Project:

The given flow chart shows the flow of data and signals from sensors till the data displayed on LCD and web page.

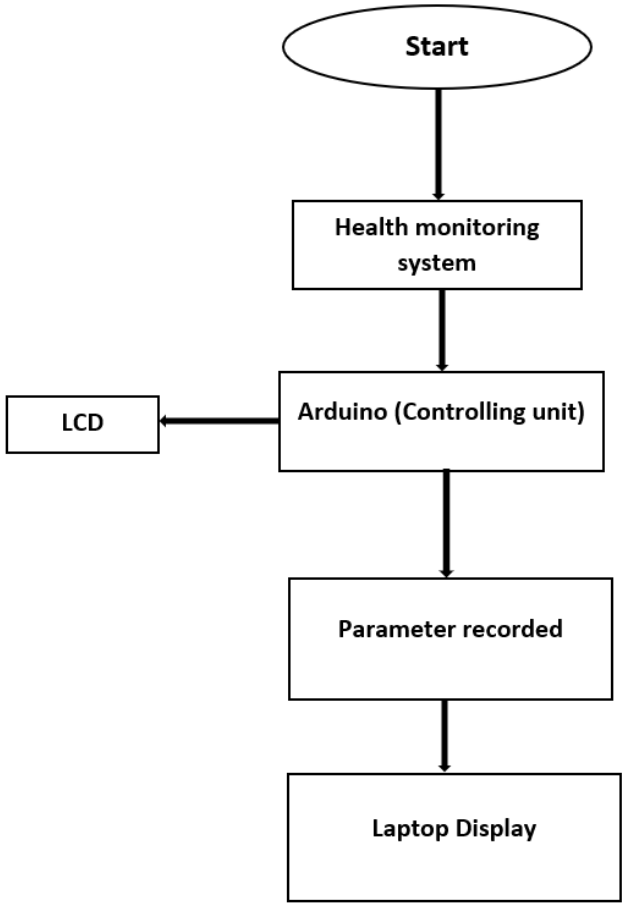

Fig.8: Flow chart of project

IV. Result:

The project is tested by activating the Arduino and all the sensors of the system that is MAX30102, pulse sensor, LM35, GSR sensors. All the components of the project are working in synchronization with each other. The data is recorded by the Arduino in real time. Output is sent to LCD and laptop display and visible in the real time.

Working model after the sensors are put on the finger and the readings over the display showing different parameters.

Fig.9a: working model temperature readings

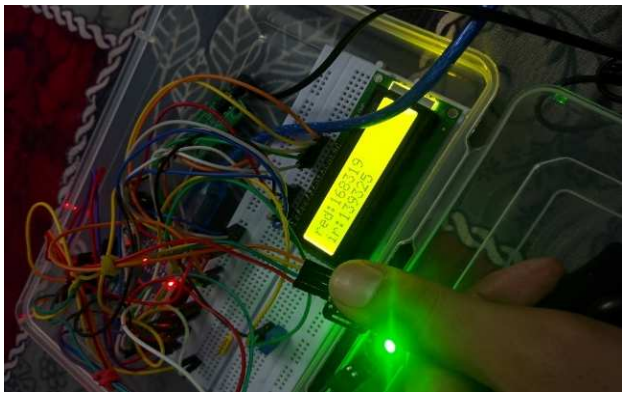

Fig.9b: working model RED and IR readings

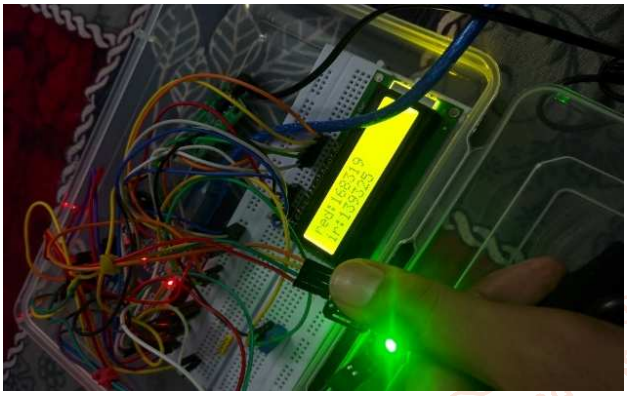

Fig.9c: working model RED and IR readings

The same parameters are displayed on serial monitor of the IDE software:

Fig.10a: working model RED and IR readings on serial monitor

Fig.10b: working model temperature readings on serial monitor

V. Conclusion:

In conclusion, the development of mental health monitoring systems represents a valuable and timely approach to address mental health challenges. By combining technological innovation, personalized interventions, and comprehensive data analysis, these systems have the potential to revolutionize mental health care, improving the well-being and quality of life for individuals facing mental health issues. It is imperative that ongoing research, development, and collaboration continue to advance the field, ensuring that mental health monitoring systems become an integral part of comprehensive mental health care in the future.

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