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Design and implementation of COVID-19 detector in doorbell

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Abstract

The Covid-19 detector in the doorbell is considered one of the important devices in our public life to prevent the spread of this epidemic and our knowledge of it by measuring the temperature of people through temperature detectors and sensors, where the resulting signal is converted into an electrical signal of valuable benefit to get rid of the spread of the epidemic and eliminate It is necessary to reduce it in the difficult circumstances facing us, whether it is at home, at work, or in government departments, schools and universities.

Keywords: Design, Covid-19, doorbell

1. Introduction

Many people with COVID-19 have a fever at some point during their illness. Common symptoms of COVID-19 include fever, cough and trouble breathing. Other possible symptoms include headaches, body aches, chills, fatigue, and loss of smell or taste. Some people may also have a runny nose, sore throat, nausea, or diarrhea.

The most common cause of a fever is an infection caused by bacteria or viruses. It's a good idea to check your temperature any time you have symptoms of a fever, such as chills, body aches, and a feeling of high temperature or flushing.

Temperature checks are often used to detect COVID-19 in the community. Contactless or contactless forehead thermometers are quick and easy to use. However, it is not always accurate. People can also catch the virus and spread COVID-19 without developing a fever. Temperature checks should always be part of other steps to prevent COVID-19. Recommendations for how often to take a temperature may depend on factors such as your job, health, and risk factors. If you are at risk of contracting COVID-19 due to possible exposure to the virus.

1.1 Thermometer Business Idea

The thermometer was built on the basis of the scientific fact that the physical properties of materials change with the change in temperature, such as the expansion of the body with its increase in temperature The physical properties of a substance changing with temperature include the volume of the liquid and the volume of the solid body, and the largest change occurs with the change in the volume of gases with temperature, as the volume of the gas increases by 1/273 of its volume for each degree Celsius that rises or for each degree Kelvin. Another property that changes with temperature is resistance, that is, the resistance to the flow of electric current in materials and metals.

1.2 There are several types of thermometers, including the main ones

- Bimetallic scales electrical gauges digital scales Single-use metrics.
- Liquid crystal gauges.

There is a new method for measuring body that the temperature based on the effect of some chemicals on heat and changing their color. This phenomenon has been applied in thermal cameras that take pictures similar to photographs with the difference. Instead of seeing the differences of light and shadow, these cameras see things according to their temperature and give a color image of them so that each color gives us a certain temperature.

The temperature is one of the important factors for detecting the presence of pathological conditions, as it is inferred from the internal body temperature and the extent of its change, using different thermometers, and according to its measurement from several places in the body and the following is an explanation of the methods of measuring temperature according to where it is taken from the body.

1.3 Project Problem

Because of the problems that occur when the Corona virus COVID-19 is not detected due to the symptoms that appear on the patient and due to the lack of sufficient knowledge and the provision of methods that can reach and detect the virus in modern and advanced ways, as the connection to a distinctive innovation that can eliminate the details that can transmit and detect infection.

1.4 Project Objective

Providing an important work environment and complete protection from the virus, as the device provides safe ways to detect the COVID-19 virus with heat and within a very short time we can know the person's condition if the temperature is high or not. This data is transferred and converted into an electrical signal given by the detector and then translated into electrical energy. Thus, turning it into an alarm in general and sounding an alarm when there is a problem, which indicates that the person has a high temperature, as this device is placed at the front of the door in the place of the doorbell.

2. Theoretical Principles

2.1 Introduction

That the entire world takes drastic measures to control this pandemic your home visitors body temperature as soon as they ring the bell using IR remote temperature thermometer theory Everything that has mass emits energy in the form of heat. Since there is heat being emitted by any object or person, an infrared thermometer can use the difference between the IR rays coming off of the person and the surrounding environment to determine temperature of the person itself.

The IR thermometer works by focusing light that is coming from the object in the form of IR rays and funneling that light into a thermopile. In the thermopile IR radiation is turned into heat, which is then turned to electricity, which is then measured.

2.2 How to detect COVID19

The symptoms of COVID-19 – fever, cough, difficulty breathing and muscle pain – can resemble those of many other diseases, such as influenza, making diagnostic tests therefore essential for identifying people who actually have COVID-19. In addition to this, these tests can also help determine who has recovered from COVID-19, as well as improve our understanding of how the virus spreads and help monitor the effectiveness of control measures. Some test for the virus itself, by looking for the RNA (the genetic blueprint) of the SARS-CoV-2 virus that causes COVID-19. When carried out properly, a result that the virus has been detected is extremely reliable. However, these tests are not very helpful for determining whether someone has recovered from the virus, and moreover can potentially miss the virus if it is present in extremely low levels in a patient's body. Other tests look for antibodies to the virus – evidence

that the body has produced an immune response to it. It takes time for such antibodies to be created, so antibody tests are not much use in confirming if someone has COVID-19 in the first few days of infection. However, in contrast to the RNA tests, they can be extremely useful in determining whether someone has previously been infected with the new coronavirus, but no longer has the virus present. A complicating factor, however, is that different people can have different antibody responses to COVID-19. For example, individuals with severe disease seem to develop higher antibody levels than individuals with mild or asymptomatic disease. As a result, a test for antibodies developed using blood samples from individuals with severe COVID-19 may not work as well in detecting antibodies in people with a mild or asymptomatic version of the disease, where there are far fewer antibodies to detect. There are two types of tests for COVID-19: the PCR test and the antigen test. Polymerase chain reaction (PCR). This tests for the presence of the actual Virus's genetic material or its fragments as it breaks down. PCR is the most reliable and accurate test for detecting active infection. PCR tests typically take hours to perform, but some are faster. Antigen test: This detects bits of proteins on the surface of the virus called antigens. Antigen tests typically take only 15 to 30 minutes. Rapid antigen tests are most accurate when used within a few days of the start of your symptoms, which is when the largest amount of virus is present in your body. Signs and symptoms include respiratory symptoms and include fever, cough and shortness of breath. In more severe cases, infection can cause pneumonia, severe acute respiratory syndrome and sometimes death. Standard recommendations to prevent the spread of COVID-19 include frequent cleaning of hands using alcohol-based hand rub or soap and water; covering the nose and mouth with a flexed elbow or disposable tissue when coughing and sneezing; and avoiding close contact with anyone that has a fever and cough.

2.3 IR Temperature Sensing

Infrared rays that are inferred from heat rays that are inferred from the temperature that are inferred from ultraviolet rays produced by ultraviolet rays. Thermometers, thermometers, thermometers, thermometry. From knowing the energy under the sun's rays, sending the message from the body and its emission, determining the body temperature in a certain range of actual heat. Infrared vision infrared current AC infrared current AC. Sometimes, especially near ambient temperatures, the readings may be subject to error due to the reflection of radiation from a hotter object - even the person holding the instrument [citation needed] - rather than being radiated by the object being measured, and to an incorrectly assumed emissivity.

The design is mainly composed of a lens to focus infrared thermal radiation on a detector, which converts the radiated energy into an electrical signal that can be displayed in temperature units after compensating for the ambient temperature. This allows the temperature to be measured from a distance without touching the object to be measured. A non-contact infrared thermometer is useful for measuring temperature under conditions where thermocouples or other probe-type sensors cannot be used or do not produce accurate data for a variety of reasons. The formulas upon which infrared temperature measurement is based are old, established and well proven. It is unlikely that most IRT

users will need to make use of the formulas, but a knowledge of them will provide an appreciation of the interdependency of certain variables, and serve to clarify the foregoing text. The important formulas are as follows:

1. Kirchoff's Law When an object is at thermal equilibrium, the amount of absorption will equal the amount of emission.
2. Stephan Boltzmann Law The hotter an object becomes the more infrared energy it emits.
3. Wien's Displacement Law The wavelength at which the maximum amount of energy is emitted becomes shorter

as the temperature increases.

4. Planck's Equation Describes the relationship between spectral emissivity, temperature and radiant energy.

2.4 Microcontrollers principles

A microcontroller is a single chip microcomputer that integrates the main parts of a microcomputer on a chip. The microcontroller was born in the middle of 1970s. After 20 years of development, its cost is becoming lower and its performance is more and more powerful, which makes its application everywhere and in all fields (Pal A, 2012) [1].

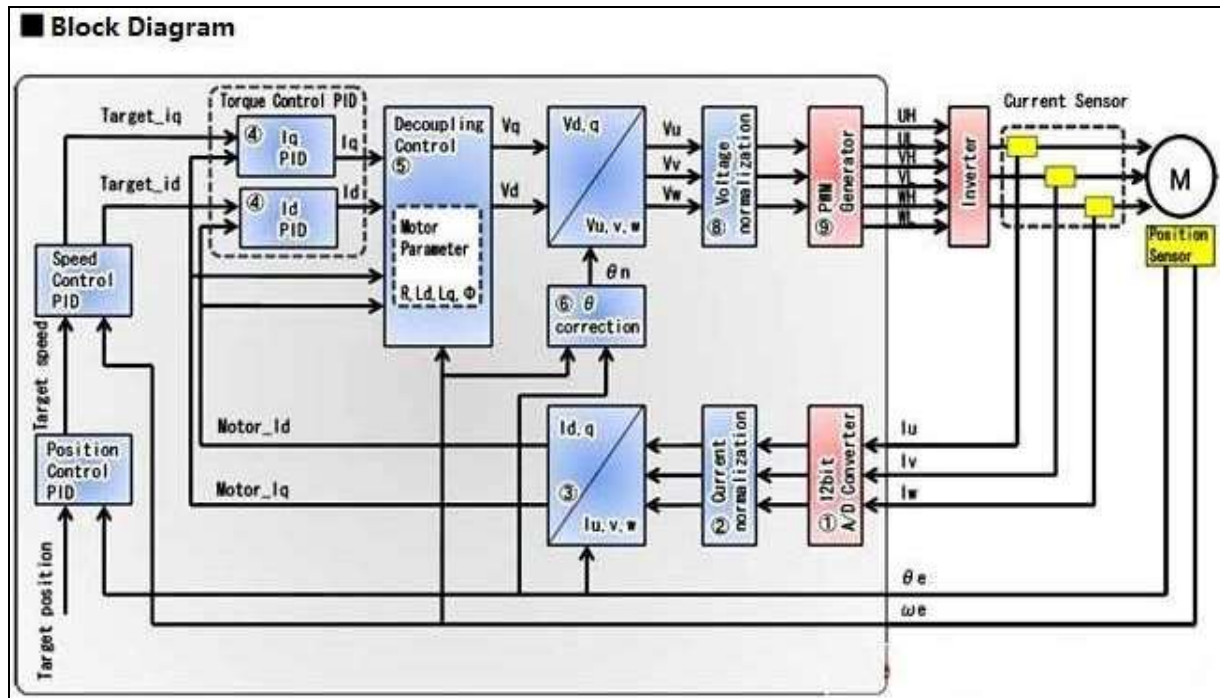


Fig 1: Diagram Microcontrollers principles

Motor control, bar code reader / scanners, consumer electronics, game devices, telephone, HVAC, building safety and access control, industrial control and automation, and white household appliances (washing machines, microwave ovens). Well, according to wiki, a microcontroller (or MCU for microcontroller unit) is a small computer on a single integrated circuit. In modern terminology, it is similar to, but less sophisticated than, a system on a chip or SoC; an SoC may include a microcontroller as one of its components. A microcontroller contains one or more CPUs (processor cores) along with memory and programmable input/output peripherals. Program memory in the form of ferroelectric RAM, NOR flash or OTP ROM is also often included on chip, as well as a small amount of RAM. Microcontrollers are designed for embedded applications, in contrast to the microprocessors used in personal computers or other general purpose applications consisting of various discrete chips. Microcontrollers are used in automatically controlled products and devices, such as automobile engine control systems, implantable medical devices, remote controls, office machines, appliances, power tools, toys and other embedded systems. By reducing the size and cost compared to a design that uses a separate microprocessor, memory, and input/output devices, microcontrollers make it economical to digitally control even more devices and processes. Mixed signal microcontrollers are common,

integrating analog components needed to control non-digital electronic systems.

2.5 Microcontroller Types

The microcontrollers can be divided into two major categories: ordinary singlechip and digital signal processing single chip microcomputer (DSP). According to the word length, the common singlechip at present is from 4 to 32. The function is strong and weak, suitable for different occasions. Most of the world's largest semiconductor companies have their own microcontrollers.

2.6 Microcontroller 8051

It is a 40pin microcontroller with Vcc of 5V connected to pin 40 and Vss at pin 20 which is kept 0V. And there are input and output ports from P1.0 – P1.7 and which having open drain feature. Port3 has got extra features. Pin36 has open drain condition and pin17 has internally pulled up transistor inside the microcontroller. When we apply logic 1 at port1 then we get logic 1 at port21 and vice versa. The programming of microcontroller is dead complicate. Basically we write a program in C-language which is next converted to machine language understand by the microcontroller. A RESET pin is connected to pin9, connected with a capacitor. When the switch is ON, the capacitor starts charging and RST is high. Applying a high to the reset pin resets the microcontroller. If we apply logic

zero to this pin, the program starts execution from the beginning.

2.7 Memory Architecture of 8051

The memory of 8051 is divided to two parts. They are Program Memory and Data Memory. Program Memory stores the program being executed whereas Data Memory temporarily stores the data and the results. The 8051 has been in use in a wide number of devices, mainly because it is easy to integrate into a device. Microcontrollers are mainly used in energy management, touch screen, automobiles, and medical devices. Just see the following pictures (Steiner C 2005) ^[2]:



Fig 2: Memory Architecture of 8051

Pin Description of 8051 Microcontroller

- 1 Pin-40: Vcc is the main power source of +5V DC.
- 1 Pin 20: Vss – it represents ground (0 V) connection.
- 1 Pins 32-39: Known as Port 0 (P0.0 to P0.7) to serving as I/O ports.
- 1 Pin-31: Address Latch Enable (ALE) is used to demultiplex the address-data signal of port 0.
- 1 Pin-30: (EA) External Access input is used to enable or disable external memory interfacing. If there is no external memory requirement, this pin is always held high.
- 1 Pin- 29: Program Store Enable (PSEN) is used to read signal from external program memory.
- 1 Pins- 21-28: Known as Port 2 (P 2.0 to P 2.7) – in addition to serving as I/O port, higher order address bus signals are multiplexed with this quasi bi directional port.
- 1 Pins 18 and 19: Used to interfacing an external crystal to provide system clock.
- 1 Pins 10 – 17: This port also serves some other functions like interrupts, timer input, control signals for external memory interfacing Read and Write. This is a quasi-bidirectional port with internal pull up.
- 1 Pin 9: It is a RESET pin, used to set the 8051 microcontroller to its initial values, while the microcontroller is working or at the initial start of application. The RESET pin must be set high for 2 machine cycles.
- 1 Pins 1 – 8: This port does not serve any other functions. Port 1 is a quasi bi directional I/O port.

2.8 Renesas Microcontroller

Renesas is latest automotive microcontroller family that offers high performance feature with exceptionally low power consumption over a wide and versatile extend of items. This microcontroller offers rich functional security and embedded safety characteristics required for new and advanced automotive applications. The core structure of microcontroller CPU support high reliability and high-

performance requirements. The Rennes's microcontroller offering low power, high performance, modest packages and the largest range of memory sizes combined together with characteristics rich peripherals.

3. Design and implementation of the project

3.1 Introduction

Despite the developments that took place in the last period with the detection and warning of the Covid-19 virus, despite the physiological changes that every person possesses, some have been used in a natural way and others have encountered several problems in its manufacture, as this device was manufactured as a Covid-19 virus detector in the doorbell. One of the important things that must be taken into account to monitor the condition of visitors who come to homes or other places, and in our role as medical engineers, something has been reached that we can identify the body before entering the place through a temperature sensor and a specific detector that can detect and identify if a person is infected first within a specific and short time Estimated at 1 second to 5 seconds and convert this received signal and send it to the detector to be detected and converted into an electrical signal and then to the alarm panel to be allowed in, Where this device is very important to identify if a person is infected first with a high or low temperature and other changes that occur and the person can be detected from near or far distances, the injury can be translated through a sound alarm that can be placed inside the device and programmed according to the mechanisms specified for that with a light Red if a person is infected and yellow if the person is not infected and his temperature is normal

3.2 Project design

3.2.1 Arduino Nano R3

The Arduino Nano is a small, complete, and breadboard-friendly board based on the ATmega328P released in 2008. It offers the same connectivity and specs of the Arduino Uno board in a smaller form factor.

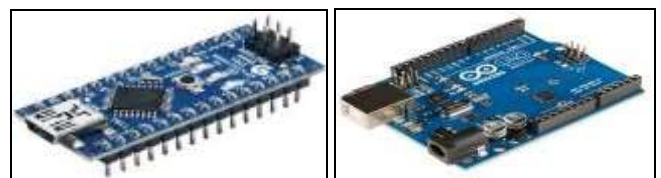


Fig 3: 1 Arduino Nano R3

The Arduino Nano is equipped with 30 male I/O headers, in a dip-30 like configuration, which can be programmed using the Arduino Software integrated development environment (IDE), which is common to all Arduino boards and running both online and offline. The board can be powered through a type-b micro-USB cable, or through a 9V battery. In 2019, Arduino released the Arduino Nano Every, an pin-equivalent evolution of the Nano. It features a more powerful ATmega4809 processor, and twice the RAM. (Ardianto ET, 2022) ^[3].

3.3 MP3 Player shield

The SparkFun MP3 Player Shield is an awesome MP3 decoder with the capabilities of storing music files onto a run-of-the-mill micro SD card, thus giving you the ability to add music or sound effects to any project. With this board

you can pull MP3 files from an micro SD card and play them using only one shield, effectively turning any Arduino into a fully functional stand-alone MP3 player! The MP3 Shield utilizes the VS1053B MP3 audio decoder IC to decode audio files. The VS1053 is also capable of decoding Ogg Vorbis/MP3/AAC/WMA/MIDI audio and encoding IMA ADPCM and user-loadable Ogg Vorbis.

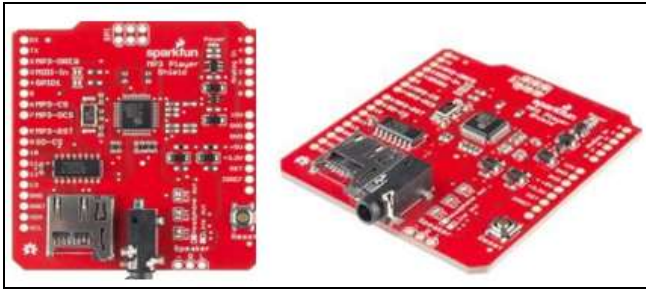


Fig 4: MP3 Player shield

The VS1053 receives its input bitstream through a serial input bus (SPI). After the stream has been decoded by the IC, the audio is sent out to both a 3.5mm stereo headphone jack, as well as a 2-pin 0.1" pitch header.

This shield comes populated with all components as shown in the images and schematic; but it does not come with headers installed. We recommend the Arduino R3 Stackable Header Kit. (Kukulska-Hulme A, 2008) [4].

3.2.2 Atmega328P Microcontroller

The Atmega328P is a high performance and low powered 8-bit microcontroller, which is based on AVR RISC Architecture. Here, AVR stands for Audio Video Recorder and RISC stands for Reduced Instruction Set Computing. It is also considered as the most popular AVR controller.

It consumes less power than Atmega328 Microcontroller. as figure shown. (Khaery M, 2005) [5]:

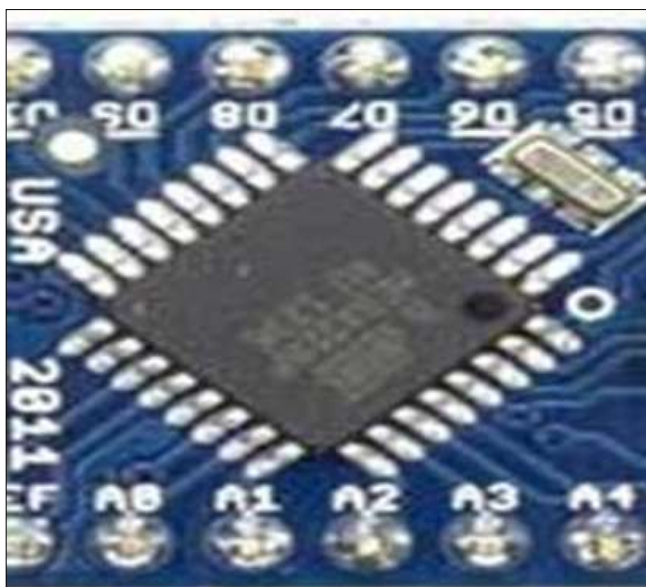


Fig 5: Atmega328P Microcontroller

4. I2C LCD Adapter Module

“I2C” or “IIC” or “I square C” based LCD adapter module, which will reduce wire connections between Arduino and LCD display to just 2 wires, also saving tons of GPIO pins for other sensors / drives etc. as figure shown.

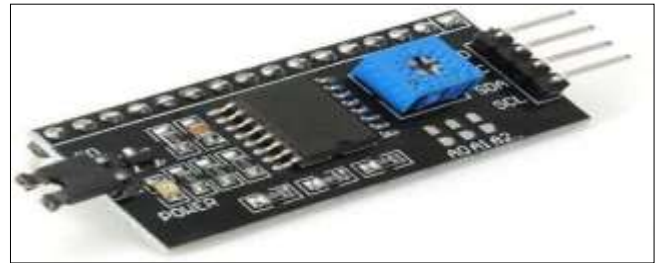


Fig 6: I2C LCD Adapter Module

The two wires are SDA and SCL which are Serial Data and Serial clock respectively.

The Serial clock or SCL is used to sync the data communication over I2C bus. The SDA or Serial Data is the data line in which the actual data is conveyed from master to slave and vice versa. The master device controls the Serial clock and decides for which slave device it needs to communicate. No slave device can initiate a communication first, only master device can do. as figure shown.



Fig 7: I2C LCD Adapter Module

4.1 SD Card Arduino

This Micro SD Card is used for transferring data to and from a standard SD card. The pin out is directly compatible with Arduino and also can be used with other microcontrollers. It allows us to add mass storage and data logging to our project. (Bradley LJ, 2020) [6].

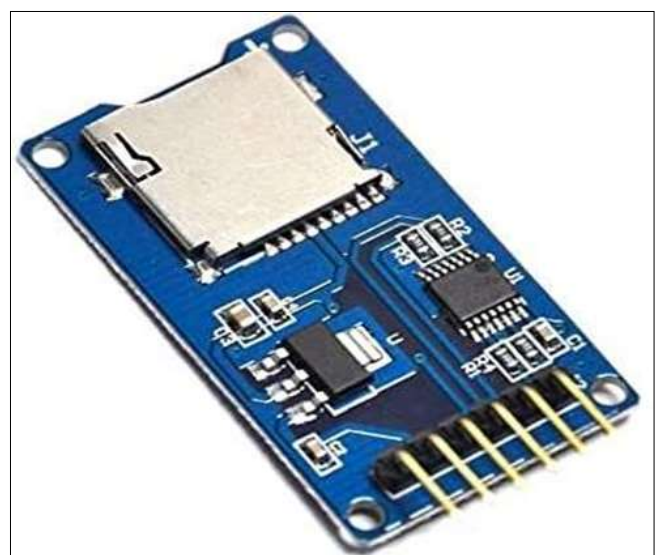


Fig 8: SD CARD ARDUINO

4.2 Speaker module for Arduino

It outputs the sound and amplifies it and considers the alarm part of the device in case of danger, Anbuselvan A, 2013 [7].



Fig 9: Speaker module for Arduino

4.3 Buzzer Arduino

Tiny speaker that you can connect directly to an Arduino. You can make it sound a tone at a frequency you set. The buzzer produces sound based on reverse of the piezoelectric effect. (Khan MM, 2021) [8].

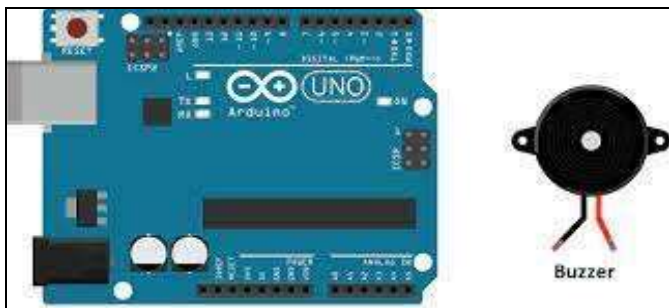


Fig 10: Buzzer Arduino

4.4 Voltage step down and current step up with Arduino

In all electronic projects, feeding the project with a source of effort is one of the most important and priority matters before starting any project. Feeding an electronic circuit with a voltage higher than what some electronic parts can bear may cause it to burn and damage, or when feeding it with a lower voltage, the circuits may not work. (Kazadi S, 2020) [9].



Fig 11: Voltage step down and current step up with Arduino

4.5 Project Implementation

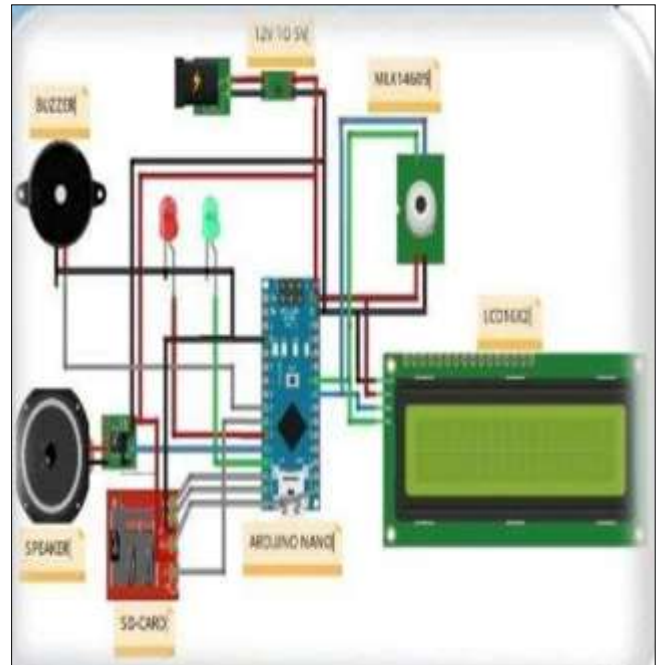


Fig 12: Blok diagram

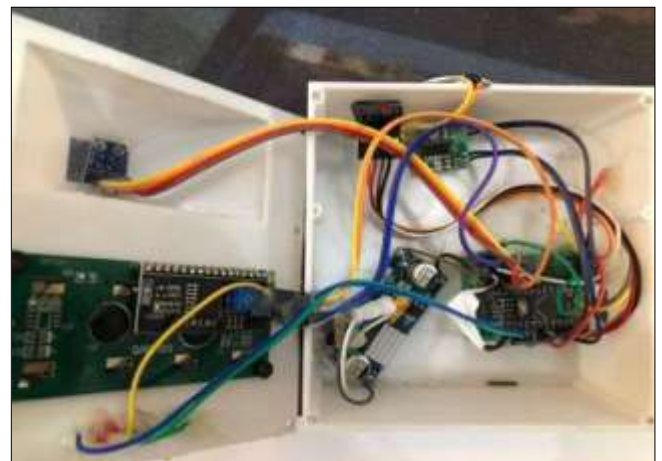


Fig 13: Project Implementation



Fig 14: Project Implementation

4.6 Programming

```
// read button
buttonValue = digitalRead(buttonPin); if (buttonValue ==
LOW) { // button has been pressed beep(); // Play a beep //
determines object temperature
```

```
bodyTemperature=mlx.readObjectTempC();
// manual adjustment to temp reading
bodyTemperature=bodyTemperature+adjustTemp;
// send temperature to the 7 segment display
display.showNumberDec(bodyTemperature, false,4);
// Play mp3 doorbell sound
execute_CMD(0x0F,0x01,0x01);
// compare temperature with high fever in celsius if
(bodyTemperature>38) {
Serial.println("High fever"); // play mp3 alert sound
execute_CMD(0x0F,0x01,0x02);
Serial.println();
// delay until next push button reading delay(5000);
} // button pressed
Discussion and Future works [10].
```

5. Discussion

One of the important discussions is that we are working in an accurate way to summarize the problems that occur in a device such as power outages and others, and turn this work to work on a battery to ensure the continuity of the device's work and provide continuous monitoring of the area for fear of the spread of the virus "Covid-19"

6. Future works

The most important future work that will be available in this device is to work with it remotely via the Internet, and we can also add some important parts such as measuring air temperature and humidity, knowing the changes that occur and eliminating problems that negatively affect the device and getting rid of them in addition to a surveillance camera. It works in conjunction with the proximity of the person to the area in which the device is located and monitoring the entire place.

7. Conclusion

The conclusion of the document on the design and implementation of a COVID-19 detector in a doorbell touches on discussions of device reliability amidst power outages and the integration of battery operation for uninterrupted functionality. It highlights future enhancements, including remote operation via the internet, addition of air temperature and humidity sensors, and the integration of a surveillance camera to monitor the vicinity of the device. These improvements aim at expanding the capabilities of the device for comprehensive environmental monitoring and ensuring operational resilience against external factors that may impact its effectiveness in detecting COVID-19 symptoms.

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