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Iot Based Employee's Health And Social Distance Monitoring System

[1]Joel Livin A, [2]Reem Hamood Salim Masaaod Al-Aameriya, [3]Abrar Fayal Salim Hamed Al Kasbi [4]Zainab Salim Nasser Hamood Al Riyami

[1]Lecturer, [2]Student, [3]Student, [4]Student,
[1]Engineering Department,
[1]University of Technology and Applied Sciences, Ibra, Sultanate of Oman

Abstract: In the current pandemic situation, ensuring the health and safety of employees in industries is a major concern for organizations. The smooth operation of industries depends on human resources, and the spread of Covid-19 within a workplace can lead to significant losses for the organization. When employees get infected with Covid-19, the organization has to operate with fewer workers, impacting overall productivity. It's crucial to consistently monitor social distancing and health parameters of employees to prevent further spread of the Covid-19 virus. In this proposed project, we aim to create a smart health monitoring system using Internet of Things (IoT) technology. The system involves using RFID and cloud monitoring to maintain social distance and keep track of various health parameters. We also suggest incorporating wearable devices to monitor important health metrics like body temperature, heart rate, position, and SpO2 of workers. These devices will alert workers if social distancing is not maintained. The system is designed to detect any abnormalities in health parameters and notify authorities about such conditions. Thus the proposed system offers smart health monitoring solutions to industries, helping to prevent the spread of Covid-19 and sustain productivity.

Index Terms **- Covid 19,Social Distance Monitoring, employee health monitoring, IoT.**

I. INTRODUCTION

The COVID-19 pandemic, which has killed some 500,000 people and affected millions more, was brought on by the novel coronavirus chain SARS-CoV-2 [10]. WHO (World Health Organization) is urging governments all over the world to set up proper surveillance and identify sick individuals in order to lessen the severity of the COVID-19 pandemic's consequences [11]. A web source claims that the community's irresponsible members, particularly those who disregarded social distance, are to be blamed for the unexpected rise in virus cases in the area. Most of the industries and organizations suffer heavy loss during this pandemic situation due to the fact that, the number of employees working is reduced to avoid the spread of covid-19. In order to maximize the production in the industries that can be done through human resources during this pandemic time, modern days technology can be greater helpful. The major factors that lead to the spread of the virus is noncompliance with social distancing guidelines and ignoring the symptoms of the infections and mingling with others. When industries start adapting the technological tools to monitor the social distancing among the employees and their vital health parameters such as temperature, blood oxygen level, pulse rate and etc., it will lead to fearless environment for the employees to deliver their work as assigned.

II. LITERATURE STUDY

An IoT-based smart health monitoring system has been designed and implemented for COVID-19 patients [1]. The system monitors vital signs such as body temperature, blood oxygen levels, heart rate, and electrocardiogram (ECG) [2]. The real-time data is uploaded to a server for remote monitoring via Wi-Fi or a GSM modem [3]. An emergency alert system is implemented to notify health experts and patients in case of abnormal health data [4]. The system also includes a health data analyzing system to identify critical patients who need special attention [5]. Another IoT-based system utilizes body temperature, pulse rate, and oxygen saturation measurements for real-time health monitoring of COVID-19 patients . The system displays the measured values on an LCD and can be synchronized with a mobile application for instant access . The proposed system has been tested and verified for accuracy . A smart health monitoring system using IoT technology is being developed to monitor blood pressure, heart rate, oxygen level, and temperature . The system alerts physicians or doctors if any changes occur in a patient's health based on standard values . Additionally, a smart health monitoring system using IoT has been designed to monitor COVID-19 patients' vital signs, including blood oxygen saturation level . The system sends immediate warnings to family members, doctors, and hospitals if the blood oxygen saturation level drops.

IoT-based remote health monitoring systems have the potential to play a crucial role in social distance and health monitoring. These systems utilize wireless sensor networks (WSNs) and wearable body area networks (WBANs) to measure important health parameters such as temperature, heartbeat, pulse rate, and pressure level remotely [6]. Motion tracking sensors, such as MEMS sensors, are used to monitor the physical state of patients when they are alone, and immediate medical assistance can be sent if there is a lack of response to physical movements [7]. These sensor values are recorded to a medical server using wireless communication in the cloud, allowing medical practitioners to view and analyze their patients' conditions [8]. Additionally, IoT-based remote health monitoring systems can provide real-time data to doctors and family members through the internet, enabling them to monitor patients in remote areas and make informed medical decisions [9].

Globally, there is an issue with COVID-19 monitoring due to a lack of healthcare infrastructure. Our strategy is to stop the spread of Covid-19 and maintain a secure environment by monitoring data from IoT sensor devices. The concept of wearable health monitoring devices and the BLE for social distance monitoring can be combined to provide a safe and healthy environment for the workers to perform their duties without fear, eradicating the fear that the COVID-19 triggered among the employees in an organization. Our device is designed for use in industries, where it might be used to gauge and keep an eye on things like temperature, heartbeat, and pulse rate.

III. PROBLEM STATEMENT

The Covid-19 virus shattered the entire world in terms of human loss, shutdown of many companies, job loss and the economy of many countries for the past 2 years. People are afraid of its effect and it affects different people differently. In a production company, if a person who is responsible for a main unit of its operation, and he is affected by the covid-19 virus, the entire operation of the company may be halted and it leads to less productivity. When the spread of this virus is more among the employees in a firm, then then firm will be forced to shut down until the complete recovery of the employees. This situation will cost them in terms of delay in completion of projects, less productivity, and thereby low revenue generation which may lead the firm not able to pay the salaries. In order to reduce this impact on the industries, the spread of covid-19 virus must be controlled by adhering to the guidelines set by the Government authorities. Many times, the workers are not following the social distance among fellow workers due the nature of work. Also, the health conditions of the employees must be continuously monitored so that, we can take preventive action if any abnormalities present in their health conditions. To make the monitoring process easier, we propose an IoT based system which will automatically monitor the movement of the workers insider the work premises and alert them if any social distance violation is done, and the health condition of them will be continuously monitored and recorded in cloud storage for taking precautionary steps towards identify the infected persons, and isolating them from others.

IV. OBJECTIVES OF PROPOSED WORK

The main objective of the work is to monitor the social distancing among employees in an organization and monitor their health conditions by continuously sensing health parameters such as temperature, heart rate, Blood Oxygen Level (SpO2) and position through cloud server with the help of electronic sensors. The following are the goals of the proposed work to achieve the objective

- To integrate RF ID based social distance sensing device to the appropriate Arduino based microcontroller to detect the social distance violation.

- To continuously monitor the health conditions of the employee while working with the help of temperature sensors, heart rate sensors, position sensors and SpO2 sensors.
- To program ESP8266 based Wi-Fi connectivity to send all these data to the cloud sever to record and analysis purposes.
- To enable the Arduino platform with Bluetooth and alert mechanism to instantly alert the worker not to violate the social distancing in the workplace.

The proposed work will help the industries to improve the rate of recovery from the revenue loss and other human resource related problems caused by the recent covid-19 outbreak by providing fearless and safe environment for the workers to actively participate in industrial functioning. It involves various electronic sensors and controlling equipment, academically it has huge potential that the students can explore engineering principles and its applications. It involves most of Electronics and Telecommunication and computer engineering concepts, the students specialized in those fields can develop their skills relevantly during the implementation phase of the proposal. The concept of emerging technologies like Internet of Things and Cloud server for monitoring and alerting. It's imperative to say that the scientific and the innovative idea behind the proposal will significantly have a positive impact on the recovery of industries during the pandemic in Oman.

V. METHODOLOGY

The proposed method uses the Arduino microcontroller platform for all of its operation and signal processing. The entire model can be separated into three sections. The first section includes all the sensors which are needed to observe the parameters from the employees and sends to Arduino based microcontroller. The second section contains a Arduino based microcontroller which integrated with a LCD display and a buzzer. This acts as a local alert system inside the work place. The third section deals with the data collection and plotting. The cloud-based storage and analysis tools such as things speak, firebase, blynk server etc., used for data interpretation and analysis.

Block diagram

Figure 1 shows the entire process of the proposed system. The heart of the proposed system is Arduino Uno board with its microcontroller. It is following 3 phases of work flow in its operation. The digital and analog data which are collected by the sensors are sent to the Arduino Uno. The Arduino Uno which is attached with the employee's body is connected with Bluetooth and Wi-Fi modules which are acting as the gateway for sending the processed data to the local alert system and to the cloud server. The local alert system is another Arduino uno based module which is integrated with an LCD display and a alarm device to display and make alarm locally. This section is connected with the employee's module through Bluetooth device.

The cloud access section serves as a cloud storage and visualization tool for the proposed model. It enables the model to be called as IoT(Internet of things) since the entire model is following the 3-layer structure of IoT such as data sensing, data processing and data visualization. The following sections discuss with technical and interfacing details of all components involved in the proposed model.

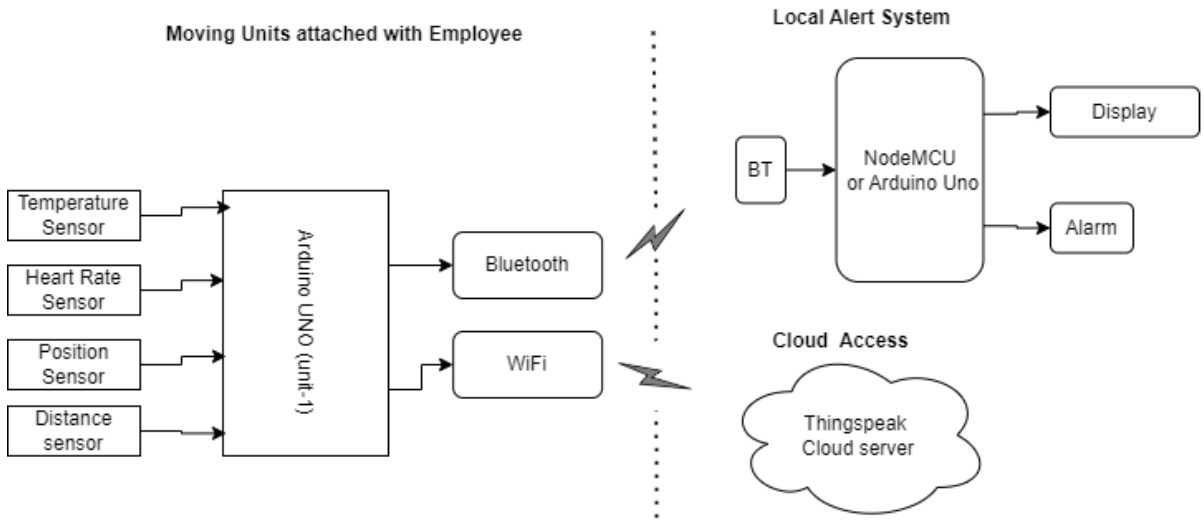


Figure 1

Wearable Unit section

The sensors which are connected to the Arduino and it has to be compacted to be wearable by the worker while working in the workspace. This unit of the proposed is considered to be movable and it will be appropriately mounted on the body of the employee of the organization. There are seven different kinds of sensors are connected to Arduino Uno as shown in Fig 2. The interfacing of all these sensors is made with help of an open-source software called as Fritzing.

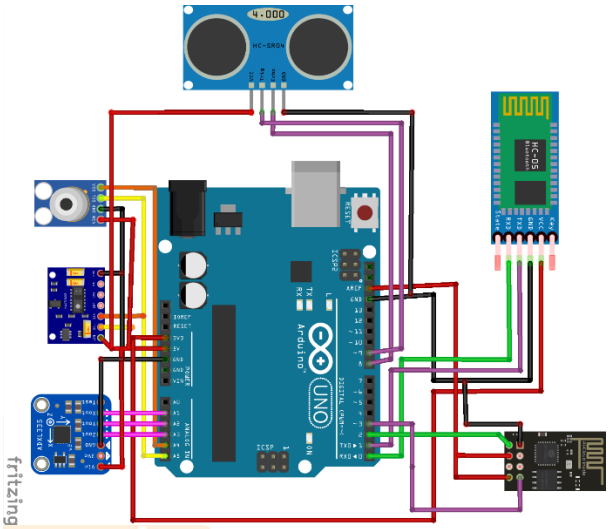


Figure 2

In order to measure the body temperature of the person, we use MLX90614 which is an infrared based contactless sensor. It can measure the temperature without touching it which is an important factor towards prevention of the spread of covid-19 virus. It uses IR radiations to measure the temperature and provides digital output through a I2C port. can measure the temperature of a particular object between -70°C – 382.2°C and an ambient temperature of -40°C – 125°C without even making physical contact with an object under observation. Its interface with Arduino is shown in Figure 3.2 and the operating power supply is 5V.

MAX30102 pulse oximeter and heart rate sensor is being used to measure the heart rate of the person and the blood oxygen level (SpO2). This module has 7 pins namely Vcc,SCL,SDA,INT,RD,IRD and GND. All the pins are digital . Vcc can be connected 3.3V . The SCL and SDA pins are connected to the A5 and A4 pins of the Arduini Uno respectively.

ADXL335 is an accelerometer which is used to know the position of a person whether he is standing or lying on the floor. Bases on the acceleration measured in x, y and z directions, we can decide a person is standing or not. It's a five-pin device and it operates at 5V. x_out,y_out,z_out of the device are connected to the A1,A2,A3 pins of the Arduino Uno respectively.

The ultrasonic sensor is used to measure the distance between the person and another object which is coming closer to him. This is used to identify any social distance violations by the employee. HC-SR04 is an ultrasonic based device used in this work. It works on the same principle of a radar system. It has 4 pins and 5V is given to the Vcc pin of it. The ECHO and TRIG pins are connected to the D8 and D9 pins of the Arduino Uno board as shown in Figure 3.2.

ESP8266 -01 and HC-05 are called as Wi-Fi and Bluetooth modules respectively which are essential in the proposed work to send the data wirelessly to the cloud server and to the local alert system. They act as a data gateway of the entire model. ESP8266 is a SoC (System on Chip) type of device which uses UART port to communicate with the microcontroller. It has 8 pins in it. It operates on 3.3V. The TX pin and RX pin are connected to the pin 2 and pin 3 respectively which are defined by software for serial communication. CH_PD pin of the ESP8266-01 is connected along with the power supply pin of the Arduino Uno.

Local Alert section

Whenever the guidelines of the social distancing are violated by any person in the workspace, the situation will be detected by the wearable unit and sent to the local alert system to make alarm sound and to display the name of the person who violates the rules. Figure 3.3 shows the local alert module which has 3 electronic devices connected to it. This unit is also based on a Arduino Uno board and it uses HC-05, LCD display and a buzzer.

The Bluetooth module Hc-05 is used to receive the alert message from the wearable unit wirelessly with the identify of social distance violator. HC-05 has active 4 pins and it operates on 5V power supply. The TX of the device is connected to the D0 of the Arduino Uno and RX of HC-05 is connected to D1 of Arduino Uno through a voltage divider circuit in order to provide a voltage of 3.3V.

The LCD interfacing with Arduino Uno is simplified with the use of I2C module. It greatly reduces the number of pins of required to be connected to Arduino Uno. It has Vcc, SCL, SDA and GND which are connected to the Arduino Uno board appropriately as shown in Figure 3. The buzzer is a simple electronic device used to make alarm to alert the people about the violation.

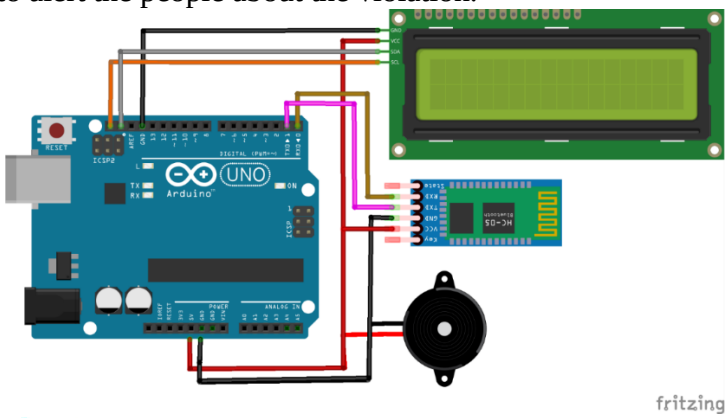
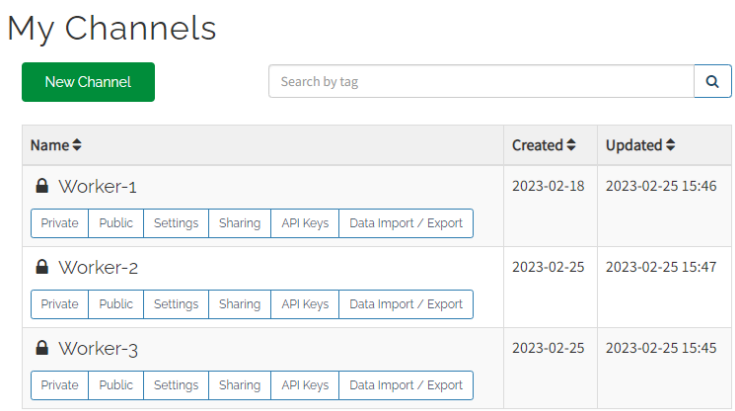


Figure 3

Cloud Access Section

This section acts as a IoT part of the proposed system which collects all the sensor data sent through the Wi-Fi module from the wearable unit. We use ThingSpeak IoT analytics platform service to aggregate, visualize, and analyse the live data streams. It requires an account to be opened with its official website which is offered for free for a limited use. Upon opening an account it allows us to create multiple channels for live data visualization purpose. In order to demonstrate our prototype we created 3 channels with worker-1, worker-2,worker-3 as shown in Figure 4. Different health monitoring parameters from the wearable unit are collected and visualized in separate fields under each channel assigned to each worker. The Figure 5 shows the various fields indicating different parameters of worker -1. Each channel will be identified by a Channel ID as stroked in the same Figure. Figure 4



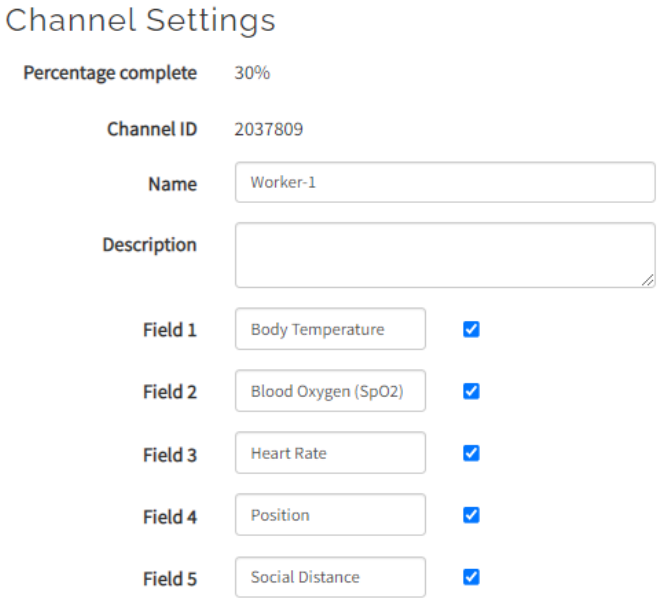


Figure 5

VI. WORKING PRINCIPLE

The flow of operation of the entire proposed system is depicted in the flow chart shown in Figure 6. The Arduino Uno with the wearable unit and the local alert system established connection with each other through Bluetooth module in the same time, the wearable module also makes connection with the cloud server through Wi-Fi module. The ultrasonic sensor always monitors the distance with the neighboring objects and if any object is detected nearby the wearable unit, it sends an alert message to the local alert system and thereby it activates the buzzer in the local alert system. Meanwhile the other sensors in the wearable unit collects the health parameters from the worker and continuously sending to the cloud server through Wi-Fi module. In the cloud server, the data has been recorded and plotted for data interpretation. If there is any abnormality is found, the alert message shall be given to the concern authorities.

The flowchart describes the operation of a single unit wearable by each worker in an organization. The local alert system is facilitated by an LCD and a buzzer to display the alert message as soon as it is sent from the wearable unit.

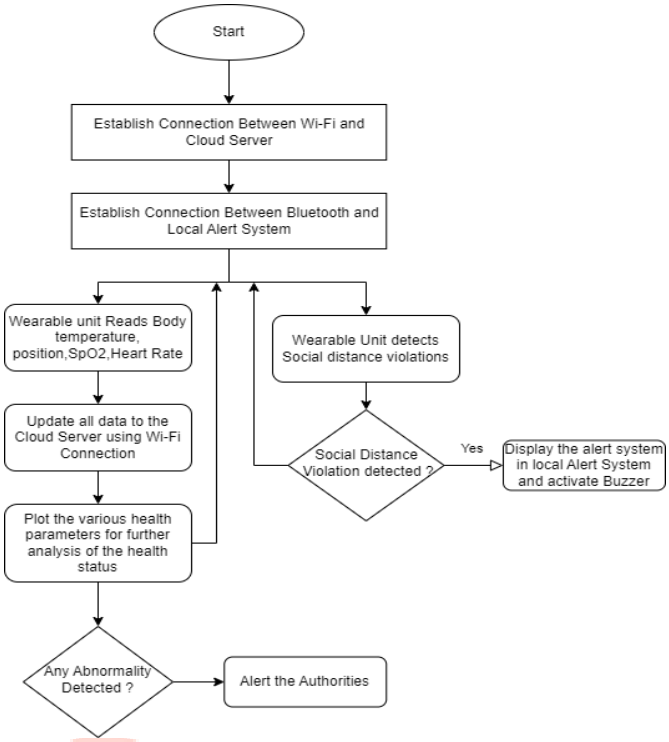


Figure 6

VII. RESULTS

The program for interfacing of all the sensors in the wearable unit as well as the local alert system was done with the help of Arduino IDE which is an software to be installed in a computer. Its expansion is integrated development environment. Initially all the sensors are interfaced with Arduino Uno and checked for working conditions. The results of each sensor are plotted with the help of serial plotter in Arduino IDE.

Serial Plotter and Monitor outputs

The Arduino program is developed Individually and tested for their results and accuracy. The necessary library files have been installed from the developers or manufacturers of the respective sensor used. We used serial plotter and serial monitor tools of Arduino IDE to visualize and read the values observed by the sensors.

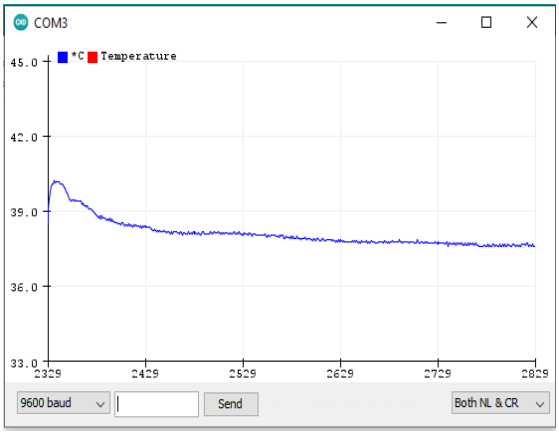


Figure 7

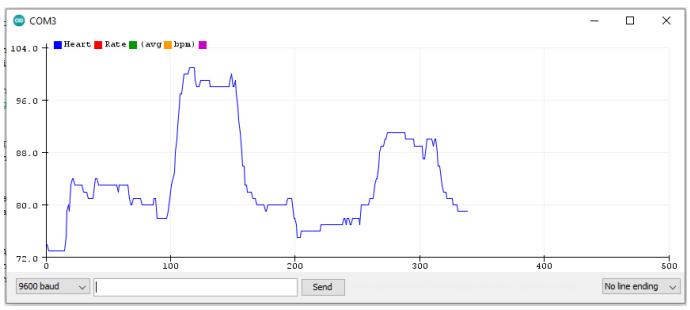


Figure 8

Figure 7 shows the temperature values measured by the MLX90614 temperature sensor and it is plotted with the help of serial plotter. Any temperature variation in the workers will reflect in the serial monitor and it will be sent to could server without much delay. Max30102 is used to measure the heartrate and blood oxygen

level of the worker. This sensor uses clock signal from Arduino Uno. All sensors which require clock signal for their operation can be connected to Arduino in parallel provided their addresses are not conflicting with each other. Figure 8 shows the serial plotter results and Figure 9 shows the serial monitor results.

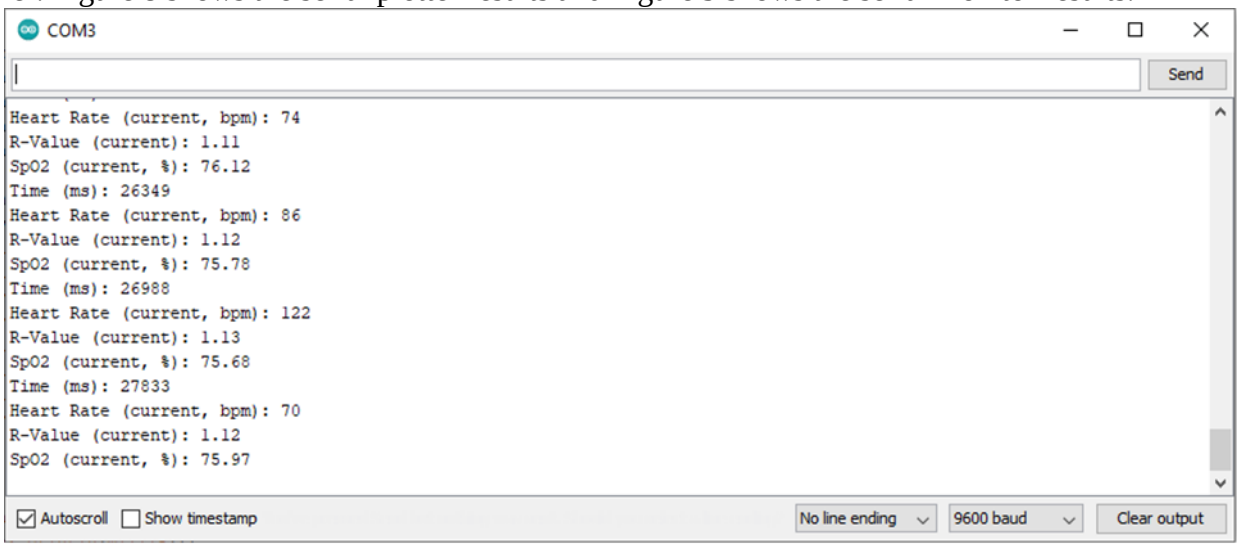


Figure 9

ADXL335 sensor is a motion and tilt sensing device which measures the pitch roll values of an object when it is in moving or tilting. If this device is attached with a person and he is lying on the floor, the pitch and roll will drastically change in opposite directions. Based on this , the position of the person can be detected. In this work, this sensor is used to sense if the person is standing or lying on the floor. Figure 9 shows the serial monitor results of the values obtained through this sensor.

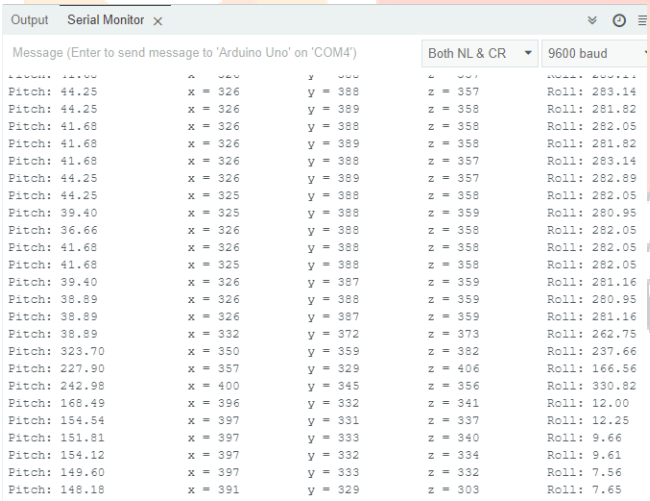


Figure 10

Results in ThingSpeak

The health parameters such as body temperature, heart rate, SpO2, position of a person working in an industry are sensed by the different type of sensors connected with the Arduino Uno. With the help of ESP8266, the Wi-Fi module is responsible for sending all data to the cloud server through an internet connection. In the ThingSpeak, 3 channels were created and each of them is linked with each of the workers under observation in the work place. The wearable unit of the proposed is worn by the workers and their live data are transmitted to the remote server and the respective data is plotted on the respective fields assigned to each parameter under each channel. Filed1,2,3,4 in each channel are assigned to receive and plot body temperature, Heart Rate, Blood Oxygen Level, and position respectively. Figure 11 shows the plotted data of worker-1. The temperature value falls between 34^{o}F to 38^{o}F. The heart rate in BPM is ranging between 76 to 92. The blood oxygen level is ranging from 90 to 99. The position values are either low or high. Low indicated that the person is lying on the floor whereas the high value indicates the person is standing. Figure 4.6 and Figure 12 show the plotted data of worker-2 and worker-3. The dummy data has been generated from the Arduino Uno and they were plotted for checking the operation of the prototype.

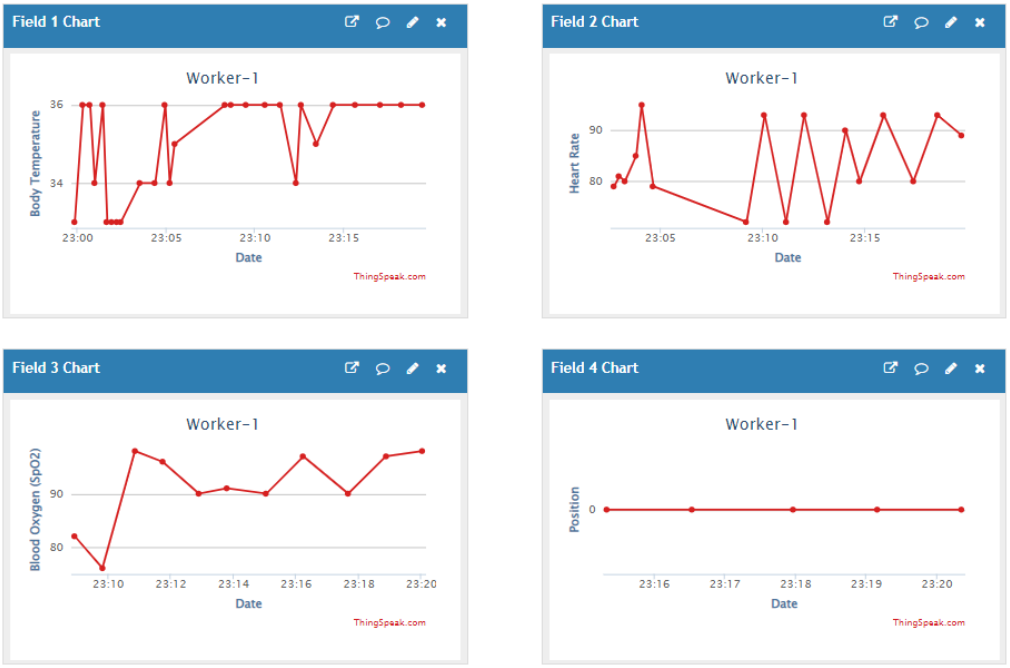


Figure 11

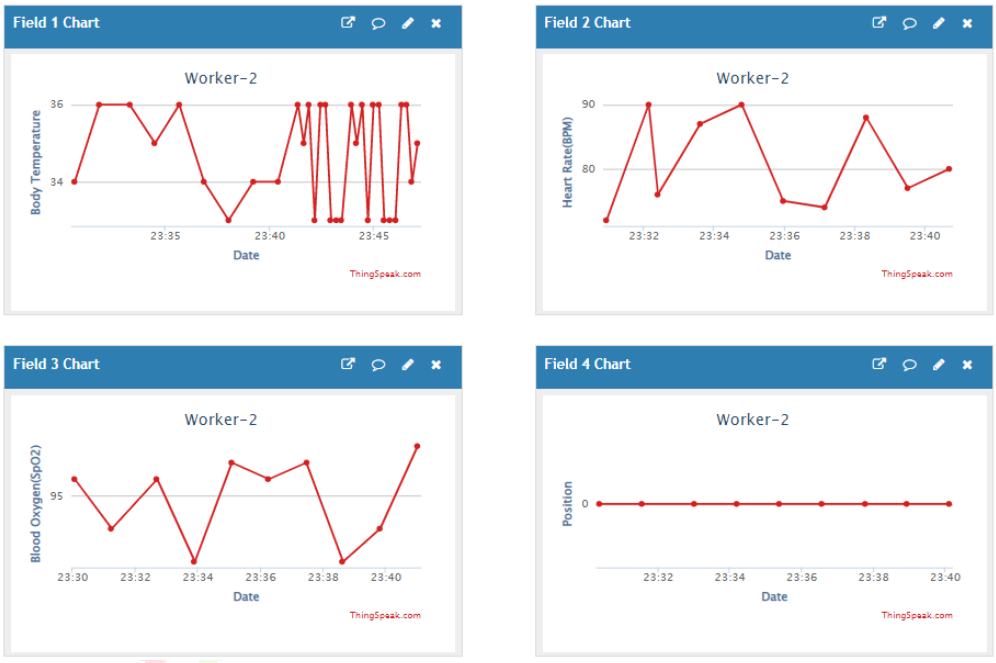


Figure 12

Figure 13

Output in Local Alert Module

The distance sensor SR-04 is used to measure the distance between 2 persons when they are coming closer than 2 meters. Once this is detected, the wearable module sends alert message to the local alert system through Bluetooth connection and the local alert unit displays the alert message on the display also, it activates the alarm. Figure 4.8 shows the display of alert message when a social distance violation(SDV) was detected.

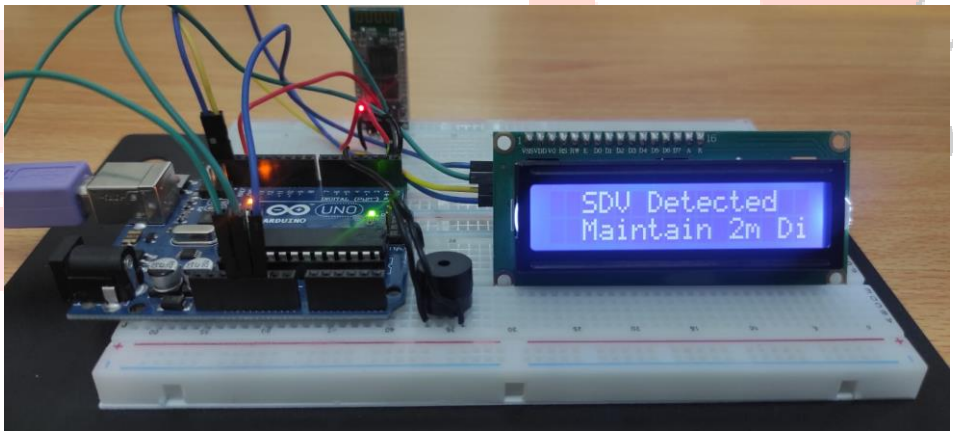


Figure 14

In summary, the proposed work has been successfully prototyped and their functions were tested against the proposed objectives and they were working perfectly.

VIII. CONCLUSION

In this work, we have developed and demonstrated the IoT based Social Distance Employee health monitoring system with various sensors to measure the health parameters and distance measurements and with Wi-Fi and Bluetooth devices for wireless transmission of live data. The proposed work has been designed in circuit level and prototyped and tested with the health of Arduino Uno based microcontroller and the live data were monitored using ThingSpeak. The remote monitoring of the health parameters of the workers in an organization will help them to take necessary alternative arrangements for the sick workers and thereby improving the productivity. The social distance maintenance shall be ensured by giving alert messages and thereby removing the fear among the workers about the spread of covid-19 virus. The proposed system will play a major role in industries, offices and organizations, in their process of recovery from the adverse effect by Covid-19.

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