A

PBL PROJECT REPORT

ON

"AUTOMATIC HAND SANITIZER DISPENSER"

FOR PARTIAL FULFILLMENT

OF THE REQUIREMENTS FOR THE

PROJECT BASED LEARNING

OF S.E. E&TC – 2019 COURSE, SPPU, PUNE

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CERTIFICATE

This is to certify that the Mini Project Report entitled

Automatic Hand Sanitizer Dispenser

has been successfully completed by

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Is a bona fide work carried out by them under the supervision of Mr. Mandar Kakade Sir and it is approved for the partial fulfillment of the requirements for the Project based learning of S.E. E&TC – 2019 Course of the Savitribai Phule Pune University, Pune.

Prof.Mandar Kakade — Dr.Mousami Munot

Project Guide — HOD, E&TC

Dept. of E&TC

Place: Pune

Date :

ACKNOWLEDGEMENT

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CHAPTER 1

Introduction

1.1 Abstract

In the wake of the global pandemic of covid-19, there is a high demand of automatic hand sanitizer dispensers as they would prevent the spread of COVID-19. They are in high demand as humans don't need to have any physical contact with the dispensers.

1.1 Background

Sanitization means cleaning or sterilizing an object or body part like hands or whole body. Sanitization can be done in many ways including UV Sanitization, Soap Sanitization, Alcohol Sanitization, Bleach Sanitization and so on. Of the above methods, alcohol was found to be more useful for human beings since it is harmless on skin surface, vaporizes easily and kills most of the viruses, bacteria, and also removes dirt in our hands. Alcohol may be expensive for mass scale sanitization of buildings or rooms and a major disadvantage is that, alcohol is highly inflammable and requires careful storage to avoid catastrophe. Alcohol also makes hands dry since it absorbs moisture, and hence also needs addition of moisturizers. Alcohol based hand sanitizers are also provided with antiseptic disinfectants like Chlorohexidine Gluconate. Minimum concentration of alcohol in hand sanitizers must be greater than 70% for effectiveness against viruses. But, repeatedly touching the hand sanitizer containers to get a drop of sanitizer again initiates contact with persons, which may be risky. Hence there is need for non-contact-based hand sanitizer dispenser.

1.2 Relevance

In the following project we have used various electronic components like Arduino UNO, Ultrasonic Sensor, Servo Motor which we have studied about in our previous semester (3rd SEM). Most of the concepts used for implementation of the

project were from the subjects of Electronic Circuits (EXC) and Digital Circuits (DCKT).

1.3 Literature Survey

In [1], the paper mainly says about the hospital grasped infections, which is about 2 million Patients per year and also says that it is 8th leading cause for deaths annually in USA. It also says that handwashing is important and also effective with proper hand washing steps, but washing with soap and water is time consuming for peak hours in hospitals. This paper also showed the effectiveness of the alcohol-based hand sanitizers, which reduced infection rates by whopping 30%. They used hand sanitizers with 60 to 70 percent ethanol or isopropanol for reducing significant number of pathogens. The patients were also given about 4.25-ounce containers of hand sanitizer alongside their beds. For 10-month period of using hand sanitizers showed a result of 36.1% infection reduction.

In [2], the paper says about the infection caused by drug resistant micro-organisms which causes increase in death rate and also complications, the multidrug resistant bacteria include Methicillin Resistant Staphylococcus aureus (MRSA), Extended Spectrum Beta-lactamase (ESBL) producing bacteria, Multidrug Resistant Pseudomonas aeruginosa (MDRP), which are very common worldwide. Several antibiotics have increasing multidrug bacteria isolation rate, even personal protection equipment (PPE) can't be effective in isolation rate of MSRA. Hence, they emphasize about the use of alcohol-based hand sanitizers since the alcohol based hand sanitizers had negative association with MRSA isolation rate, which means that hand hygiene is very important in hospitals.

In [3], the paper says about emergence of the novel Coronavirus (SARS-CoV-2), which has caused unexpected challenges to health of the people of this world, the paper also aims at reducing the transmission rate of the disease. The paper explains about the virus structure and how is it different from that of the bacterial structure, which means that virus has single stranded or double stranded RNA or DNA encapsulated in 'capsid' and virus can replicate only in presence of a host and described as 'living entities. Bacteria also has almost the same structure including DNA or RNA along with 'Cell Membrane' and can replicate without a host. The

paper also gives a complete comparison between hand sanitizers and soap, foam vs gel, and it says that high concentration of ethanol can reduce the amount of virus particle present in the hand and hence proves the effectiveness of alcohol-based hand sanitizer.

1.4 Motivation

Being the students of Electronics and Telecommunications Engineering, during the pandemic almost two of our academic years were completely online and we haven't got any hands-on experience some important subjects like Workshop in FE and Electronic Skills Development in SE SEM-I. So, we thought the awareness of this topic would not only make a change in the current world scenario but it would also be a perfect start to help us get an actual experience of hardware project for the first time and develop our skills for the future.

1.5 Aim of the Project

The aim of this project is to make an Automatic Hand Sanitizer Dispenser using the components like Arduino Uno, Ultrasonic Sensor HC-SR04, Servo Motor and Jumper Cables and the system should be adjustable to accommodate most sanitizer bottles.

1.6 Scope and Objectives

So, to tackle this problem we have made a contactless, automatic hand sanitizer dispenser. This automatic hand sanitizer should automatically release the hand sanitizer fluid which approves the sensor under the user's hand protective device. Here, an ultrasonic sensor should sense the hand placed near it. The Arduino uno should be used as a microcontroller, which senses the distance and the result is the pump running to pump out the hand sanitizer. This is really useful as it prevents cross

contamination of any bacteria and viruses. This also minimizes the spread of viruses and diseases in public and can be used at various public places and working sectors.

CHAPTER 2

Description of Project

2.1 Technical Approach

Making an Automatic Hand sanitizer based on a Microcontroller is an automatic system that functions to increase the efficiency of using the hand sanitizer so that it is more effectively used and does not run out quickly in use. Automatic hand sanitizer is useful for making it easier for the hand sanitizer liquid to come out of the bottle, so that you don't have to press the bottle first. This Automatic Hand sanitizer uses the Arduino Uno as a microcontroller and an ultrasonic sensor as a human hand detector.
Research and Development (R&D) methods are research methods used to research a product to produce a new product and then test the effectiveness of the product so that it can function in the wider community. This research and development method was chosen because it is longitudinal and still can be developed in the future. Using online simulators like tinker CAD to ensure the circuit that we put together is error free and correct to the mark

2.2 Block diagram

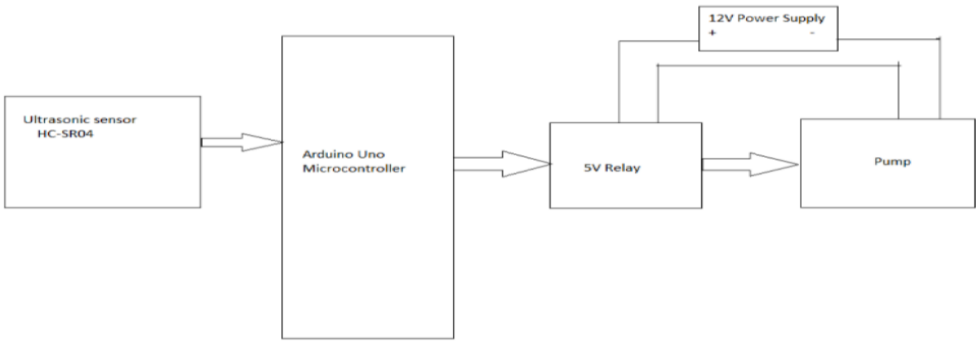

Fig No.2.1(Block Diagram)

The working principle of the automatic sanitizer dispenser is to actuate the servo to press the sanitizer tap whenever the sensor observes a low distance reading due to an obstruction in its line-of-sight. When a person’s hand comes below the sanitizer and obstructs the sensor line-of-sight, the Arduino board receives a low distance reading and instructs the servo motor to actuate and dispense the sanitizer.

2.3 Flow chart

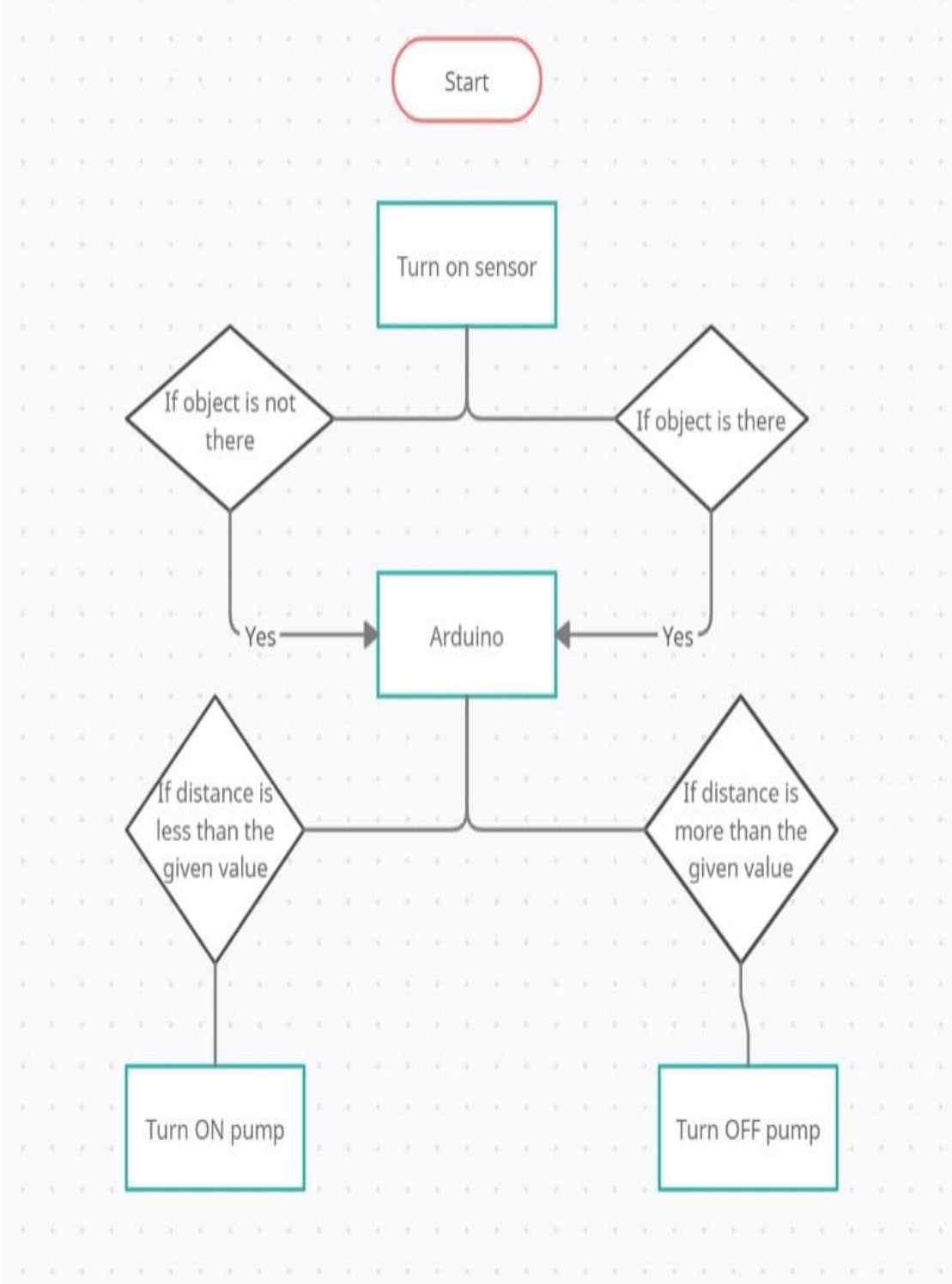

Fig No. 2.2(Flowchart)

2.4 Hardware / software resources

1)Arduino Uno:

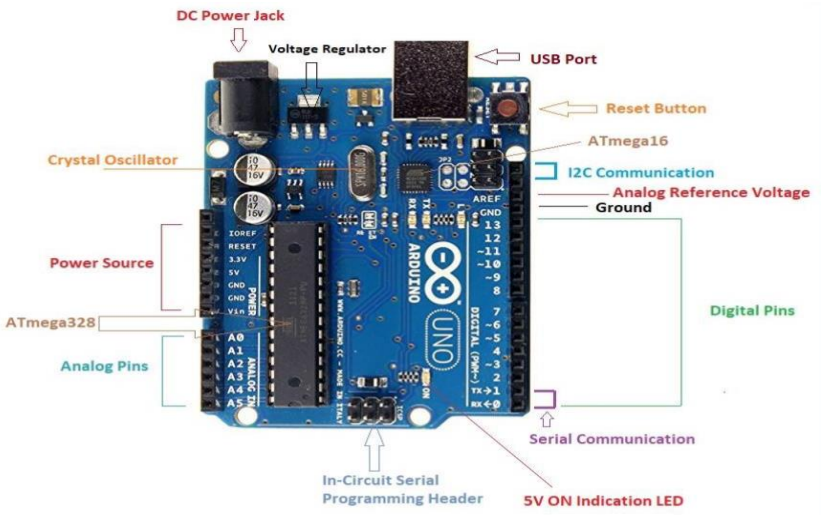

Fig.No.2.3(Arduino UNO)

Arduino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator (CSTCE16M0V53-R0), a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. You can tinker with your Uno without worrying too much about doing something wrong, worst-case scenario you can replace the chip for a few dollars and start over again. “Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0. The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform.

2)MG995 Servo Motor:

Fig 2.4(MG995 Servo Motor)

Since MG995 is a servo motor providing precise rotation over 180º range its applications are many and in them a few are stated below; The servo is suited for designing robotic arm in which wear and tear of motor is high. Being metal geared, the servo has long life and can be installed on system like robotic arm were motor work is huge. The servo is also suited to be used in drones and toy planes. Having a satisfying torque which is enough to overcome air resistance and control wings of plane, the servo is preferred in toy planes and drones which need precision control no matter the condition.

3)HC-SR04 Ultrasonic Sensor:

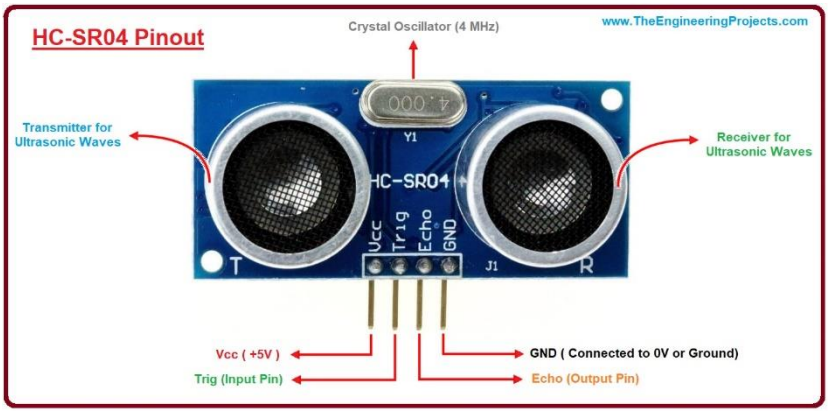

Fig 2.5(HC-SR04 Ultrasonic Sensor)

At its core, the HC-SR04 Ultrasonic distance sensor consists of two ultrasonic transducers. The one acts as a transmitter which converts electrical signal into 40 KHz ultrasonic sound pulses. The receiver listens for the transmitted pulses. If it receives them, it produces an output pulse whose width can be used to determine the distance the pulse travelled. The sensor is small, easy to use in any robotics project and offers excellent non-contact range detection between 2 cm to 400 cm (that's about an inch to 13 feet) with an accuracy of 3mm. Since it operates on 5 volts, it can be hooked directly to an Arduino or any other 5V logic microcontrollers.

4)Jumper Wires:

Fig 2.5(Jumper Wires)

Jumper wires typically come in three versions: male-to-male, male-to-female and female-to-female. The difference between each is in the end point of the wire. Male ends have a pin protruding and can plug into things, while female ends do not and are used to plug things into. Male-to-male jumper wires are the most common and what you likely will use most often. When connecting two ports on a breadboard, a male-to-male wire is what you'll need.

5)TinkerCAD:

Fig 2.6(TinkerCAD software)

Tinkercad is a free, easy-to-use app for 3D design, electronics, and coding. It's used by teachers, kids, hobbyists, and designers to imagine, design, and make anything! Users can quickly learn how to use the Tinkercad software through basic tutorial lessons that focus on the basics of the Tinkercad tool. Additional lessons help users create artistic objects of increasing complexity by tinkering with existing designs, as well as to work collaboratively to create new designs.

6)Proteus Simulation Software:

Fig 2.7(Proteus Software)

Proteus is used to simulate, design and drawing of electronic circuits. It was invented by the Lab center electronic. By using proteus you can make two-dimensional circuits

designs as well. With the use of this engineering software, you can construct and simulate different electrical and electronic circuits on your personal computers or laptops. There are numerous benefits to simulate circuits on proteus before make them practically. Designing of circuits on the proteus takes less time than practical construction of the circuit. The possibility of error is less in software simulation such as loose connection that takes a lot of time to find out connections problems in a practical circuit. Circuit simulations provide the main feature that some components of circuits are not practical then you can construct your circuit on proteus. There is zero possibility of burning and damaging of any electronic component in proteus. The electronic tools that are very expensive can easily get in proteus such as an oscilloscope. Using proteus you can find different parents of circuits such as current, a voltage value of any component and resistance at any instant which is very difficult in a practical circuit.

CHAPTER 3

System Design

3.1 Circuit diagram

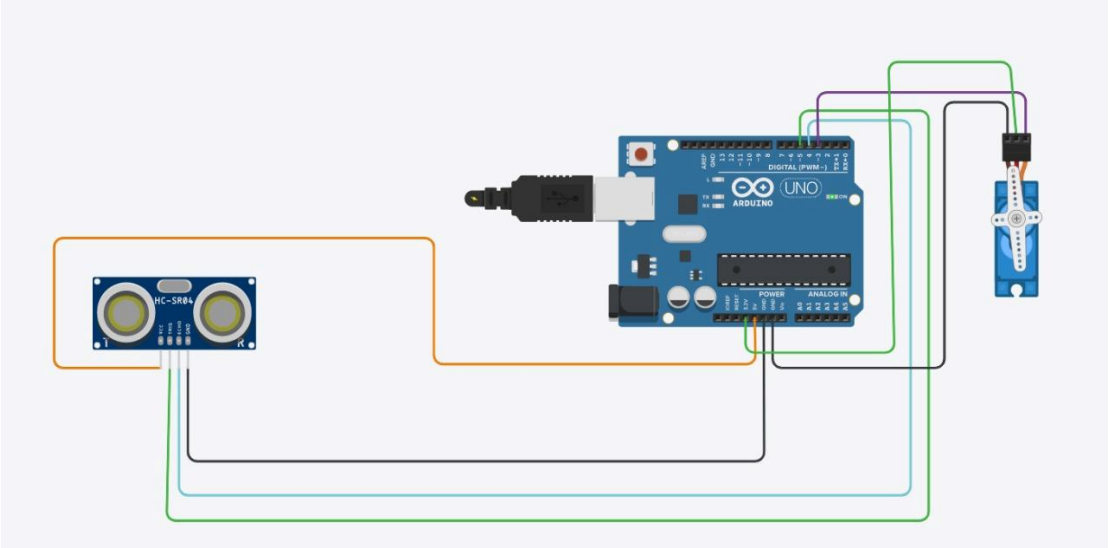

Fig 3.1(Circuit Diagram)

3.2 Design calculation

We actually know both the speed and the time values. The time is the amount of time the Echo pin was HIGH, and the speed is the speed of sound which is 340m/s. There's one additional step we need to do, and that's divide the end result by 2. and that's because we are measuring the duration the sound wave needs to travel to the object and bounce back.

distance = duration*(0.034/2); // (speed in microseconds) // Speed of sound wave (340 m/s) divided by 2 (forward and backward bounce)

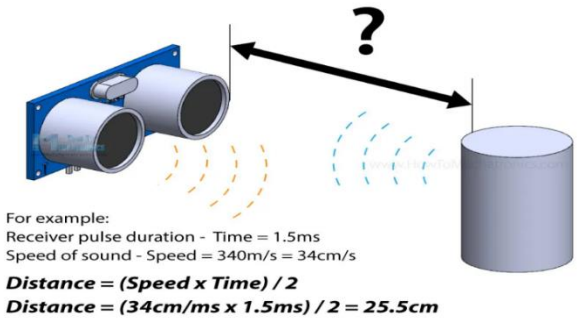

Fig.3.2(Design calculation example)

Let’s say the Echo pin was HIGH for 2ms. If we want the get the distance result in cm, we can convert the speed of sound value from 340m/s to 34cm/ms.

Distance = (Speed x Time) / 2 = (34cm/ms x 1.5ms) / 2 = 25.5cm.

So, if the Echo pin was HIGH for 2ms (which we measure using the pulseIn() function), the distance from the sensor to the object is 34cm.

CHAPTER 4

Implementation and Testing

4.1 Implementation

Firstly take two jumper wires and connect one of them to each pin of HCSR04 and other end of the wire to digital pin 4 of Arduino UNO.The other wire should be connected to trigger pin of HCSR04 and the other end of the wire to digital pin 5 of Arduinon UNO (which is the PWM pin).Connect the ground pin of HCSR04 and MG995 servo motor to the two ground pins of Arduino UNO.Connect the Vcc(power) of HCSR04 to 5V pin of Arduino for power supply.Connect the 2nd pin of MG995 to 3.3V pin of Arduino,which operates on power wrt 3.3V .Connect the 3rd pin of servo to digital pin of Arduino which is the PWM pin. For high power of servo you can also connect the sscond pin of servo to 5V pin of Arduino by soldering .

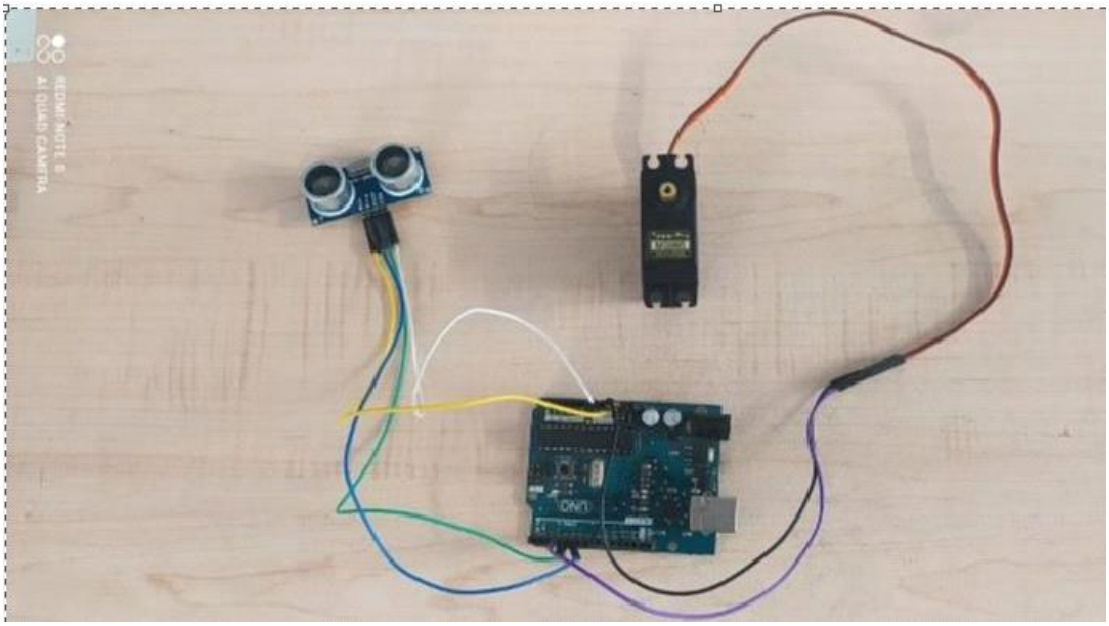

Fig 4.1(Circuit Implementation)

4.2 Testing and debugging

Step - 1

First we launched Proteus simulation software and opened the Arduino IDE in a new window. Here we are using Servo motor. So we need to use the "Servo.h" library for better communication between Arduino and servo motor. Then we define the "echoPin" on digital pin 4 and "trigPin" on digital pin 5. And also declare the variable for calling Servo motor.

Step - 2

While programming the setup part, first we set the attach pin of servo motor by Servo.attach() on the digital pin 3. Then set the echoPin as "INPUT" and trigPin as "OUTPUT" by using the keyword pinMode(). And hence we completed our setup part.

Step - 3

In void loop() part we need to read the total travel time of sound and calculate the distance. The code is explained here. Now we need to write the servo motor to 180 degrees only when the distance is less than or equal to 5 cm. Else the servo position keeps in 0 degree. Then after multiple turns of trial and error we added a delay instruction for wait of 500 milliseconds for the next read. Which completes our coding part in the Arduino IDE.

Step - 4

Now we started working on the setup of circuit. There is only one 5V female Header available in Arduino Uno. So, We need to Joint three male to male jumber wire connect together. After that one end of this jumber wire connect to Arduino board and other to Vcc of the Servo Motor and Vcc of the HC-SR 05. There are two GND connects available in Arduino Uno. So connect the one GND to GND of Servo motor and other GND connect to GND of HC-SR 05. The electronic connection is completed. Then take a thread and tie one end with trigger of the bottle and other end tied with arm of the servo motor. Mound the Servo motor on the bottle. And our hardware setup was completed

We also faced the problem while uploading the code where we were not able to serial port the code even after verifying the code and checking for bugs and errors which should be running perfectly. To solve this we tried uninstalling and installing or even troubleshooting the Arduino library and the Proteus Software. Later the error was fixed when we ran the code through a different device.

CHAPTER 5

Results and conclusion

5.1 Results

In the final product, Arduino is used as a microcontroller for calculating the distance between the sensor and the hand placed below it. If it is less than 5 cm, then pump runs for 100ms through a relay and pumps out few mL of liquid alcohol-based hand sanitizer and also senses the distance for every 1000ms. Components like pump, relay, Arduino microcontroller were tested. The Hand Sanitizer used was liquid type with Isopropanol and Chlorohexidine Gluconate (0.3%). This can also be used for gel type hand sanitizer also.

5.2 Conclusion

Based on the results of the research on the design of the automatic hand sanitizer that the researchers did, it can be concluded that the hand sanitizer can work well when the hands are at a distance of 5 cm. According to the researchers, 5 cm is considered ideal because it has been adjusted to the discharge pipe for the hand sanitizer. The hand sanitizer can be active for approximately 20 hours and one time filling of the hand sanitizer liquid can be used up to 400 times.

5.2 Future Scope

Covid -19 pandemic was an avid example as to why sanitization (and cleanliness in general,) is crucial. As predicted by WHO, there is a possibility for occurrence of more such deadly viral diseases. Hence it is must that we remain prepared for them. This project can be used in various scenarios such as homes, offices, hospitals, schools, institutions. Places where microbial spread is prominent, this unit can be used. As a future expansion, this project idea can also be used for full body sanitization using more number of sensors, and dispensers. Using the basic idea of this project, several smart homes chore can be carried out.

Bill of material

Components	Unit Price	Tax	Quantity	Total Cost
MG995 Servo Motor	Rs.480	Rs.0	1	Rs.480
Jumper Wires	Rs.7	Rs.0	1	Rs.7

References

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[2] Satoru Mitsuboshi, Masami Tsugita, **"Impact of alcohol-based hand sanitizers, antibiotic consumption, and other measures on detection rates of antibiotic resistant bacteria in rural Japanese hospitals"**, *Journal of Infection and Chemotherapy, 2018.*

[3] Golin, A. P., Choi, D., & Ghahary, A. **"Hand Sanitizers: A Review of Ingredients, Mechanisms of Action, Modes of Delivery, and Efficacy Against Coronaviruses".** *American Journal of Infection Control ,2020.*