CHAPTER 1: INTRODUCTION

1.1 Literature Survey:

At present, the whole world is going through a pandemic due to coronavirus disease (COVID-19), which was first spotted in December 2019 in Wuhan, China. Since this virus is highly contagious,the World Health Organization (WHO) [1] has provided some guidelines to reduce its community trans-mission in various ways. One of the mandatory recommended actions is to perform hand washes/rubwith soap/hand sanitizer in a frequent manner [1]. In principle, hand hygiene is now recognized as oneof the most crucial issues for infection prevention and control. In the wake of the increasing severity ofdisease and treatment complexity, and a global pandemic superimposed by multidrug resistant (MDR)pathogen infections, the healthcare professionals (HCPs) are now returning to the basics of infectionprevention by simple measures such as hand hygiene [2]. A relevant study conducted by White et al.[3] has shown a decrease of 14.8–39.9disease symptoms among residential students (university) due toa general improvement of hand hygiene behavior. Alcohol-based hand sanitizer (ABHS) is a usefulmaterial against the spread of infectious viruses in crowded areas such as clinics, workplaces, schools,etc. [2] It also helps to reduce the spread of disease-causing germs and bacteria. Early comprehensiveresearch on the effectiveness of antiseptic hand rubs revealed that ABHS significantly reduces bacterialcounts on hands [3]. Ehrenkranz et al. [4] reported that the ABHS is more effective in preventingthe hand transfer of Gram-negative bacteria than the bland soap hand wash. The hand sanitizerdispenser plays a significant role to allow individuals to wash/rub their hands using ABHS while onthe go. A study by Fournier et al. [5] reported that the use of a strategically positioned hand sanitizerdispenser was successful in raising hand hygiene activity from 1.52with pushbuttons, touchless, etc.,are available to dispense the liquid or gaseous sanitizing materials. In public places including hospi-tals, the use of mechanical dispensers is found widespread. Since physical contact is mandatory forusing mechanical dispensers, they are vulnerable to pathogen infection. By performing a study on thehospital-based mechanical hand sanitizer dispenser, Erief et al. [6] concluded that the infected personmay contaminate the dispenser which may trigger hospital-acquired infection. Automated pushbuttonhand sanitizer dispensers are usually deployed in healthcare facilities, but these devices often havethe possibility of being contaminated and become a center for pathogens [7]. Based on some otherearlier studies [6,7], it is clear that mechanical and electrical dispensers (having a pushbutton) are vulnerable as these can be contaminated with pathogens that cause hand-associated infections (HAI).Consequently, nowadays, automated touchless sanitizers are taking place in healthcare facilities, es-pecially in developed countries

[8]. As this dispenser does not require any human contact to operate,it can be very effective to stop the spread of infectious diseases if used carefully. A sanitizer dispensercan be made touchless automatic in different ways since various types of sensors can be used to sensethe proximity [8]. Generally, ultrasound sensors [9–15] and infrared sensors [16–20] are used to makea low-cost sanitizer dispenser, but they show poor performances in public places where there is alot of noise. Some dispensers are based on infrared radiation (IR) sensors, but they show malfunc-tions especially on sunny days where sunlight intensity varies because of clouds or reflection from theground. However, such drawbacks can be easily overcome by using a light-dependent resistor (LDR)or photoresistive light sensor. In the present study, a laser light is used to block other reflectionsof light in the photoresistive light sensor, and this method of laser-based proximity tracking usingan LDR sensor has proven to be more effective and more user friendly while considered to be usedin busy public places. It is true that a large number of very low-income populations are living inthe so-called developing countries like Bangladesh, Afghanistan, Cambodia, Guinea, Haiti, Laos, etc.,and most of the time, some public places like bus stands, train stations, raw markets, hospitals, etc.,remain crowded in those countries. The common population usually does not have the capability oris careless to maintain individual sanitization in a frequent manner. In such a situation, a touchlessautomated hand sanitizer dispenser is essential to stop the spreading of pathogens. Fortunately, dueto the advancement of science and technology, it becomes possible to locally fabricate a Healthcare2021, 9, 445 3 of 17 low-cost automated hand sanitizer dispenser, and such a low-cost device maybe very effective to be deployed in public places and individual use as well. After a thorough anal-ysis of both the online and offline market authors found that photo resistor sensor-based dispenserdevices are not available in the market. In most of the dispenser devices, an infrared sensor is usedfor reducing the complexity and some devices are based on ultrasonic sensors. Based on the authors'knowledge, this unique concept of making dispenser devices using an LDR (light dependent resistor) sensor with a laser light has received less attention from the scientific community, thus forms the mainsubject matters of this study. The main objective of this study is to facilitate the process of assem-bling and making a low-cost hand sanitizer dispenser, which is fully touchless and automated usinglaser detection technology. In this paper, a novel design of an automated hand sanitizer dispenser isproposed, and subsequently, fabricated using the low-cost components that are commonly available inalmost every developing country. A photoelectric resistor (LDR) is used to detect human hands insidethe laser detection chamber, and this sensor is perfectly compatible with both daylight and night. Acomprehensive discussion of the fabricated device with respect to the conventional ones is presented toshow the pros and cons of this device.

Thus, this study may help to stop the COVID-19 transmissionin densely populated developing countries where industrial/commercial dispensers are costly and notreadily available.

1.2 Problem Definition:

The government through the Ministry of Education and Culture has made a decision to suspend teaching and learning activities in schools. The learning process that starts face to face directly in the classroom turns into distance learning /brave. However, the government decided to reopen schools in the Covid-19 corona virus green zone for teaching and learning activities for students. The opening of special schools in the green zone will be held in mid-July 2020. School openings must be opened with strict health protocols, no updated potential for new Covid-19 clusters in schools. This is a form of application of the "New Normal" that is being adapted to the people of Indonesia. Indonesian people must consider the existence of this corona virus pandemic with new normalcy, such as using a compilation mask outside the home, always using a hand compass tool and using a loudspeaker and distance measuring device. The purpose of this study was to make an automated hand sanitizer design as an effort to improve the delivery of Covid-19 in schools. Automatic hand sanitizer is useful to facilitate the hand sanitizer liquid out of the bottle, so it is more effective to use and does not run out quickly. This study uses an Arduino Nano microcontroller as the main control, a human hand detection sensor, and a servo motor as an actuator that will activate the automatic bottle. The mouth of the hand sanitizer bottle uses an elastic hose that leads to the part where the cleaning liquid comes out. This research uses the Research and Development (RnD) method. The result of this research is an automatic hand sanitizer with a large size hand sanitizer that can be mounted into a tool with a maximum of 500 ml. This automatic hand sanitizer will automatically release the hand sanitizer fluid which approves the sensor under the user's hand protective device.

1.3 Objectives:

1. To design an automatic hand sanitizer which dispenses on its own whenever someone place its hand beneath it.
2. This should be easy to use, light weight and occupy less space.

1.4 Proposed Solution:

This project is all about how to create an automatic hand sanitizer using an Ultrasonic sensor and Arduino. You have already seen a lot many hand sanitizers based on IR sensors, and those hand sanitizers are really simple and easy to make. But those sanitizers are not efficient and accurate as hand sanitizers based on the ultrasonic sensors. The main problem with the IR sensor-based hand sanitizer is that you can't place them under direct sunlight as the sunlight interferes with the IR sensor. Also, the maximum distance of the IR sensor for detecting the hand is less than 10cm but in an Ultrasonic sensor-based hand sanitizer you can set the distance to more than 10 cm.

In our project when the sensor detects the hand of a person it will automatically dispense the sanitizer on the user's hand. We have used Ultrasonic sensor to calculate the distance of our hand from the sensor. If the hand is close to the dispenser the Arduino will activate the pump and the sanitizer will be expelled out of the bottle through the tube. Ultrasonic sensor is an electronic device which is capable of transmitting and receiving ultrasonic sound wave and calculating the distance from the sensor to the obstacle by making use of time required for sound wave to reach back to the sensor. Using this we can calculate the distance of our hand from the dispenser bottle. If the hand is right below i.e. 5cm from the sensor we turn on the pump using the transistor which is connected to the pin 5 of Arduino. Below is the given circuit diagram of our project.

1.5 Wireless Technology Used:

1. Ultrasonic Sensor:

An ultrasonic sensor is a device that is capable of transmitting and receiving ultrasonic sound waves out into the air and calculates the distance from the sensor to the obstacle by making use of the time required for the sound wave to reach back the sensor. If you are not sure about the Ultrasonic sensor and distance calculation, we have an entire article just for that. Using this, we can calculate the distance of our hands from the dispenser bottle. If the hand is right below the valve, that is 5 cm from the sensor, we turn on the pump using a transistor which is connected to pin 5 of the Arduino.

An ultrasonic sensor is an instrument that measures the distance to an object using ultrasonic sound waves. An ultrasonic sensor uses a transducer to send and receive ultrasonic pulses that relay back information about an object's proximity. High-frequency sound waves reflect from boundaries to produce distinct echo patterns.

How Ultrasonic Sensors Work?

Ultrasonic sensors work by sending out a sound wave at a frequency above the range of human hearing. The transducer of the sensor acts as a microphone to receive and send the ultrasonic sound. Our ultrasonic sensors, like many others, use a single transducer to send a pulse and to receive the echo. The sensor determines the distance to a target by measuring time lapses between the sending and receiving of the ultrasonic pulse.

The working principle of this module is simple. It sends an ultrasonic pulse out at 40 kHz which travels through the air and if there is an obstacle or object, it will bounce back to the sensor. By calculating the travel time and the speed of sound, the distance can be calculated.

Ultrasonic sensors are a great solution for the detection of clear objects. For liquid level measurement, applications that use infrared sensors, for instance, struggle with this particular use case because of target translucence. For presence detection, ultrasonic sensors detect objects regardless of the colour, surface, or material (unless the material is very soft like wool, as it would absorb sound.) To detect transparent and other items where optical technologies may fail, ultrasonic sensors are a reliable choice.

2. Arduino Uno:

Arduino UNO is a low-cost, flexible, and easy-to-use programmable open-source microcontroller board that can be integrated into a variety of electronic projects. This board can be interfaced with other Arduino boards, Arduino shields, Raspberry Pi boards and can control relays, LEDs, servos, and motors as an output. Arduino UNO features AVR microcontroller Atmega328, 6 analogue input pins, and 14 digital I/O pins out of which 6 are used as PWM output. This board contains a USB interface i.e. USB cable is used to connect the board with the computer and Arduino IDE (Integrated Development Environment) software is used to program the board.

Arduino UNO Components-

The Arduino UNO board contains the following components and specifications:

ATmega328: This is the brain of the board in which the program is stored.

Ground Pin: there are several ground pins incorporated on the board.

PWM: the board contains 6 PWM pins. PWM stands for Pulse Width Modulation, using this process we can control the speed of the servo motor, DC motor, and brightness of the LED.

Digital I/O Pins: there are 14 digital (0-13) I/O pins available on the board that can be connected with external electronic components.

Analogue Pins: there are 6 analogue pins integrated on the board. These pins can read the analogue sensor and can convert it into a digital signal.

AREF: It is an Analog Reference Pin used to set an external reference voltage.

Reset Button: This button will reset the code loaded into the board. This button is useful when the board hangs up, pressing this button will take the entire board into an initial state.

USB Interface: This interface is used to connect the board with the computer and to upload the Arduino sketches (Arduino Program is called a Sketch)

DC Power Jack: This is used to power up the board with a power supply.

Power LED: This is a power LED that lights up when the board is connected with the power source.

Micro SD Card: The UNO board supports a micro SD card that allows the board to store more information.

3.3V: This pin is used to supply 3.3V power to your projects.

5V: This pin is used to supply 5V power to your projects.

VIN: It is the input voltage applied to the UNO board.

Voltage Regulator: The voltage regulator controls the voltage that goes into the board.

SPI: The SPI stands for Serial Peripheral Interface. Four Pins 10(SS), 11(MOSI), 12(MISO), 13(SCK) are used for this communication.

TX/RX: Pins TX and RX are used for serial communication. The TX is a transmit pin used to transmit the serial data while RX is a receive pin used to receive serial data.

The unit comes with 32KB flash memory that is used to store the number of instructions while the SRAM is 2KB and EEPROM is 1KB. The operating voltage of the unit is 5V which projects the microcontroller on the board and its associated circuitry operates at 5V while the input voltage ranges between 6V to 20V and the recommended input voltage ranges from 7V to 12V.

How to Program Arduino UNO?

Arduino UNO is easy to program and a person with little or no technical knowledge can get hands-on experience with this board. The Arduino UNO board is programmed using Arduino IDE software which is an official software introduced by Arduino.cc to program the board. The Arduino program is called a sketch which you need to unload into the board. The sketch is nothing but a set of instructions that allow the board to perform certain functions as per your requirements.

Each Arduino sketch comes with two main parts:

void setup() – this sets up the things that need to be done once and they don’t happen again in the running program.

void loop() – this part comes with the instructions that get repeated again and again until the board is turned off.

CHAPTER 2: SYSTEM DESIGN

2.1 Block Diagram

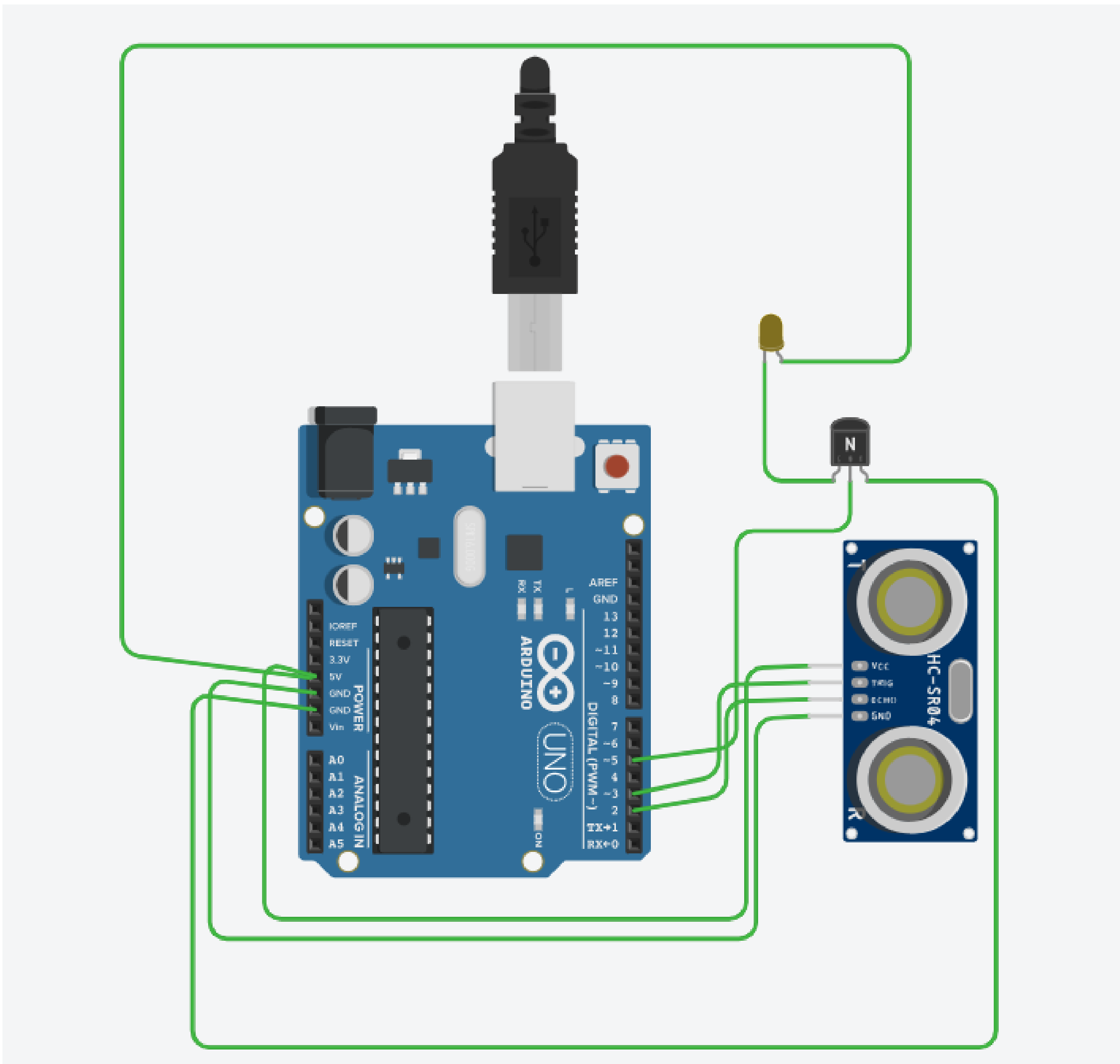


Fig 2.1: Block Diagram

2.2 Circuit Diagram

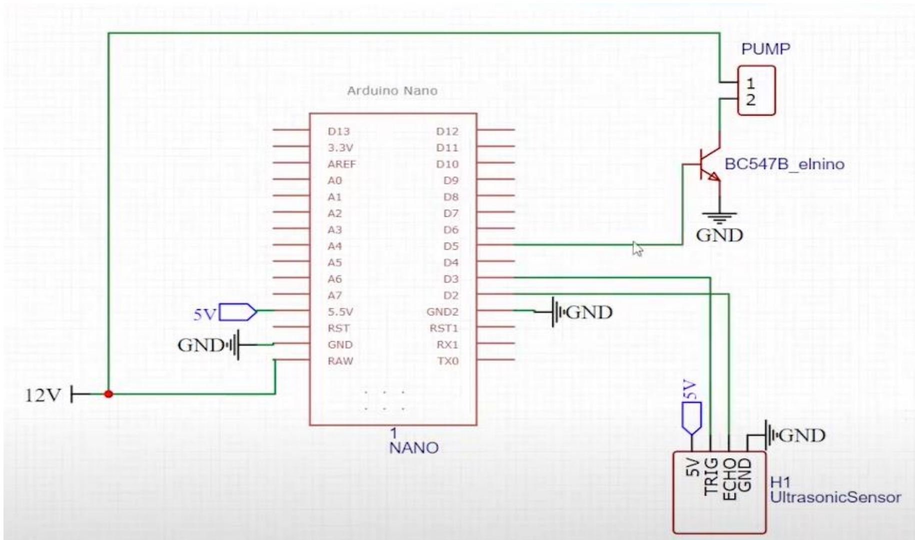


Fig 2.2: Circuit Diagram

In this project, ultrasonic sensor, voltage regulator (IC 7805), Transistor (BC547) and a pump is interfaced with arduino uno along with a 12V adapter. Arduino Uno has both digital as well as analog pins but for our project we will be using the digital pins of arduino uno for connections. Adapter's (12V) positive pin is connected to the terminal 1 of IC 7805. Basically, IC 7805 has 3 terminals if the flat side of IC faces us, Then the 1st terminal is for the input voltage, 2nd terminal is for ground and 3rd terminal is for 5V output as we need 5V to operate ultrasonic sensors and arduino. Adapter's negative pin is connected to the common ground rail on breadboard. 2nd terminal(Ground) of IC 7805 is connected to the common ground rail on breadboard and from 3rd terminal of IC 7805, wire is being taken out and connected to the arduino's 5V pin using breadboard. Arduino uno's common ground too is connected to the common ground rail on breadboard. Ultrasonic sensor's vcc is connected along with arduino uno's 5V point on breadboard and ground of ultrasonic sensor is being connected to the common ground rail on breadboard. Ultrasonic sensor's trigger pin is connected to digital pin D3 whereas echo pin is connected to digital pin D2. A wire is being taken out from arduino uno's digital pin D5 and it is connected to the base of transistor whereas emitter of transistor is grounded to the common rail on breadboard. Pump has 2 terminals. Transistor's collector pin is connected to one of the terminal of pump. Pump's second terminal is connected to the positive pin of 12V adapter as the pump operates on 12V. After powering on the circuit, Ultrasonic sensor transmits the signals from trig end. Basically, the function of a transistor in this project is, it is doing switching operation. Whenever the sensor detects anything in its path it will reflect back to echo end of sensor and further activate the transistor to turn on the pump for the specified duration till the path of sensor is clear. If nothing is detected, pump will never turn on.

2.3 Flowchart

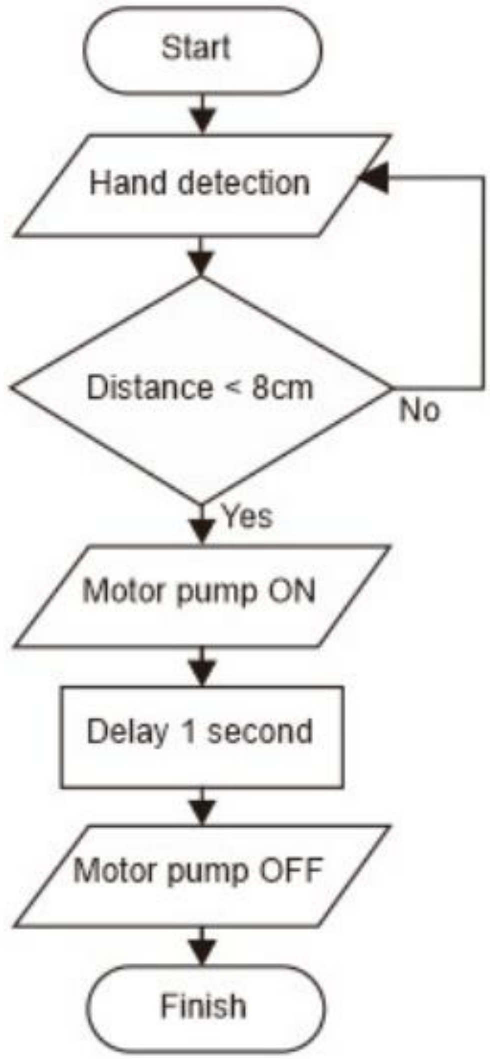


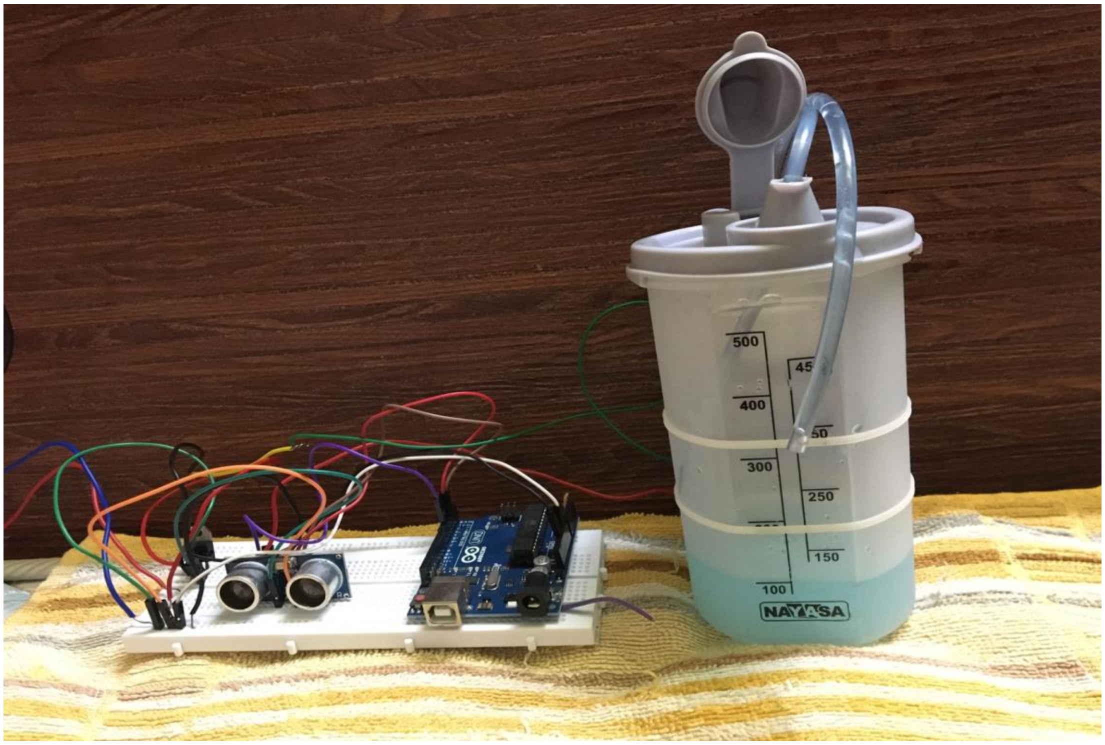
Fig 2.3: Flowchart

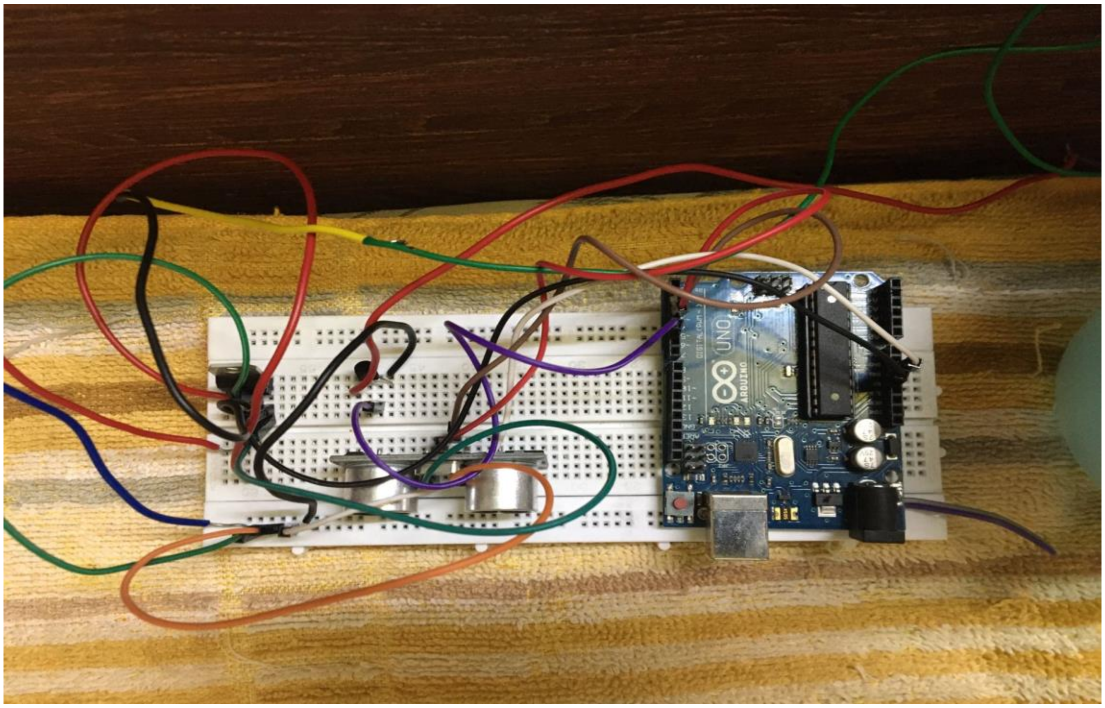
2.4 Hardware and software requirements

Sr. No	Name of Component	Specification	Quantity	Cost
1	Breadboard	-	1	93/-
2	Arduino Uno	UnoR3	1	520/-
3	Ultrasonic Sensor	-	1	239/-
4	Pump	12 V	1	449/-
5	Connecting wires	-	As per required	96/-
6	Transistor	5 V	1	5/-
7	Adapter	12 V	1	250/-
8	IC	5 V	1	10/-
9	Arduino Cable	-	1	75/-
			Total	1737/-

CHAPTER 3: IMPLEMENTATION

3.1 Snapshots





3.2 Photograph and Working video links

Link for video: https://github.com/AfrahMukadam/Sensor-Lab-Project.git

3.3 Code

```
#define echoPin 2

#define trigPin 3

long duration;
int distance;

void setup() {
  pinMode(trigPin, OUTPUT);
  pinMode(echoPin, INPUT);
  pinMode(5, OUTPUT);
  Serial.begin(9600);
}
void loop() {

  digitalWrite(trigPin, LOW);
  delayMicroseconds(2);
  digitalWrite(trigPin, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPin, LOW);
  duration = pulseIn(echoPin, HIGH);
  distance = duration * 0.034 / 2;
  Serial.print("Distance: ");
  Serial.print(distance);
  Serial.println(" cm");
  if (distance<=3)
  {
    digitalWrite(5, HIGH);
    Serial.print("Pump On");
    delay(150);
    digitalWrite(5, LOW);
    Serial.print("Pump OFF");
    delay(2000);
  }
  else
  {
```

```
    digitalWrite(5, LOW);
    Serial.print("Pump OFF");

  }
  delay(50);
}
```

The code is pretty simple. Here we initialize the pins, the echo pin, the trigger pin and the pump, set the pin mode and initialize the serial interface. Then, we make use of the Ultrasonic sensor to measure the distance from the hand, convert it to centimeters and store the value in the variable distance. In the final step, we write a condition to turn on Pin 5 for a particular duration when the hand is close to the sanitizer bottle.

3.4 Future scope

1. In future, we can enhance this project by displaying the message on LCD display when the sanitizer bottle becomes empty.
2. Also, we can detect the user's body temperature while dispelling the sanitizer on user's hand once the hand is detected by the ultrasonic sensor.

CHAPTER 4: CONCLUSION

Based on the results of the research on the design of the automatic hand sanitizer, it can be concluded that the hand sanitizer can work well when the hands are at a distance of at most 3 cm. According to the researchers, 7 cm is considered ideal because it has been adjusted to the discharge pipe for the hand sanitizer. The hand sanitizer liquid can be used up to 100 times.

CHAPTER 5: REFERENCES

1. https://rootsaid.com/automatic-hand-sanitizer-dispenser-using-arduino/

2. https://www.maxbotix.com/articles/how-ultrasonic-sensors-work.htm#:~:text=An%20ultrasonic%20sensor%20is%20an,information%20about%20an%20object's%20proximity.

3. Design Automatic Hand Sanitizer Microcontroller Based using Arduino Nano and Ultrasonic Sensors as an Effort to Prevent the Spread of Covid-19 Meini Sondang Sumbawati1* Aditya Chandra H1 Tri Wrahatnolo1 Ibrohim1 L. Endah Cahya Ningrum1 Khusnul Khotimah2 Ali Nur Fathoni3

4. https://www.youtube.com/watch?v=6hASapzMa-o&t=126