A Survey of Health by Using IoT-Based Health Monitoring System Using Arduino

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***Abstract*—In this paper an IoT-based health monitoring system is proposed and developed focusing on developing pulse oximeter for measuring parameter like heart rate and oxygen concentration level in our body. All of us seen a covid-19 pandemic which make all of us think about how we can monitor general health parameter and its importance in keep us healthy. In all over world, the price of pulse oximeter raised and its was available in black market with approximately 400 times higher price. After paying that much amount it was not easy to get pulse oximeter. We developed a system which measured the heartbeat as Bpm and Blood oxygen concentration as SpO_2. Along with these two parameters we measured the room temperature and humidity condition to study its impact on heartrate and blood oxygen levels. For studying its impact, we measured this for 200 people and find pattern among those parameters.**

***Keywords*—IoT, Health Monitoring System, Pulse oximeter, Bpm, SpO_2, Heart rate and Blood oxygen concentration.**

I. INTRODUCTION

The ability of hospitals and personal healthcare providers to interact with and obtain information over the Internet has revolutionised many industries, most notably the biomedical sector. As a result, smart systems that offer dependable and easy-to-use care have been developed, negating the need for costly daily health examinations in developing countries. The Online World of the Next Generation allows distant devices to connect to a network and access data, allowing products with Internet of Things capabilities to engage with people and exchange information.

Recently, we all have seen a covid-19 pandemic which make all of us think about how we can monitor general health parameter and its importance in keep us healthy. In all over world, the price of pulse oximeter raised and its was available in black market with approximately 400 times higher price. After paying that much amount it was not easy to get pulse oximeter. By enabling home monitoring, lowering healthcare costs, and preserving patients' freedom, IoT-based patient health monitoring can dramatically enhance patients' quality of life. This technology connects a cloud database system that acts as a server to an Arduino Uno, which is used to monitor various health parameters of patients. Health metrics can be continuously monitored thanks to the data transmission to the receiving system. The World Health Organisation describes this state-of-the-art system that guarantees everyone's fundamental right to the best possible health. The system prevents mortality rates by using sensors to track vital statistics and notify doctors in advance of possible issues.

The Internet of Things (IoT) enables devices to be controlled by other machines and the Internet. As a result, environments that are intelligent, ubiquitous, and constantly connected have been created, making it possible to continuously monitor physiological markers like blood oxygen concentration, heart rate, and temperature. With greater freedom to communicate with digital systems, machines that take over could completely transform how we use technology today. IoT makes pervasive and ubiquitous computing a reality by allowing commonplace objects to interact with people and assist them at every turn, including automobiles, roadways, heart pacemakers, and even cattle.

II. LITERATURE REVIEW

A wearable IoT device for Dotage that is low-power and intended to improve health-related risks while lowering healthcare expenses. Users can save expenses and improve their health thanks to the system's real-time data stream collection, analysis, and sharing capabilities. When limits are exceeded, the system also notifies emergency services and physicians, enabling them to take quicker action. Reducing hospital stays, doctor visits, and diagnostic test procedures is the aim. The intended result is to connect and gather data through IoT devices, such as blood pressure and heart rate, and provide accurate and effective medical care to patients by alerting physicians and emergency services [1].

Remotely monitoring patients' body temperatures and heart rates is currently one of the most urgent needs in healthcare. This will allow for early intervention and help predict illness early on, which will lower the death rate. Temperature and heart rate sensors at the data sensing layer detect the vital signs of a person and send the information to the data processing module's microcontroller for additional processing. The doctor can view the patient's vital signs on Cayenneapp through the data communication layer. The patient's location can be tracked using Google Maps on the mobile app [5].

The study offers an automated, small, wireless, customised, economical, and all-encompassing healthcare system architecture for assessing people's stress levels. To automatically recognise conditions of stress in a mobile setting, the architecture makes use of artificial neural networks, fuzzy logic modelling, and an autoregressive model. Human motion and ECG signals are used by the architecture to assess stress levels. This technology is a technological advance in personal health systems that encourages a move away from symptom-based diagnosis and treatment towards risk assessment. The architecture's efficiency was evaluated based on the classification of stress conditions [4].

In comparison to traditional systems, health monitoring systems offer a more effective and economical solution that is tailored to the demands of the patient. With additional medical equipment facilities on a single chip, thanks to ZigBee, a sensor with a wireless network's size, cost, and complexity has all decreased. This technology is helpful for patients who live far away, as it reduces gadget size and permits everyday use. Health monitoring can greatly benefit from the low-cost deployment of the Programmable Interface Controller (PIC), which records and transmits bio-medical signals [3].

This article suggests a heart rate sensor-based and temperature-remote patient monitoring system. The Arduino Uno, which uses RF24L01 technology to handle the data, is coupled to the heart rate sensor (KY039) and temperature sensor (MLX90614ESF). The patient's range of motion is then improved by utilising an Arduino Uno to display the results on an LCD screen. This system makes use of wireless technologies as well [2].

III. HARDWARE

A. Arduino UNO

The Arduino Uno R3 is a microcontroller board with 20 digital I/O pins, six of which are for PWM outputs and six for analogue inputs. It contains an Arduino computer programme that is simple to use and is based on a detachable ATmega328 AVR microprocessor. The most recent iteration of the Arduino Uno, the R3, has a large support community and provides an easy approach to interacting with embedded electronics.

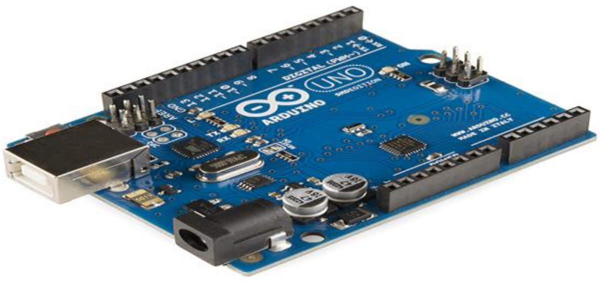

Fig. 1 Arduino UNO R3 Hardware

B. MAX30100 Sensor

Modern integrated heart rate sensors and pulse oximeters are available from Analog Devices in the MAX30100 design. Pulse oximetry and heart rate signals are detected by combining two LEDs, a photodetector, optimised optics, and low-noise analogue signal processing technologies. On the left side of the module is a sensitive photodetector, and on the right side are RED and IR LEDs. The module detects blood oxygen level and heart rate by illuminating a single LED at a time.

Fig. 2 Pulse Oximeter (MAX30100) Sensor

C. DHT 11 Sensor

The humidity and temperature readings from the DHT11 sensor are used by HVAC systems and weather stations to forecast the weather, which is especially useful for residences where humidity levels are high.

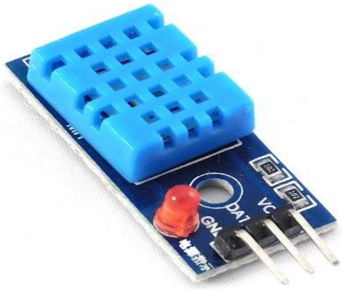

Fig. 3 DHT 11 Temperature and Humidity Sensor

D. ESP8666-01

The ESP8266 is an 802.11b/g/n HT40 transceiver-equipped low-cost Wi-Fi microcontroller that can establish its own wireless network or connect to one to access the internet. Its four GPIOs allow for peripheral control, and its 1MB of memory in flash allows it to fit into any container. Use one of the prior boards for projects that call for additional peripherals.

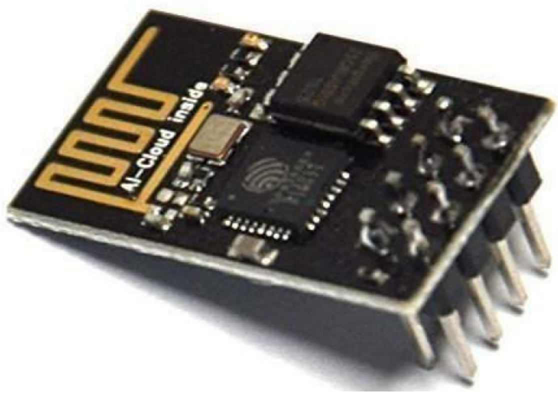

Fig. 4 ESP8266-01 Wi-Fi Module

E. LCD display

To display Arduino data, the Serial Monitor is a helpful tool, but it needs a lot of pins. Instead, think about utilising liquid crystal displays (LCDs) to make your idea portable. These displays use half of the digital I/O pins available on the Arduino, but they may show a string of text or sensor data. You can share an I2C LCD display with other I2C devices, and it just requires two I/O pins.

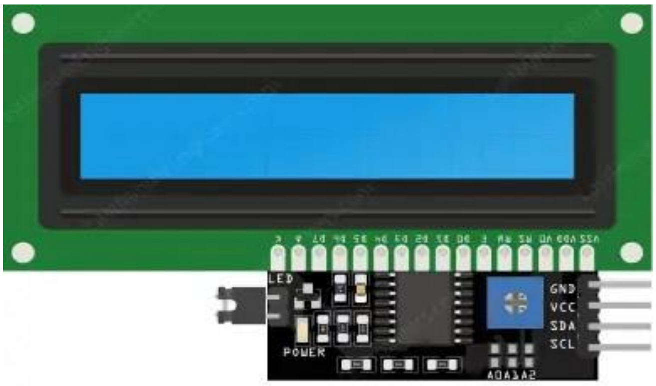

Fig. 5 I2C LCD display

IV. METHODOLOGY

A. Flowchart

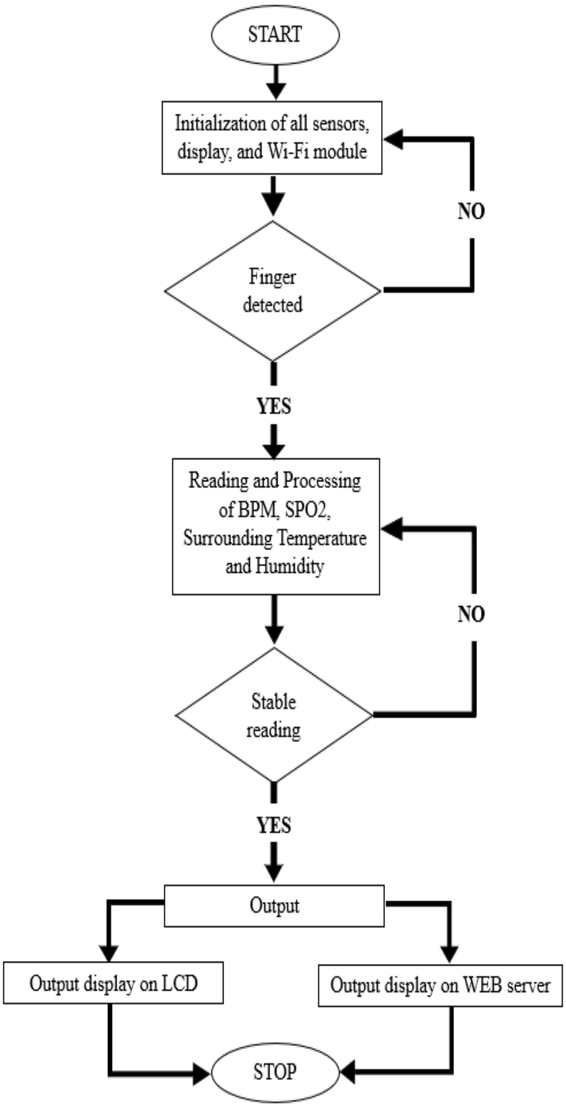

Fig. 6 Flowchart of Proposed System

Intialise all sensor by providing vcc (5v) to the all sensors and lcd display, 3.3v for ESP82666-01 wifi module and grounding all of them. Place the finger on IR led blinking in MAX30100 sensor. It will detect your finger and after that it will provide a stable reading. If not detected finger or providing stable reading replace your finger with a sligtl touch not pressing on that.

B. Block daigram

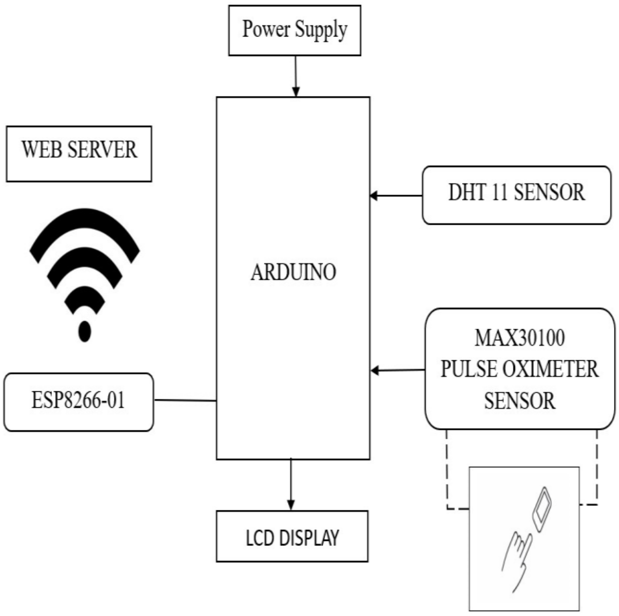

Fig. 7 Block diagram of proposed System

In our project we are going to connect our our sensors and lcd display and esp8266-01 wifi module in the above pattern as per mentioned in block daigram figure and place your finger on blinking light in MAX301000 sensor. Slightly touch on that don’t press them. It will give you reading on serial monitor, lcd display and cloud server. On cloud server record of a person can be kept for analysing his health pattern and providing him better treatment or a person is in remote area can consult on call and send him cloud server record by providing credentials. On the basis of that a doctor can advise and prescribe him.

V. RESULTS

Based on available data, a variety of factors seem to influence health indicators, including gender, weight, temperature, and humidity. Understanding these linkages is necessary to develop a comprehensive health monitoring system. One may evaluate an individual's general health by using the recognized healthy Bpm and SpO_2 values as a point of reference. The research also highlights how important it is to include environmental elements when assessing health and how timing drug delivery may affect various health metrics.
According to the data analysis report of the project survey Average of Bpm of female is greater than male. Whereas Average of SpO_2 of female is lower than male. The above analysis proves the hemoglobin in female is lower in compare of male and it is directly responsible for SpO_2 percentage in body.

A. Bpm and SpO₂ by Sex

The analysis output depicts that the Environment has direct impact on our health parameters such as Bpm and SpO_2. A person who is in the ground has more Bpm and SpO_2 in comparison to a person inside the room at that time of period.

'Bpm' and 'Spo2' by 'Sex'

Sex	Average of Bpm	Average of Spo2
F	86.0728571	94.5238095
M	83.0163303	94.9357798
Grand Total	**83.5100769**	**94.8692308**

Fig. 8 Average of Bpm and SpO_2 by Sex

B. Bpm and SpO₂ by Environment

The below analysis output is depicting that the Environment has direct impact on our health parameter such as Bpm and SpO_2. A person who is in the ground has more Bpm and SpO_2 in comparison to a person inside the room at

'Bpm' and 'Spo2' by 'Environment'

Environment	Average of Bpm	Average of Spo2
GROUND	101.0225	95.1666667
INSIDE ROOM	81.7291525	94.8389831
Grand Total	**83.5100769**	**94.8692308**

that time of period.

Fig. 9 Average of Bpm and SpO_2 by Environment

C. Bpm and SpO₂ by Weight

From the survey analysis output, it can be stated that there is inverse relation in between weight and Bpm but the SpO_2 has not any kind of impact of weight of person.

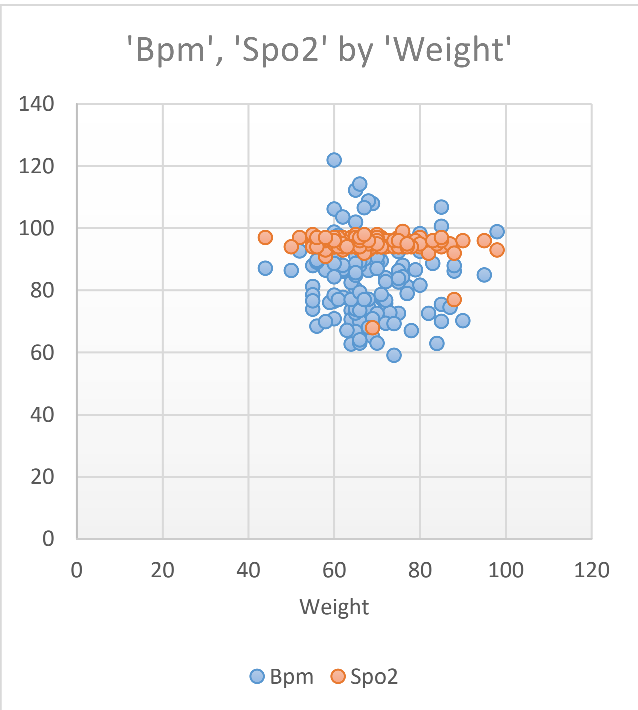

Fig. 10 Bpm and SpO_2 by Weight

D. Frequency Of Bpm

The following two outputs represent the frequency of Bpm and SpO_2 by the bar graph out in given sample size. What is the frequency of getting a particular range if bpm or SpO_2 in Survey conducted.

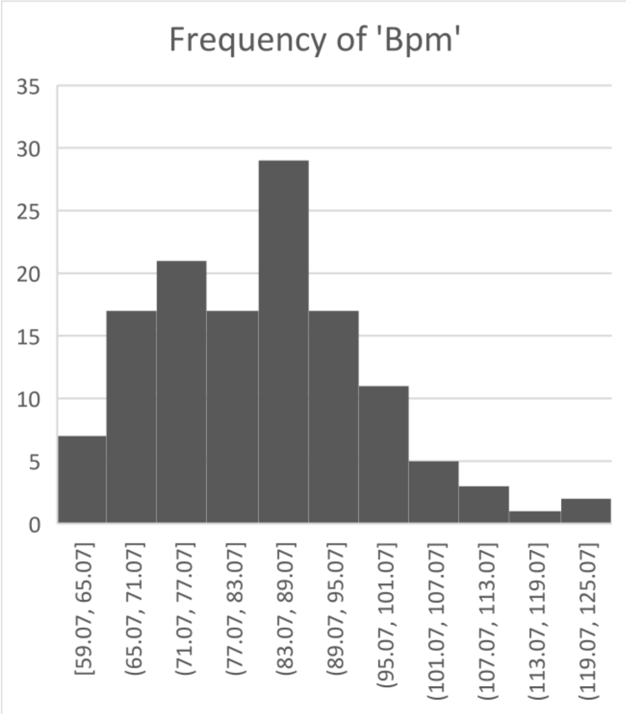

Fig. 11 Frequency of Bpm

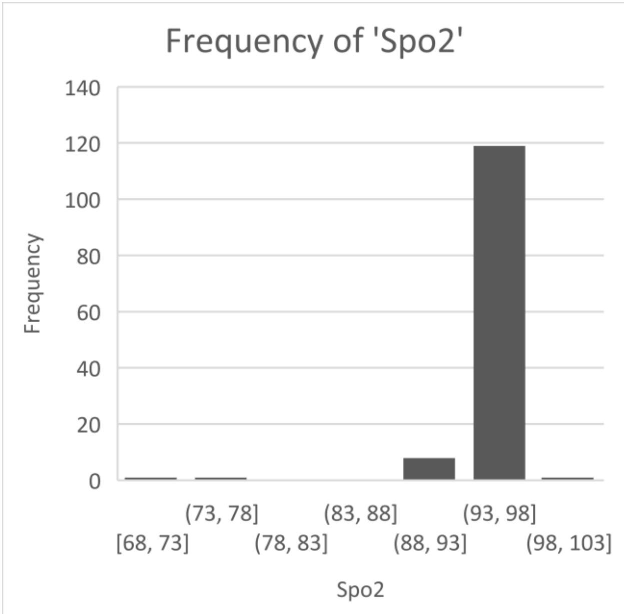

Fig. 12 Frequency of SpO_2

E. Temp by Bpm

Below graphical output is depicting the relation of Temperature with the result of Bpm obtained. If the Temperature is increased, then the Bpm will also increase. This shows the direct relation between these two parameters.

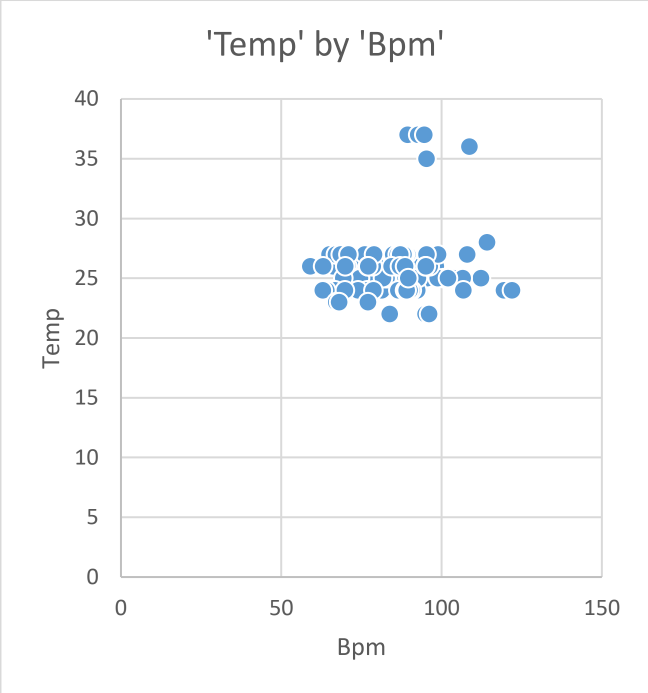

Fig. 13 Temperature by Bpm

F. Humidity By SpO_2

This below graphical output depicts the relation of humidity with the result of SpO_2 obtained. If the humidity is increased, then the SpO_2 will also increase. This shows the direct relation between these two parameters.

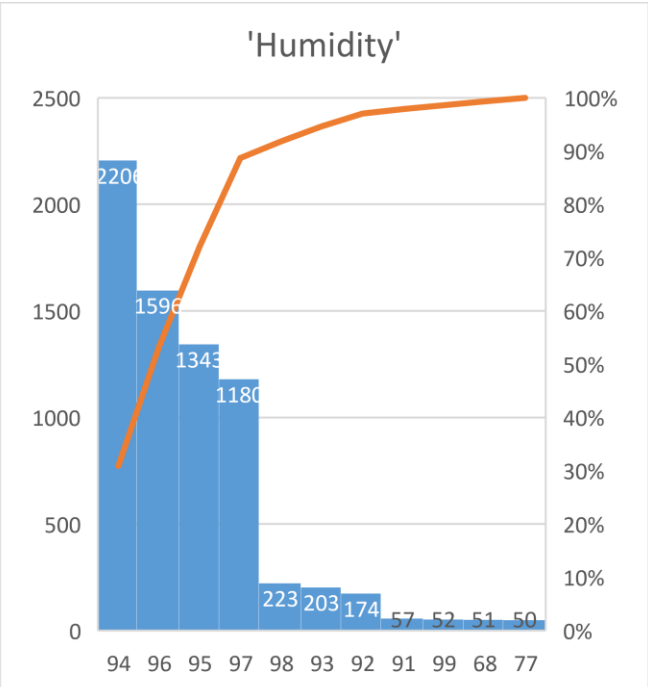

Fig. 14 Humidity by SpO_2

G. Working Model

In the below figure we can see a person is measuring his Bpm and SpO_2 and the same time atmospheric temperature and humidity is also measured for stating the environmental impact on Bpm and SpO_2. This result is shown on lcd display also.

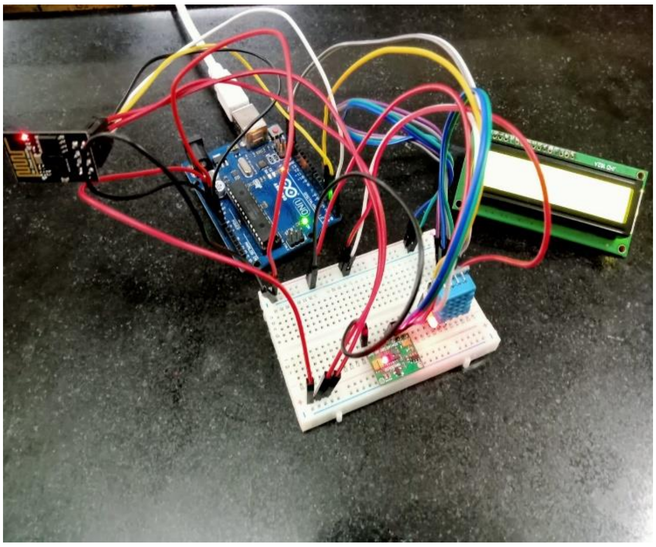

Fig. 15 Working model Hardware

The project's goal is to use Arduino to develop an Internet of Things (IoT)-based health monitoring system that can concurrently measure humidity, air temperature, beats per minute (Bpm), and SpO_2. The system connects a 16x2 LCD display, a DHT11 sensor, and a MAX30100 sensor via an Arduino GND and 5V pin. The LCD display and MAX30100 are attached to the Arduino via their SDA and SCL pins. The D4 (Digital pin 4) pin is linked to the output pin of the DHT11 sensor. Next, the web server and LCD display show the data from the DHT11 (temperature and humidity) sensor and the pulse oximeter MAX30100 sensor.

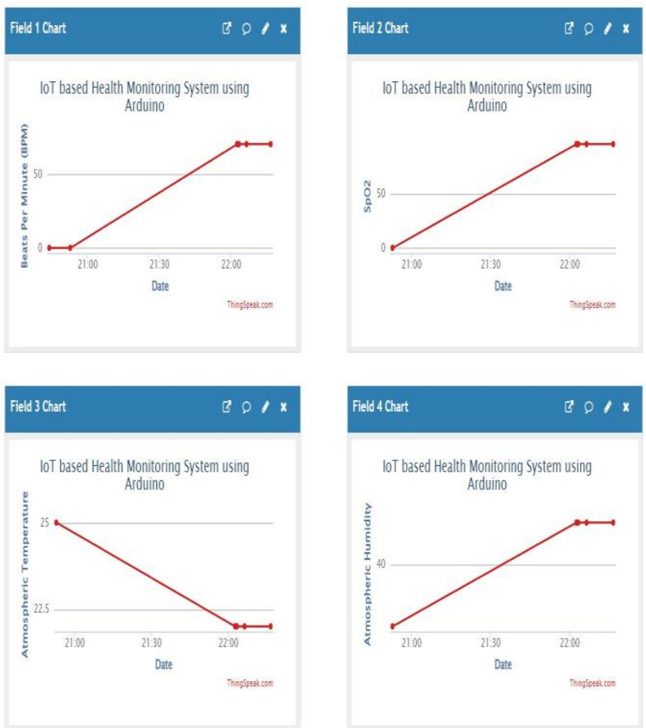

Fig. 16 Data uploaded on Thingspeak Server

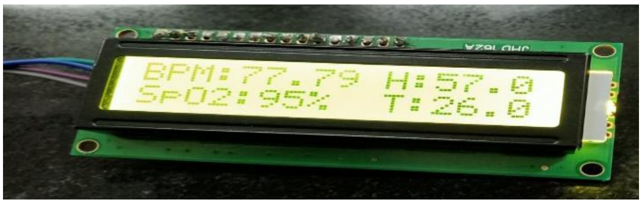

Fig. 17 Reading on LCD display

VI. Conclusion

The research shows that a number of variables, including gender, weight, temperature, and humidity, affect health markers like SpO_2 and Bpm. Comprehending these connections is essential to creating an all-encompassing health monitoring system. The study also highlights how important it is to include environmental factors when evaluating health and how different health indicators may be impacted by the timing of medicine administration. There is a clear correlation between haemoglobin levels and body SpO_2 percentage, as evidenced by the study's findings that females had greater Bpm and SpO_2 values than males. Health indicators are also directly impacted by the environment; people who are outside have higher blood pressure and oxygen saturation levels than people who are indoors. Additionally, the study demonstrated a clear correlation between temperature and Bpm, with higher temperatures causing higher SpO_2 and Bpm.

Acknowledgment

We would like to express our deepest gratitude to all the individuals who have supported and contributed to the successful completion of this college project.

First and foremost, I am immensely grateful to my supervisor Parveen Badoni, Assistant Professor for their guidance, expertise, and valuable insights throughout the project. Their continuous encouragement and constructive feedback have been instrumental in shaping the direction and quality of this work.

We extend my heartfelt thanks to the faculty members of Computer Science and Engineering at Chandigarh University for their commitment to excellence in education and for providing a conducive learning environment. Their extensive knowledge and passion for the subject matter have been a constant source of inspiration.

Although it is not possible to name everyone individually, I sincerely appreciate the contributions of all those who have played a role, no matter how big or small, in the completion of this project. Thank you all for your valuable support and encouragement.

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