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IoT Enabled Smart Hospital Management System

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Abstract: *Coronavirus disease, also known as COVID-19, is an infectious disease which spreads between humans. The incubation period of coronavirus is on average 5-6 days, but it could also be up to 14 days. During this incubation period, before the person begins experiencing symptoms, the person could be contagious.[1] The virus would spread to the people with whom the infected person is interacting, and this is dangerous. Since the last days of the previous year, the occurrence of novel infectious flu-alike respiratory disease COVID-19 caused by SARS-Cov-2 virus (also known as coronavirus) has affected almost every aspect of people's lives globally. First, it was discovered in China, but spread quickly to other continents in just a few weeks. Until July 11th 2020, the total number of identified cases was 12,653,451, while taking 563,517 lives worldwide.*

Keywords: Hospital Management

I. INTRODUCTION

Coronavirus disease, also known as COVID-19, is an infectious disease which spreads between humans. The incubation period of coronavirus is on average 5-6 days, but it could also be up to 14 days. During this incubation period, before the person begins experiencing symptoms, the person could be contagious.[1] The virus would spread to the people with whom the infected person is interacting, and this is dangerous. Since the last days of the previous year, the occurrence of novel infectious flu-alike respiratory disease COVID-19 caused by SARS-Cov-2 virus (also known as coronavirus) has affected almost every aspect of people's lives globally. First, it was discovered in China, but spread quickly to other continents in just a few weeks. Until July 11th 2020, the total number of identified cases was 12,653,451, while taking 563,517 lives worldwide. Common symptoms of coronavirus disease include fever, tiredness, sore throat, nasal congestion, loss of taste and smell. In most cases, it is transmitted directly (person to person) through respiratory droplets, but also indirectly via surfaces. Incubation period could be quite long and varies (between 14 and 27 days in extreme cases). Furthermore, even asymptomatic persons (almost 45% of cases) can spread the disease making the situation even worse. Therefore, the usage of face masks and sanitizers has shown positive results when it comes to disease spread reduction. However, the crucial problem is the lack of approved vaccines and medication. Fever is a common symptom of coronavirus disease. Studies have shown that this disease could also accelerate heart rate. In our project, the body temperature will be measured and data logged in google sheets with the help of pushing online service. Due to these facts, many protection and safety measures were taken by governments in order to reduce the disease spread, such as obligatory indoor mask wearing, social distancing quarantine self-isolation, limiting citizens movement within country borders and abroad often together with prohibition and cancellation of huge public events and gatherings. Despite the fact that the pandemic seemed weaker at some points, most safety regulations are still applied due to unstable situations. From workplace behaviour to social relations sports and entertainment, coronavirus disease.[2]

Face masks are becoming more popular in public due to the global outbreak of the coronavirus COVID-19. Before Covid-19, people wore masks as air pollution protective measures to protect their welfare. A few of them cover faces, and others are conscious of their look, to conceal their feelings from the public. According to scientists, wearing face masks slows COVID-19 transmission. The most recent influenza virus to strike human health in the 20th century is COVID-19. The World Health Organization(WHO) proclaimed it a global pandemic in 2020 because of its rapid expansion. In under six months, COVID-19 infected over five million people in 188 countries. The coronavirus outbreak prompted unprecedented levels of international scientific collaboration. [2]

In this cost-effective IoT-based system aiming to help organizations respect the COVID-19 safety rules and guidelines in order to reduce the disease spread is presented. We focus on the most common indoor measures- people with high body temperature should stay at home, wearing a mask is obligatory and the distance between persons should be at least 1.5-2 meters so we decided to use the components we had at home we would recommend you to use those two sensors instead of the MLX90614ESF temperature sensor module and Ultrasonic sensor module for the first scenario. Arduino Uno, a microcontroller board with a contactless temperature sensor is used while we rely on aArduino Uno Single board computer equipped with a camera making use of computer vision techniques for the other two scenarios.[3]

1.1 Problem Definition

Virtual Reality tricks one's mind by using computers that allow one to experience more The development of the COVID-SAFE platform relies on three parts including a wearable to a smartphone app, and a fog (or cloud) server. The hardware contains nodes that were developed on the Arduino Uno. The software parts include an application program interface for interacting with users on a smartphone, and a fuzzy decision-making system on the fog server Nodes collect specific vital data from participations and upgrade their decision-making regulations to and users in various scenarios, such to detect temperature and face mask and as the need to refer to a doctor maintaining physical distance from others, and alerts regarding high-risk areas illustrate the high-level architecture of the COVID-SAFE framework.[4]

Covid-19 infections are spreading and can kill people, but there aren't enough treatments and vaccines to combat them. As a result of these facts, governments have implemented a variety of disease-prevention and safety measures, including mandatory indoor mask use, social distancing, quarantine, self isolation, and limiting citizens' movement across country borders and abroad, often in conjunction with the prohibition and cancellation of large-scale events. Many people in the COVID-19 pandemic suffer from a lack of artificial ventilators; therefore, we devised a plan to limit the number of people infected by developing an interior safety monitoring system.

1.2 Objectives

The world has been facing the challenge of COVID-19 since the end of 2019. It is expected that the world will need to battle the COVID-19 pandemic with precautionary measures until an effective vaccine is developed. This paper proposes a real-time COVID-19 detection and monitoring system. The proposed system would employ an Internet of Things (IoTs) framework to collect real-time symptom data from users to early identify suspected coronavirus cases.

1.3 Organization Of Report

COVID-19 Indoor Safety Monitoring systems are introduced in chapter 1. Chapter 2, summarizes different papers on Virtual reality. In chapter 3, the actual implementation of systems and how it's working. Chapter 4 is related to hardware and software descriptions. In chapter 5 is given about the experimental results, advantages, and disadvantages ofthe application. And finally, in chapter 6 information is related to conclusions and future scopes of systems.

II. LITERATURE REVIEW

2.1 History

Since its discovery in late December of 2019, there have been more than 145 million confirmed cases of COVID-19 reported in 185 countries as of July 21 2020 with approximately a 2- daily increase. Among these cases there have been more than 95 thousand deaths, which represents an approximate 42% mortality rate. This novel coronavirus was characterized on March 11 2020 as a pandemic to the World Health Organization. Unfortunately, there is no successful treatment procedure or vaccine set. It is expected that the development of an effective vaccine will take more than a year especially since the nature of the virus has not yet been completely characterized. Currently, the only way that the world can deal with this coronavirus is to slow down its spread to "flatten the curve" by using measures such as social distancing, hand washing and face masks. However, technology could also help slow its spread, through early identification (or prediction) and monitoring of new cases. Such technologies include big data as well as cloud and fog capabilities the use of data gathered through remote monitoring, such as mHealth, teleHealth, and real-time.[5]

Independent and convenient healthy livingis the aim of any human being no matter their age, gender, location or health status. However, there are limitations due to age, illness, medication, hospitalization, epidemic, pandemic and other circumstances. Health monitoring systems have evolved to assist convenient healthy living, more accessible communication between healthcare givers and patients for close monitoring, measurement of vital health parameters, routine consultation and overall healthy living. Moreover, with the recent advances in information and communication technologies (ICT) through the adoption of Internet of Things (IoT) technology, smart health monitoring and support systems now have a higher edge of development and acceptability for enhanced healthy living. The study conducted by Zikali, revealed that with the rapid increase in the population of older or senior citizens, patients who require health monitoring have also increased exponentially. The same study predicts that by the year 2045 the number of senior citizens who are considered the most vulnerable in society will exceed the number of children and young adults as a recent population census shows an increase in older people. However, a shortage of home health helpers, nursing assistants and home healthcare givers is looming worldwide, which makes care for the elder's expensive. Therefore, a health monitoring system can play a vital role in lessening physical contact, hospitalization, consultation time, queuing list and overall health cost for a patient while also reducing workload burden and stress on medical staff. Advancements in information and communication technologies for connectivity anywhere and anytime make a valuable contribution to the development of the modern healthcare system utilized in telemedicine solutions and other portable medical platforms.[6]

Wireless Temperature detector System using ARDUINO and IOT. Author: Arian Rosebrock. IEEE in Proceedings of Eighth International Conference on Document Analysis and Recognition, pp 257 – 261 Vol. 1 ISSN:15200-5263, 2020 concentrates on loading this disc mask detection dataset, trained model on this dataset and serialized face mask into a disc. After the face mask detector is trained, the mask detector is loaded and faces are detected and each face is classified as masked or unmasked.[4]

Wireless Temperature detector System using ARDUINO and IOT. Authors: M.J. Pramila, P. S. Shweta et al uses a non-contact infrared sensor thermometer that is useful for measuring temperature under circumstance where thermocouple or other probe type sensors cannot be used or do not produce accurate data for a variety of reasons. IoT based devicesin homes and industries are used for controlling all the electrical or electronic devices which are present. Additionally, the saved information of the IoT devices can be controlled from anywhere. The sensor analyses the graphical representation of the observed data in every user-defined format wherever in the world. In this work, IoT based Arduino is used. Furthermore, this flexible system obtains morevalues in calculating the actuator from the data saved on the internet. IoT is used for connecting the electronic devices with the internet. The devices may vary from the temperature measuring equipment and vehicles SOS system to other electronic devices such as sensors, software's, and network connectivity facilities, which sanction collecting and exchanging data. [5]

III. OVERVIEW

3.1 Working

There are several existing works that contain some of the elements relevant to the work presented in this report. However, to the best of our knowledge, there is no such solution covering all these aspects together to achieve this goal while allowing execution on low-cost IoT devices at the same time. A masked face recognition is introduced and its application by different algorithms in the context of campus and enterprise coronavirus prevention discussed. Moreover, in a highaccuracy method for facial mask detection using semantic segmentation based on fully convolutional networks, gradient descent and binomial cross entropy was presented. However, performance-wise, it is too heavy for low-power IoT devices, such as Arduino Uno. On the other side, a state model-based solution for face mask detection relying on Viola-Jones algorithm in the context of ATM center security was described. When it comes to temperature sensing, there are several variants of Arduino-based solutions. Arduino was used for real-some temperature visualization using temperature sensors. However, the used sensor does allow contactless temperature sensing. Our main goal is to provide a comprehensive solution for COVID-19 safety monitoring which relies on IoT devices as much as possible in order to be affordable at the same time.

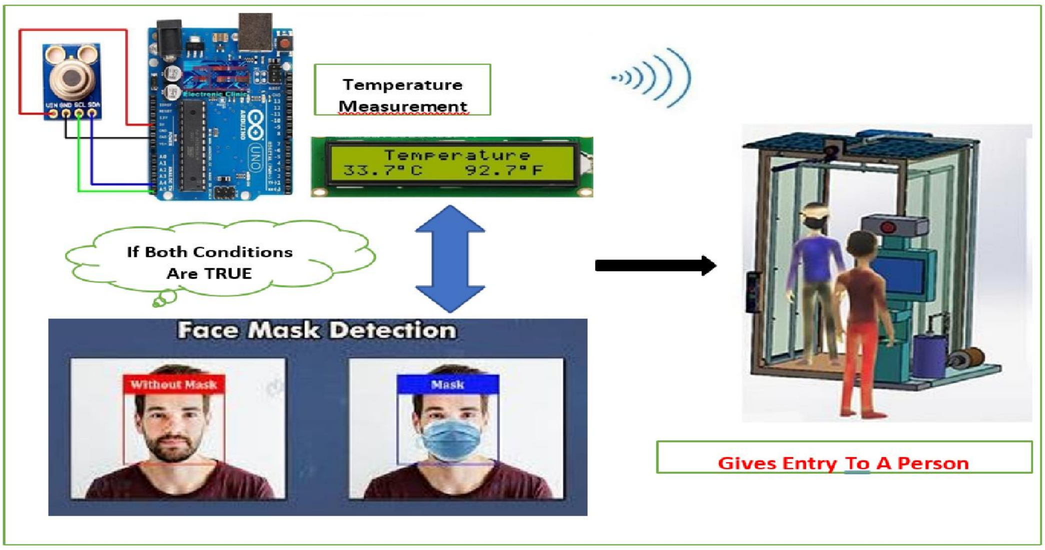

Fig 3.1.1 IoT enabled system overview

I-Passenger arrival 2-Temperature value 3-face mask detection 4-distance measure according to our set value 1.5 metre 5- message warning if someone has higher body temperature than average 6-Wears mask/doesn't wear mask 7-Social distancing satisfied/not satisfied 8-MQTT warning message telling that person without mask tries to enter 9-MQTT warning message that passengers do not respect social distance measures 10-it does not give the permission to the people if any condition is not satisfied.

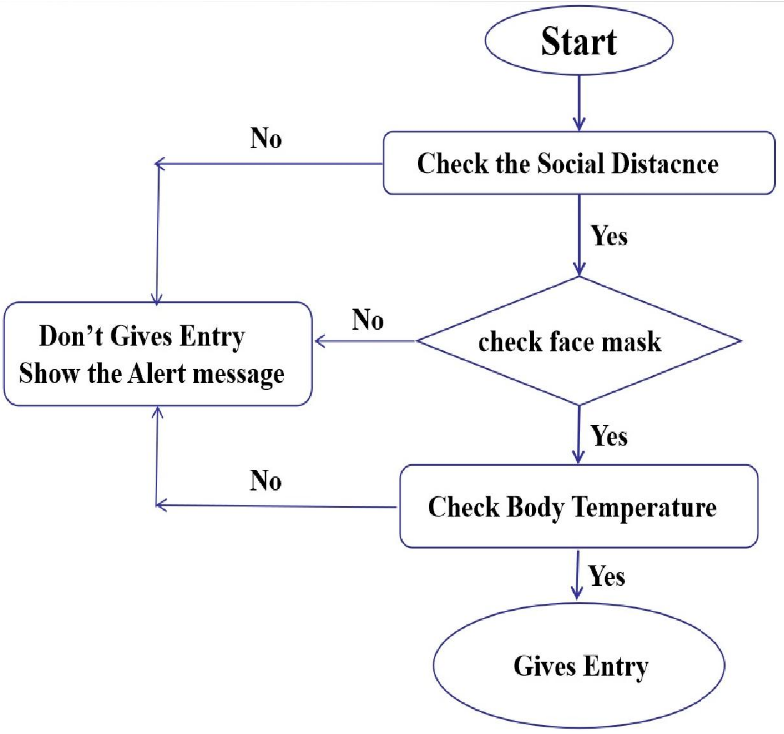

Fig. 3.1.2 Flowchart for interpreting system

IoT-Enabled System For Smart Hospital

The highest-level concept in this ontology is the Monitoring System. It consists of heterogeneous Devices, such as Arduino Uno, ESP32-camera, temperature sensors, and ultrasonic sensor. Each device is equipped with different sensors and is able to detect is expressed as the average percentage of successfully detected cases for mask detection and social distancing, while in the case of temperature measurement, it is the average measurement error for the corresponding sensor.

To create a truly immersive virtual reality there are certain prerequisites - a frame rate of a minimum of 60fps, an equally competent refresh rate, and a minimum 100-degree field of view (FOV) (though 180 degrees is ideal). The frame rate is the rate at which the GPU can process the images per second, the screen refresh rate is the pace of the display to render images, and FOV is the extent to which the display can support eye and head movement.

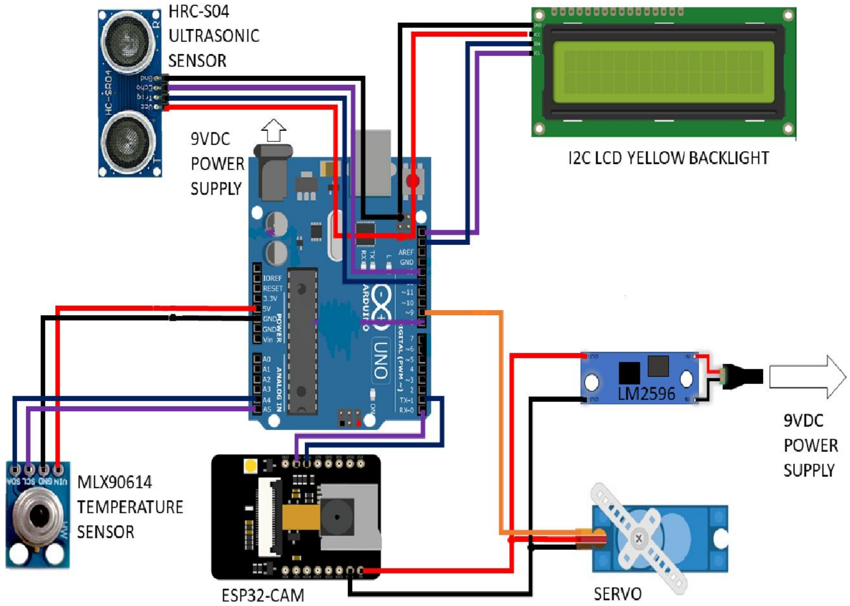

Fig.3.1.3 Circuit Diagram of System

If either of these doesn't work as per the standards the user can experience latency i.e. too much time gap between their actions and the response from the screen. We need the response to be less than 20 milliseconds to trick the brain which is achieved by combining all the above factors in the right proportion. Another issue that needs to be catered to here is to prevent tearing (cybersickness) resulting due to the inconsistency between the frame rate and refresh rate. If the GPU's fps is more than the screen refresh rate then the image can become distorted. To counter this issue, we limit the framerate to the monitor's refresh rate this is done using a tech called Vertical Sync (VSync). Among the major headsets available today.

This system could be made into a medical device and used to record the health measurements of the people living in remote areas or villages. The people in a particular area will record their health measurements. However, the person must practice hand hygiene-wash hands for at least 20 seconds. A touchless faucet. After the person washes his/her hands, the healthcare worker willbe allocated for the body temperature measurements. The non-contact temperature sensor module will be used to take body temperature measurements of the person. After the measurement is taken press the push-b again to record it. If the temperature is above 37 °C the person will not be able to allow for entry.

After the health measurements are taken, the healthcare worker can detect their face mask. If the person did not wear a mask properly then the system will not allow them entry. If the temperature exceeds 37°C then also the person will not be allowed by the system. If all the scenarios are obeyed then and then only the system will allow to person for entry. This practice will make it easier for doctors to detect COVID-19 patients in remote areas or villages. This remote monitoring system could also be used at homes where elderly people can take their health measurements by themselves. By following this practice, people do not have to travel in noisy placesand go out to take their health measurements.

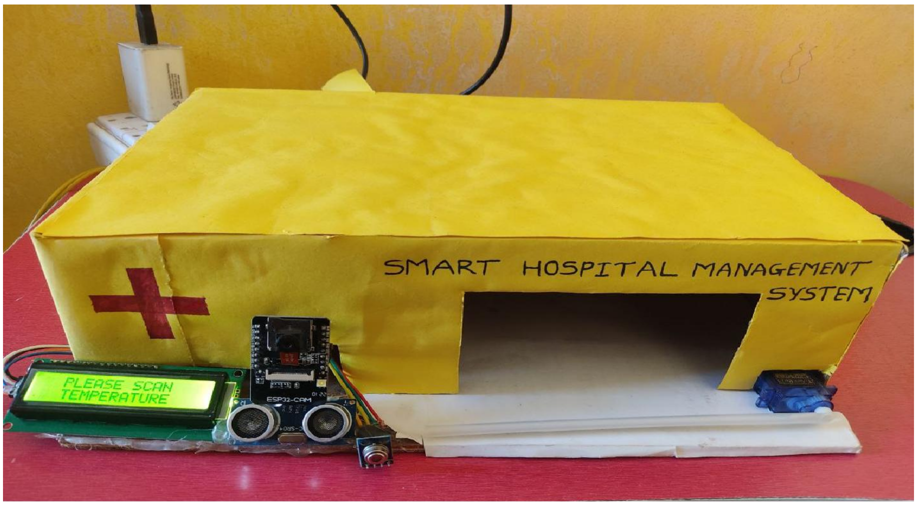

Fig.3.1.4 Smart Hospital Management System

IV. HARDWARE DESCRIPTION

4.1 Hardware Components

Arduino Uno: The **Arduino Uno** is one kind of microcontroller board based on ATmega328, and Uno is an Italian term that means one. Arduino Uno is named for marking the upcoming release of the microcontroller board namely **Arduino UnoBoard 1.0**. This board includes digital I/O pins-14, a power jack, analogi/ps-6, ceramic resonator-A16 MHz, a USB connection, an RST button, and an ICSP header. All these can support **the microcontroller** for further operation by connecting this board to the computer. The power supply of this board can be done with the help of an AC to DC adapter, a USB cable, otherwise a battery. This article discusses what is an **Arduino Uno microcontroller**, pin configuration, **Arduino Uno specifications or features,** and applications.

The **ATmega328** is one kind of single-chip microcontroller formed with Atmel within the **megaAVR family**. The architecture of this Arduino Uno is a customized Harvard architecture with 8 bit **RISC processor** core. Other boards of Arduino **Uno** include Arduino Pro Mini, Arduino Nano, Arduino Due, Arduino Mega, and Arduino Leonardo.The Arduino Uno board can be built with power pins, analog pins, ATmegs328, ICSP header, Reset button, power LED, digital pins, test led 13, TX/RX pins, USB interface, and an external power supply.

The **Arduino Uno power supply** can be done with the help of a USB cable or an external power supply. The external power supplies mainly include AC to DC adapters otherwise a battery. The adapter can be connected to the Arduino Uno by plugging into the power jack of the Arduino board. Similarly, **the battery** leads can be connected to the Vin pin and the GND pin of the POWER connector. The suggested voltage range will be 7 volts to 12 volts.

The Arduino Uno board has a rearrangeable poly fuse that defends the USB port of the PC from the over-voltage. Though most of PCs have their own inner protection, the fuse gives an additional coating of safety. If above 500mA is given to the USB port, then the fuse will routinely crack the connection until the over-voltage is removed.

Fig.4.1.1 Arduino Uno

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Arduino Uno can detect the surroundings from the input. Here the input is a variety of sensors and these can affect its surroundings by controlling motors, lights, other actuators, etc. The ATmega328 microcontroller on the Arduino board can be programmed with the help of an Arduino programming language and the IDE (Integrated Development Environment). **Arduino projects** can communicate by software while running on a PC.

Esp32-Camera module: The ESP32 CAM Wi-Fi Module Bluetooth with OV2640 Camera Module 2MP For Face Recognition has a very competitive small-size camera module that can operate independently as a minimum system with a footprint of only 40 x 27 mm; a deep sleep current of up to 6mA and is widely used in various IoT applications**.** It is suitable for home smart devices, industrial wireless control, wireless monitoring, and other IoT applications.

This module adopts a DIP package and can be directly inserted into the backplane to realize rapid production of products, providing customers with high-reliability connection mode, which is convenient for application in various IoT hardware terminals.

ESP integrates Wi-Fi, traditional Bluetooth, and BLE Beacon, with 2 high-performance 32-bit LX6 CPUs, 7-stage pipeline architecture. It has the main frequency adjustment range of 80MHz to 240MHz, on-chip sensor, Hall sensor, temperature sensor, etc. The Esp32 is better than ESP8266. It provides with faster processor and good memory size, which allow considerable large projects to be designed on only one SOC.

The ESP32 have reliable board, firmware, and peripherals. The processing power also creates secure socket layer connections and great essential requirements in the world of IoT. RSP32 devices have more GPIO to work with more useable and complicated projects. It is a better suited for every situation where an application needs a microcontroller.

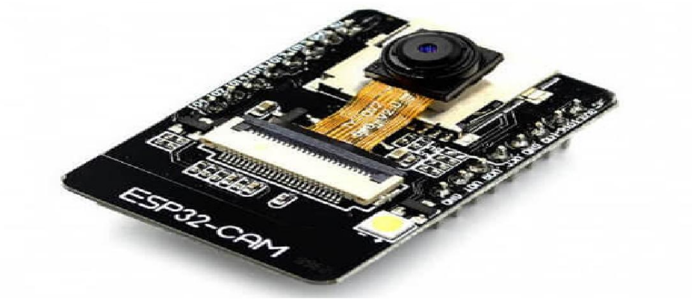

Fig.4.1.2 ESP32-Camera Module

ESP32-CAM can be widely used in various IoT applications. It is suitable for home smart devices, industrial wireless control, wireless monitoring, QR wireless identification, wireless positioning system signals and other IoT applications. It is an ideal solution for IoT applications.

4.2 Wireless Temperature Sensor

The MLX90614ESF(Temperature sensor) is an Infrared-Temperature-Measuring-Module for the use with Arduino or another microcontroller which can communicate via an I2C-interface. Remarkable is also its small size, its accuracy and the low price. The chip is on a breakout board and is delivered with the two necessary kinds of pins. In addition to that, does it have a sleep mode for low electricity consumption. The MLX90614ESFis a non-contact temperature sensor that detects infrared radiation generated by an object to determine its surface temperature.

The user can configure the digital output to be PWM. As a standard temperature sensor, the 10-bit PWM is configured to continuous transmit the measured temperature in the range of -20 to 120ºC, with an output resolution of 0.14ºC.

Fig.4.1.3 Wireless temperature sensor

A wireless temperature sensor is a device used to measure and transmit temperature information without the use of cables or wires. The sensor relies on a battery-powered microprocessor, which captures temperature and humidity information from the nearby area. The unit then uses radio waves to send this data back to a central receiver or thermostat. A wireless temperature sensor may be used in both residential and commercial settings to maintain a comfortable and efficient environment.

Wireless temperature sensors provide a number of advantages over traditional hard-wired units. These devices eliminate the need for wires or cabling between the sensor and the main thermostat or control panel. This allows for easy installation without the need to disturb existing walls and ceilings. When used properly, these sensors serve as a simple yet effective way to maximize energy efficiency and comfort while keeping heating and cooling costs to a minimum.

4.3 Servo Motor

A **servo motor** is a type of motor that can rotate with great precision. Normally this type of motor consists of a control circuit that provides feedback on the current position of the motor shaft, this feedback allows the servo motors to rotate with great precision. If you want to rotate an object at some specific angles or distance, then you use a servo motor. It is just made up of a simple motor which runs through a **servo mechanism**. If motor is powered by a DC power supply then it is called DC servo motor, and if it is AC-powered motor then it is called AC servo motor. For this tutorial, we will be discussing only about the **DC servo motor working**. Apart from these major classifications, there are many other types of servo motors based on the type of gear arrangement and operating characteristics. A servo motor usually comes with a gear arrangement that allows us to get a very high torque servo motor in small and lightweight packages. Due to these features, they are being used in many applications like toy car, RC helicopters and planes, Robotics, etc.

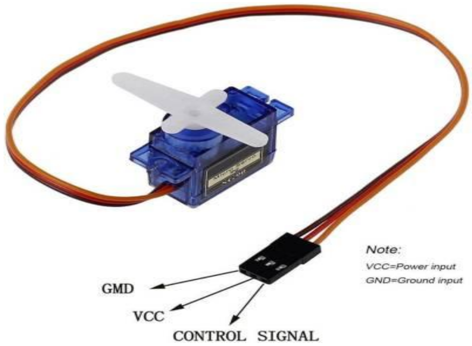

Fig.4.1.4 Servo motor

A servo consists of a Motor (DC or AC), a potentiometer, gear assembly, and a controlling circuit. First of all, we use gear assembly to reduce RPM and to increase torque of the motor. Say at initial position of servo motor shaft, the position of the potentiometer knob is such that there is no electrical signal generated at the output port of the potentiometer. Now an electrical signal is given to another input terminal of the error detector amplifier. Now the difference between these two signals, one comes from the potentiometer and another comes from other sources, will be processed in a feedback mechanism and output will be provided in terms of error signal. This error signal acts as the input for motor and motor starts rotating. Now motor shaft is connected with the potentiometer and as the motor rotates so the potentiometer and it will generate a signal. So as the potentiometer's angular position changes, its output feedback signal changes. After sometime the position of potentiometer reaches at a position that the output of potentiometer is same as external signal provided. At this condition, there will be no output signal from the amplifier to the motor input as there is no difference between external applied signal and the signal generated at potentiometer, and in this situation motor stops rotating.

4.4 LCD Display

The term LCD stands for liquid crystal display. It is one kind of electronic display module used in an extensive range of applications like various circuits & devices like mobile phones, calculators, computers, TV sets, etc. These displays are mainly preferred for multi-segment light-emitting diodes and seven segments. The main benefits of using this module are inexpensive; simply programmable, animations, and there are no limitations for displaying custom characters, special and even animations, etc.

- The operating voltage of this LCD is 4.7V-5.3V
- It includes two rows where each row can produce 16-characters.
- The utilization of current is 1mA with no backlight
- Every character can be built with a 5×8 pixel box
- The alphanumeric LCDs alphabets & numbers

Fig.4.1.5. 16 x 2 LCD Display

- Pin1 (Ground/Source Pin) : This is a GND pin to display, used to connect the GND terminal of the microcontroller unit or power source.
- Pin2 (VCC/Source Pin) : This is the voltage supply pin of the display, used to connect the supply pin of the power source.
- Pin3 (V0/VEE/Control Pin) : This pin regulates the difference of the display , used to connect a changeable POT that can supply 0 to 5V.
- Pin4 (Register Select/Control Pin) : This pin toggles among command or data register, used to connect a microcontroller unit pin and obtains either 0 or 1 (0 = data mode, and 1 = command mode).
- Pin5 (Read/Write/Control Pin) : This pin toggles the display among the read or writes operation, and it is connected to a microcontroller unit pin to get either 0 or 1 (0 = Write Operation, and 1 = Read Operation)
- Pin6 (Enable/Control Pin) : This pin should be held high to execute Read/Write process, and it is connected to the microcontroller unit and constantly held high.
- Pins 7-14 (Data Pins) : These pins are used to send data to the display. These pins are connected in two-wire modes like 4-wire mode and 8-wire mode. In 4-wire mode, only four pins are connected to the microcontroller unit like 0 to 3, whereas in 8-wire mode, 8-pins are connected to microcontroller unit like 0 to 7.
- Pin15 (+ve pin of the LED) : This pin is connected to +5V.
- Pin16 (-ve pin of the LED) : This pin is connected to GND.

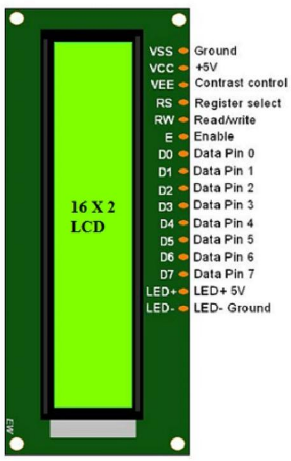

Fig. 4.1.6. LCD 16x2 pin-diagram

4.5 Software and Algorithm

The Arduino Software (IDE) makes it easy to write code and upload it to the board offline. We recommend it for users with poor or no internet connection. This software can be used with any Arduino board.

There are currently two versions of the Arduino IDE, one is the IDE 1.x.x and the other is IDE 2.x. The IDE 2.x is new major release that is faster and even more powerful to the IDE 1.x.x. In addition to a more modern editor and a more responsive interface it includes advanced features to help users with their coding and debugging.

The Arduino Integrated Development Environment - or Arduino Software (IDE) - connects to the Arduino boards to upload programs and communicate with them. Programs written using Arduino Software (IDE) are called **sketches**. These sketches are written in the text editor and are saved with the file extension .ino.

Mask detection algorithm: If a face was detected, mouth and nose detection are further applied to the corresponding camera frame version. In case that image does not contain mouth and nose, it means that person wears mask properly and corresponding door will be opened. However, if mouth is detected and its coordinates are within the area of the detected face, then the person is warned that mask is needed in order to proceed. If nose is detected within face area, then the person is warned to put the mask properly (covering nose).The algorithm is working in single person mode. In single-person mode, it is assumed that people pass one by one near the mask detection system's camera. In Fig. 4.2.1, a screenshot of successful mask detection on Arduino Uno model is given.

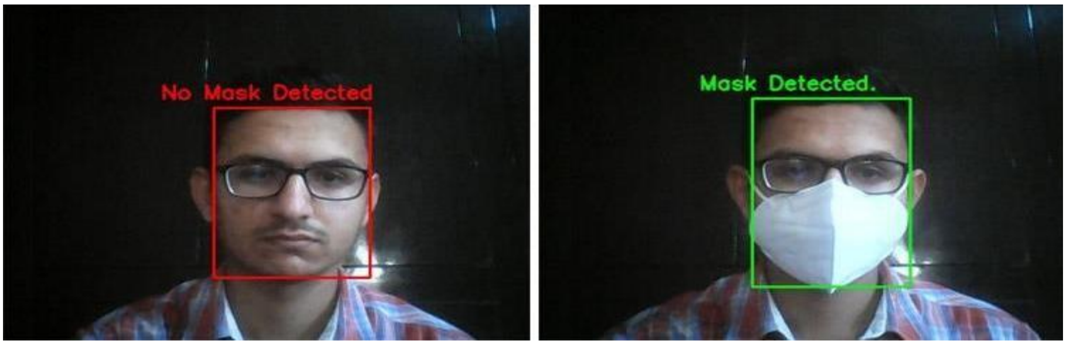

Fig.4.2.1 Mask Detection Algorithm

Temperature measurement: The temperature measurement subsystem based on Arduino Uno measures passenger's temperature using wireless temperature sensor. The passengers pass one by one. In case that passenger's temperature exceeds the average human body (37 °C), then Arduino Uno generates a signal to keep the door lock in order to prevent the person from entering the building and sends an MQTT message which tells that person with high body temperature was detected at a certain location. Otherwise, the door is opened to let the person in.

V. RESULTS AND DISCUSSION

5.1 Result and Discussion

For evaluation, the following, the following devices were used: Arduino board, wireless temperature sensor, ESP32-camera module, Servo Motor, LCD display. The accuracy of both computer vision scenarios increases with resolution, but the cost is paid with performance decrease. Despite the acceptable accuracy of the mask detection algorithm, it is not designed to detect transparent masks and face shields, which is a potential drawback. On the other hand, regarding the contactless temperature measurement, we can see that thermal cameras are less accurate and more demanding for computation, as it includes 64 measurements (8x8 matrix). However, its main advantage over IR sensor is the ability to measure the temperature of several persons at once, but requires additional data processing.

5.2 Advantages

1. Convenience, which can lead to improved efficiency, for starters: With the effortless, near-instant communication capabilities offered by remote care, practices can shift to a more automated system of scheduling, bypassing in-person appointments without reducing doctor patient facetime.

2. Timeliness, which can lead to earlier intervention, is another key factor IoT healthcare can maximize. Especially for more serious, time-critical medical events, the extra minutes offered by continuous monitoring can be the difference between life and death.
3. Accuracy, which can boost both efficiency and early intervention, is another important by product of healthcare IoT Connecting all devices and alerts into the same sophisticated GPS network provides not just the prospect of early intervention for flagged patient conditions, but also the ability for relief teams to respond faster and with more clarity in emergency situations -particularly useful for patients who live in rural or remote areas.
4. Safety and security realized by sophisticated network protection. Patient monitoring not only allows for improved physical safety with better tools for fall prevention, but improved digital security, too, via access to a highly secure network for accessing patient health information.
5. Mobility, which can help improve patient satisfaction. Patients are increasingly demanding access to care via their everyday consumer devices, a trend that's well often identified with the rise of FitBit Granting them this option, then exceeding their expectations with engaging. easy-to-use content and interactivity, means helping ensure greater rates of satisfaction.

VI. CONCLUSION AND FUTURE SCOPE

6.1 Conclusion

According to the achieved results, the proposed solution is usable for its purpose under certain performance limitations (such as number of processed frames or measurements per second). Moreover, it relies on both open hardware and free software, being definite and desirable advantage for such systems. In future, it is planned to experiment with various deep learning and computer vision frameworks for object detection on Raspberry Pi in order to achieve higher framerate.

6.2 Future Scope

We would like to extend this solution with environment sensing mechanisms for adaptive building air conditioning and ventilation airborne protection in order to reduce the spread of coronavirus indoors 14, 8, 24], especially during summer. Furthermore, we will consider the implementation of mechanisms for transparent face shield detection. Finally, the ultimate goal is to integrate the system presented in this paper with our framework for efficient resource planning during pandemic crisis in order to enable efficient security personnel scheduling and mask allocation, together with risk assessment based on statistics about respecting the safety guidelines and air quality.

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