AUTOMATIC HAND SANITIZER DISPENSER USING ARDUINO

REPORT OF PROJECT SUBMITTED FOR PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF

BACHELOR OF TECHNOLOGY

IN

ELECTRICAL ENGINEERING

By

NAME OF THE STUDENT	REGISTRATION NO.	UNIVERSITY ROLL NO.
SAYATREE PANDIT	171170110408	11701617038
ADITYA SEN	171170110370	11701617076
SAHELI SAHA	171170110402	11701617044
SANDIP KUMAR VERMA	171170110405	11701617041

UNDER THE SUPERVISION OF

MR. DIPANKAR SANTRA

ASSOCIATE PROFESSOR

DEPARTMENT OF ELECTRICAL ENGINEERING

RCC INSTITUTE OF INFORMATION TECHNOLOGY

AT

Department of Electrical Engineering

RCC Institute Of Information Technology

Canal South Road, Beliaghata, Kolkata-700015, West Bengal

Maulana Abul Kalam Azad University of Technology(MAKAUT)

श्रमम् बिना न किमपि साध्यम्

Department Of Electrical Engineering
RCC Institute Of Information Technology
Ground Floor, New
Building, Canal South Road,Beliaghata,
Kolkata-700015, West Bengal
Phone: 033-2323-2463-154, Fax: 033-2323-4668
Email : hodeercciit@gmail.com, Website: http://www.rcciit.org/academic/ee.aspx

CERTIFICATE

To whom it may concern

This to certify that the project work entitled Automatic Hand Sanitizer Dispenser Using Arduino is the bona fide work carried out by Sayatree Pandit(11701617038), Aditya Sen(11701617076), Saheli Saha(11701617044) & Sandip Kumar Verma(11701617041), a student of B.TECH in the Department of Electrical Engineering, RCC Institute Of Information Technology (RCCIIT), Canal South Road, Beliaghata, Kolkata-700015, affiliated to Maulana Abul Kalam Azad University of Technology (MAKAUT), West Bengal, India, during the academic year 2020-21, in partial fulfilment of the requirements for the degree of Bachelor of Technology in Electrical Engineering and this project has not been submitted previously for the award of any other degree, diploma and fellowship.

HoD, Dept. of EE
RCC Institute of Information Technology
Kolkata-700015

Signature of the Guide
Name: Mr. Dipankar Santra
Designation: Associate Professor.
Department of Electrical Engineering.
RCC Institute of Information Technology.

Signature of the HOD
Name: Dr. Debashish Mondal
Designation: HOD, Department Of Electrical Engineering.
RCC Institute of Information Technology.

Signature of the External Examiner
Name:
Designation:

ACKNOWLEDGEMENT

It is our great fortune that we have got opportunity to carry out this project work under the supervision of **Mr. Dipankar Santra** in the Department of Electrical Engineering, RCC Institute of Information Technology (RCCIIT), Canal South Road, Beliaghata, Kolkata-700015, affiliated to Maulana Abul Kalam Azad University of Technology (MAKAUT), West Bengal, India. We express our sincere thanks and deepest sense of gratitude to our guide for his constant support, unparalleled guidance and limitless encouragement.

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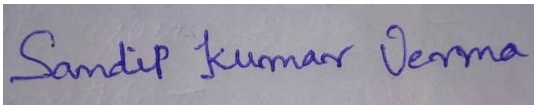
Thanks to the fellow members of our group for working as a team.

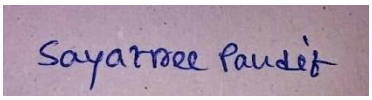
ADITYA SEN (11701617076),

SAHELI SAHA (11701617044),

SANDIP KUMAR VERMA (11701617041),



SAYATREE PANDIT (11701617038)



DEPARTMENT OF ELECTRICAL ENGINEERING.

B.TECH. 4TH YEAR. 8TH SEMESTER.

RCC INSTITUTE OF INFORMATION TECHNOLOGY.

BATCH OF 2017-2021.

To

The Head of the Department

Department of Electrical Engineering

RCC Institute of Information Technology

Canal South Rd.

Beliagahata, Kolkata-700015

Respected Sir,

In accordance with the requirements of the degree of Bachelor of Technology in the Department of Electrical Engineering, RCC Institute of Information Technology, We present the following thesis entitled "**Automatic Hand Sanitizer Dispenser Using Arduino**". This work was performed under the valuable guidance of **Mr. Dipankar Santra**, Associate Professor in the Department of Electrical Engineering.

We declare that the thesis submitted is our own, expected as acknowledge in the test and reference and has not been previously submitted for a degree in any other Institution.

Yours Sincerely,

- **SAYATREE PANDIT (11701617038),**
- **ADITYA SEN (11701617076),**
- **SAHELI SAHA (11701617044),**
- **SANDIP KUMAR VERMA (11701617041)**

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ACRONYMS

PWM - Pulse Width Modulation

ICSP - In Circuit Serial Programming

LED - Light Emitting Diode

USB - Universal Serial Bus

COM - Common

NO - Normally Open

NC - Normally Closed

ABSTRACT

COVID pandemic has influenced human life in various sectors. Various attempts were made to reduce the virus transferring by work from home, social distancing, and also including hand hygiene. As COVID-19 are transferrable through touch and contact, there are WHO guidelines to clean or sanitize hands regularly to reduce the risk of infection. Dispensing of sanitizer from bottle and storage would require manual intervention. And so far, most of the available hand sanitizers do not operate automatically. This article aims to make an automatic hand sanitizer which finds it's use in hospitals, work places, offices, schools and much more to reduce the risk due to contact. Here, the system can sense the proximity with the help of ultrasonic sensor and sends signal to microcontroller (Arduino Nano).The controller processes the sensor data & actuates the pump and solenoid valve. And the result is the sanitizer liquid dispenses through mist nozzle.

CHAPTER 1

(INTRODUCTION)

INTRODUCTION

Hygiene is an important aspect to remain healthy. There are various aspects of hygiene. A clean hand is one of them. Hands generally are touched at various surfaces and can be exposed to direct contamination. Cleaning hands at regular interval is recommended by various health organizations including WHO.

Hand hygiene is now regarded as one of the most important element of infection control activities. In the wake of the growing burden of health care associated infections (HCAIs), the increasing severity of illness and complexity of treatment, superimposed by multi-drug resistant (MDR) pathogen infections, health care practitioners (HCPs) are reversing back to the basics of infection preventions by simple measures like hand hygiene. This is because enough scientific evidence supports the observation that if properly implemented, hand hygiene alone can significantly reduce the risk of cross-transmission of infection in healthcare facilities (HCFs)1-5.

Evidence suggests that hand sanitization significantly reduces the transmission of healthcare-associated pathogens and the incidence of HCAI (healthcare associated infections).[6]. According to the Centre for Disease Control and Prevention (CDC), hand hygiene encompasses the cleansing of your hands using soap and water, antiseptic hand washes, alcohol-based hand sanitizers (ABHS), or surgical hand antiseptics. These days, alcohol-based hand sanitizers are increasingly being used instead of soap and water for hand hygiene in healthcare settings.

Poor or inadequate hand washing and/or hand hygiene is known to be problematic in hospital settings, and is a major source of infections contracted while patients are admitted to a hospital. While hand washing and hygiene policies and training are important and can be effective in reducing the spread of infections, the problem of infections due to unsatisfactory hygiene of staff, medical professionals, and even patients continues to be problematic. It is known to place hand washing stations and hand sanitizer dispensers throughout medical facilities including in examination rooms, hallways, lobbies, and even patient rooms. However, such systems are purely mechanical and are incapable of providing an automated means of establishing accountability of good hygienic practices [7].

During the last quarter of 2019, a collection of unusual pneumonia cases went from a local concern to a global pandemic in a matter of 70 days. The infamous Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) is the virus [8] that was first reported in Wuhan,

China on December 31, 2019, and was announced as a pandemic by the World Health Organization on March 11, 2020. This virus is zoonotic (a virus that is transmitted between animals and humans) and originates from bats [9]. Besides, this virus can also be transmitted from humans to humans. Coronavirus can be transmitted either by air, direct contact, or indirectly. However, it is most commonly spread by droplets. Symptoms caused by this virus include the mild flu, namely a cold, sore throat, cough, fever, and difficulty breathing. In severe cases, Covid-19 can manifest as pneumonia. Patients can develop acute respiratory distress syndrome for a short time and die from multiple organ failure [10].

The existence of this disease has a big impact on both socials and economics. WHO has declared this a pandemic disease and many cities around the world are in a lockdown situation. To prevent the cause of this virus, it can be done by keeping a distance at least 1 meter, avoid going to crowded places, avoid touching the eyes, mouth, and nose when outside, and cleaning hands with soap or alcohol-based hand rub [11]. Providing containers for cleaning fluids in public spaces is a form of Covid-19 prevention, but the provision of containers is currently ineffective because there are parts that are often touched. This could be a point of transmission for Covid-19. Many health actions are carried out using automatic systems including air quality monitoring [12], hand sanitizers [13],hand hygiene[14].Hand sanitizers are an alternative for washing hands during a pandemic. It can be used when and water are not available. Hand sanitizer is also available in several forms such as liquid (spray) or gel [15]. Hand sanitizer is usually made from materials such as alcohol, polyacrylic acid, glycerine, propylene glycol, or plant extracts [16]. The process of killing germs starts with removing the oil on the skin, then the bacteria in the body will come to the surface. Soap or alcohol will kill bacteria after rubbing to your hand. Hand sanitizer is effective against Covid-19.

So far, most of the available hand sanitizers do not operate automatically. This article aims to make an automatic hand sanitizer where sanitizer liquid can come out automatically. Here, the circuit includes a ultrasonic sensor SC-04. The sensor senses the proximity of hands under the machine. The machine is designed for wall mount at a height of 4ft such that anyone can reach to get sanitizer dispense. The sensor send signal to the microcontroller and the controller takes decision to actuate the pump and valve simultaneously to dispense the liquid sanitizer through a mist nozzle.

CHAPTER 2

(LITERATURE SURVEY)

LITERATURE SURVEY

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. In the absence of availability of vaccine or effective antiviral drugs, hand hygiene is a mainstay of efforts to prevent the spread of severe acute respiratory syndrome corona virus 2 (SARS- CoV-2), the virus that causes COVID-19. In the hand sanitizer study, the researchers evaluated the effectiveness of different concentrations of two WHO-recommended and two modified hand sanitizer formulations on COVID-19 virus. The WHO recommends two formulas: (1). 80% ethanol, 1.45% glycerol and 0.125% hydrogen peroxide and (2). 75% 2-propanol, 1.45% glycerol and 0.125% hydrogen peroxide.

However, these formulas failed to meet the effectiveness requirements of European Norm 1500. So, the modified versions used in this study was (1). 80% ethanol,0.725% glycerol and 0.125% hydrogen peroxide and (2). 75% 2-propanol, 0.725% glycerol and 0.125% hydrogen peroxide.

It has been found that WHO formulation had a virus reduction factor of >= 3.8, while the modified versions had a reduction factor of >= 5.9. [17]

This paper showed the effectiveness of the alcohol based hand sanitizers, which reduced infection rates by whopping 30%. The paper also explains about the virus structure and how it is 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.

CHAPTER 3

(PROPOSED SYSTEM)

PROPOSED SYSTEM (Methodology)

Several steps were carried out in this research to test the Automatic hand sanitizer container has shown in Figure.1. Due to the spread of Covid disease, first we analyse the importance of environment needed for automatic hand sanitizer. The second step we make the literature study about the related article. We design the hardware, examine the product and report the result.

Here is the flowchart of the events as follows:

case analysis => research reference => design & modelling => creating an algorithm => connecting hardware => fabrication => testing & debugging => finish report

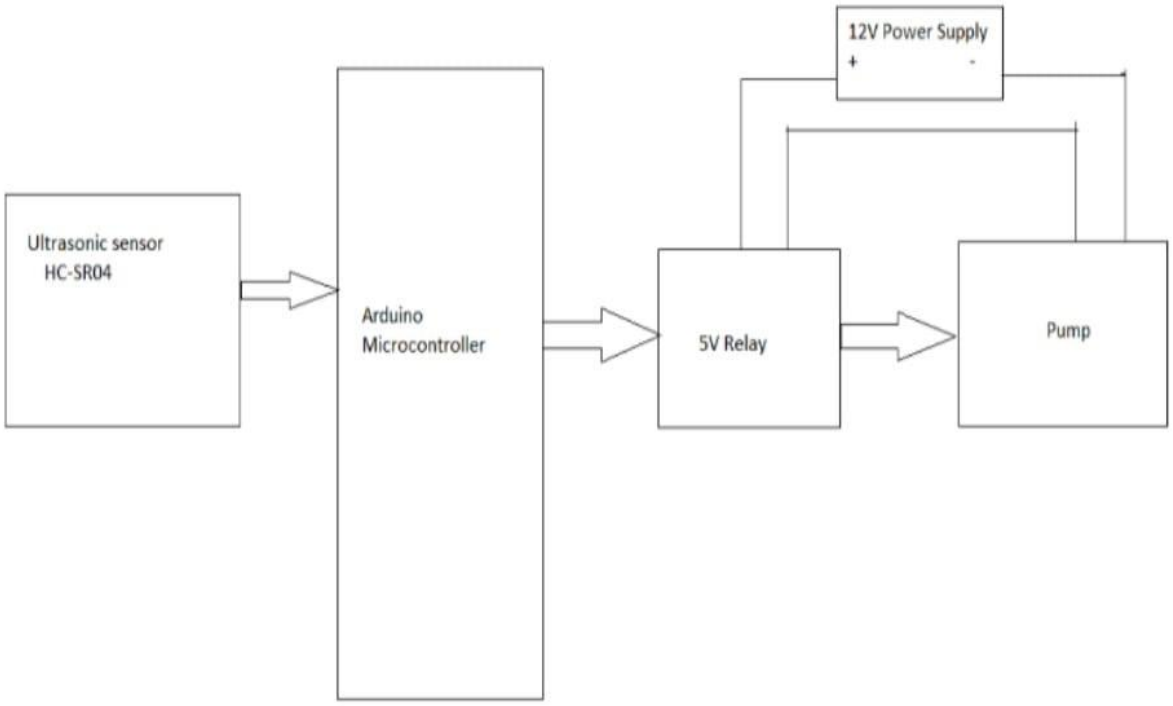


Figure 1

Here, An Arduino Nano microcontroller is used since it is easy to program, has inbuilt ADC, DAC. The input to the Arduino is given using an ultrasonic sensor, which is used to sense the distance, it emits ultrasonic frequency from one side and the notes the time taken by sound wave to get reflected back. The ultrasonic sensor is used to detect hands with a distance of approximately 7 cm from the sensor. If a human hand has been detected, the sensor will send input to the Arduino Nano as a microcontroller (central controller). The Arduino Nano microcontroller is the control main which has a program to access data from the input of the ultrasonic sensor. The Arduino gives a 100ms pulse from it’s digital output pin. The pump cannot be used directly, hence a relay is used as a switch. The relay accepts the pulse from Arduino and makes the pump run. The pump is 3V to 6V submersible type, which pumps out a few drops of hand sanitizer on to the hands, after pumping, the distance is sensed for every 1000ms(1s) for scanning purposes.

CHAPTER 4

(PREPARATION OF HAND SANITIZER)

PREPARATION OF HAND SANITIZER

At present, alcohol-based hand rubs are the only known means for rapidly and effectively inactivating a wide array of potentially harmful microorganisms on hands [18-23]. To help the countries and healthcare facilities, the World Health Organization (WHO) has recommended formulations for local preparation of alcohol-based hand rubs to be used for hand hygiene. Logistic, economic, safety, cultural, and religious factors have all been carefully considered by WHO before recommending such formulations for use worldwide. Hand sanitizer used in the automated touchless hand sanitizer dispenser developed in this study was prepared strictly following the WHO recommended formulation and procedure for local production, as shown in Table. The choice of components for the WHO-recommended hand rub formulations takes into accounts the cost constraints and microbicide activity.

World Health Organization recommended formulations for local production of alcohol-based hand sanitizer as follows:

Formulation	Required Ingredients (Starting % of Ingredient)	Concentrations in Final Product, % (v/v), (Final % of Ingredient)	Required Volume of Ingredients for 10-L Preparation, mL
1	(i). Ethanol 96%	80	8333
	(ii). Hydrogen peroxide 3%	0.125	417
	(iii). Glycerol 98	1.45	145
	(iv). Sterile distilled water or boiled cold water	—	1105
2	(i). Isopropanol 99.8%	75	7515
	(ii). Hydrogen peroxide 3%	0.125	417
	(iii). Glycerol 98%	1.45	145
	(iv). Sterile distilled water or boiled cold water	—	1923

The required volume of ingredients (isopropyl alcohol, hydrogen peroxide and glycerol) was calculated using the following equation:

$$\text{Volume of starting ingredient required, (mL)} = \frac{(\textit{Final \% of ingredient})(\textit{Final volume of preparation})}{\textit{Starting \% of ingredient}}$$

Table 1

CHAPTER 5

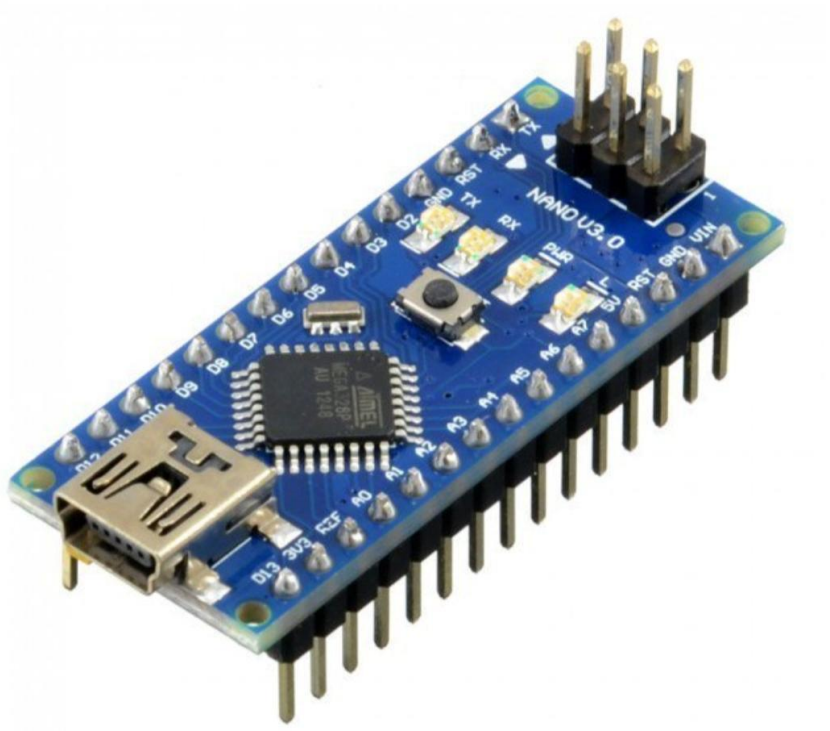
(TOOLS & SPECIFICATIONS)

TOOLS & SPECIFICATIONS

A) **ARDUINO NANO**:- **Arduino Nano** is a microcontroller board based on the ATmega328P (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 8 Analog inputs, a 16 MHz ceramic resonator (CSTCE16M0V53-R0), a USB connection, a power jack, an ICSP header and a reset button.

Digital I/O Pins: 14 (of which 6 provide PWM)

Analog Input Pins: 8



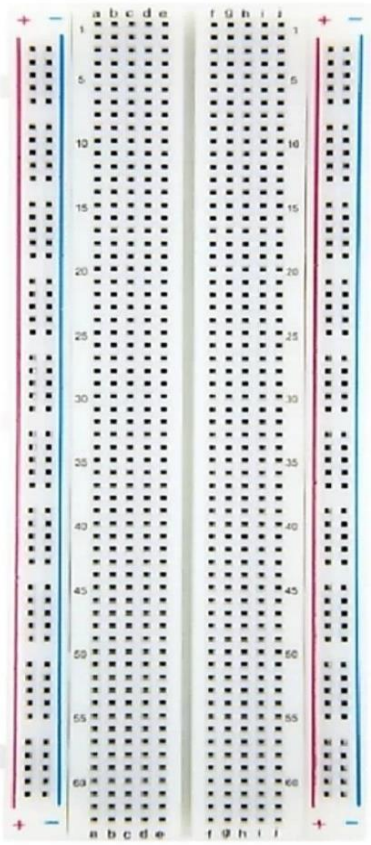
Flash Memory: 32 KB (ATmega328P)

B). **ULTRASONIC SENSOR**:-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.

- Power Supply: DC 5V
- Working Current: 15mA
- Working Frequency: 40Hz
- Ranging Distance : 2cm – 400cm/4m
- Resolution : 0.3 cm
- Measuring Angle: 15 degree
- Trigger Input Pulse width: 10uS
- Dimension: 45mm x 20mm x 15mm

c) **BREADBOARD**:- A **breadboard** is a rectangular plastic board with a bunch of tiny holes in it. These holes let you easily insert electronic components to prototype (meaning to build and test an early version of) an electronic circuit, like this one with a battery, switch, resistor, and an LED (light-emitting diode).

- Height / Thickness: 0.5118 inch.
- Length: 7.87 to 47.24 inch.
- Units: Metric.
- Width: 7.87 to 47.24 inch.



D) **ADAPTER**:- An **adapter** is a device that allows a specific type of hardware to work with another device that would otherwise be incompatible. Examples of **adapters** include electrical **adapters**, video **adapters**, audio **adapters**, and network **adapters**.

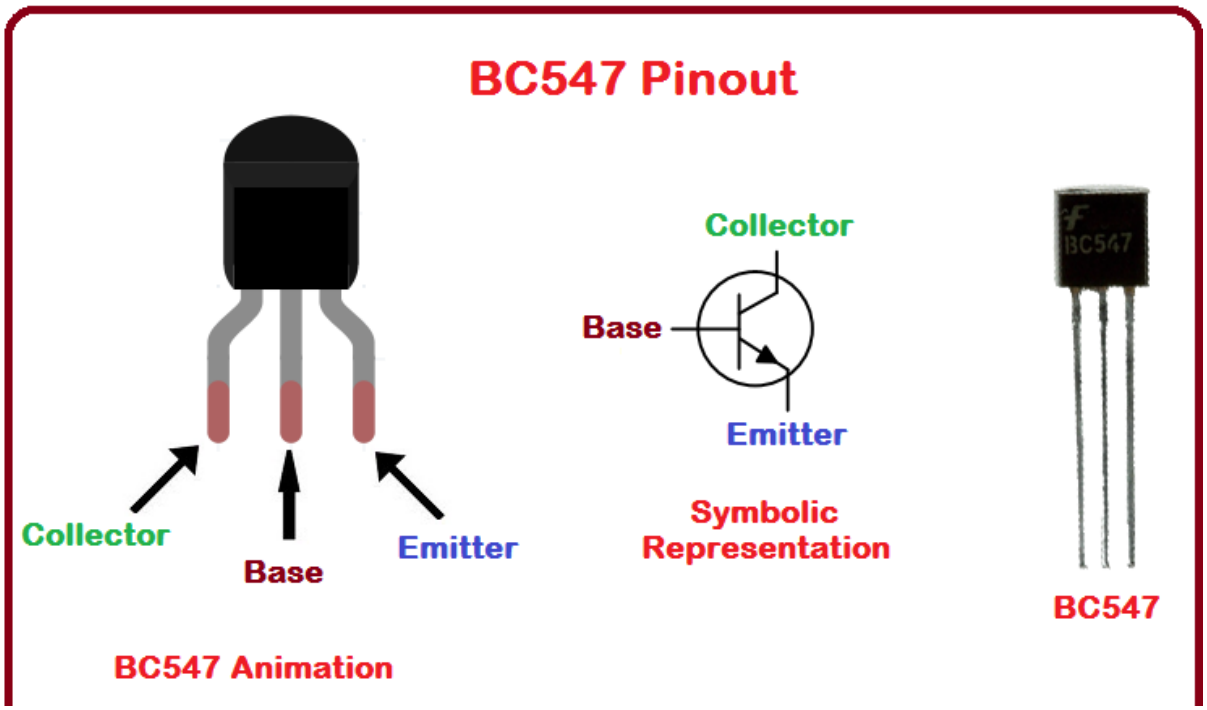
• **Brand Name**	Orange
• **Input Voltage (V)**	100 ~ 280 VAC @50 ~ 60Hz
• **Input current (mA)**	100
• **Output Voltage (V)**	5
• **Output current (A)**	1
• **Load regulation (%)**	**+/- 0.5**

E) **3-6v Submersible Water Pump:-** Make sure that the **water** level is always higher than the motor. The dry run may damage the motor due to heating and it will also produce noise.

• **Operating Voltage (VDC)**	2.5 to 6
• **Operating Current (mA)**	130 to 220
• **Flow Rate (L/H)**	80 to 120
• **Maximum Lift (mm)**	40 to 110
• **Continuous Working Life (hours)**	500
• **Driving Mode**	DC, Magnetic Driving
• **Material**	Plastic
• **Outlet outside diameter (mm)**	7.5
• **Outlet inside diameter (mm)**	5
• **Shipment weight**	0.06 kg
• **Shipment dimensions**	5 cm *4 cm *3 cm

F) **PNP TRANSISTOR (BC547) :-**

- **Transistor Type:** NPN
- **Max Collector Current (I_C):** 100mA
- **Max Collector-Emitter Voltage (V_{CE}):** 45V
- **Max Collector-Base Voltage (V_{CB}):** 50V
- **Max Emitter-Base Voltage (VEBO):** 6V
- **Max Collector Dissipation (Pc):** 500 mW
- **Max Transition Frequency (fT):** 300 MHz



CHAPTER 6

(HARDWARE MODELING)

Hardware Modelling

The circuit scheme can be shown in Figure 2 and Figure 3.

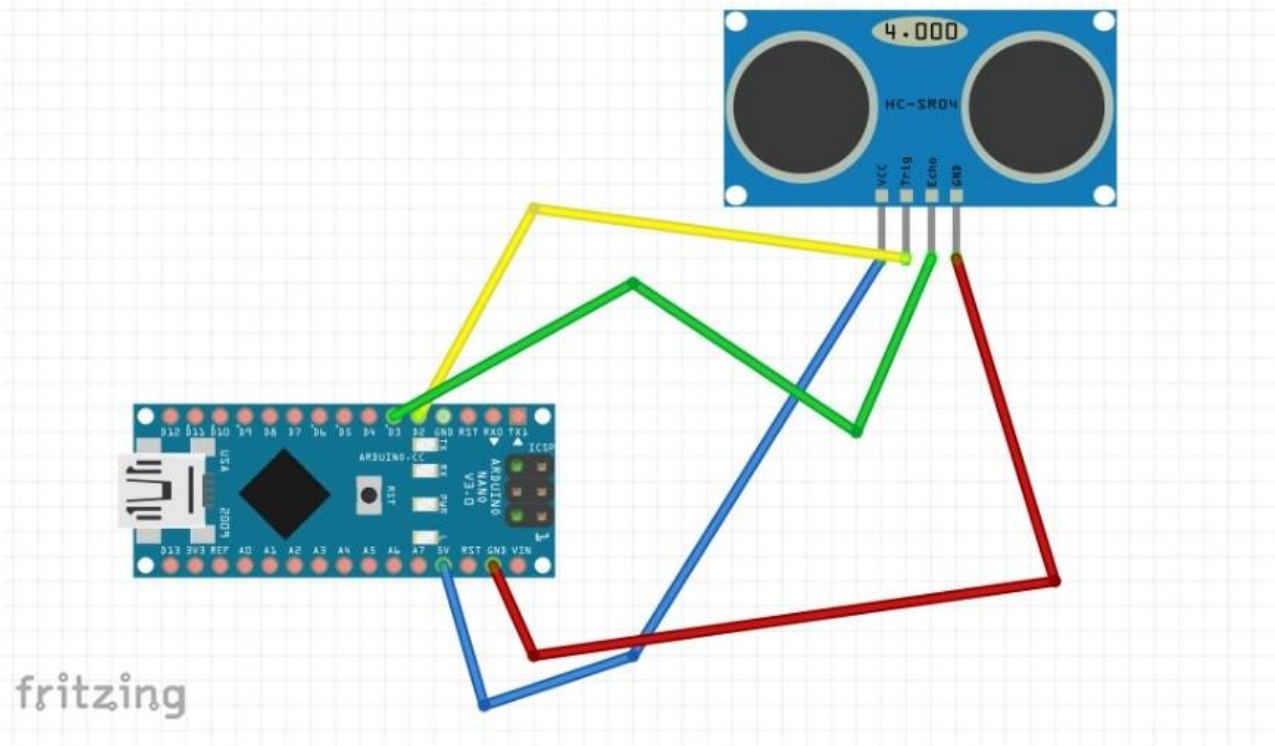


Figure 8. Arduino Nano and ultrasonic sensor HCSR04

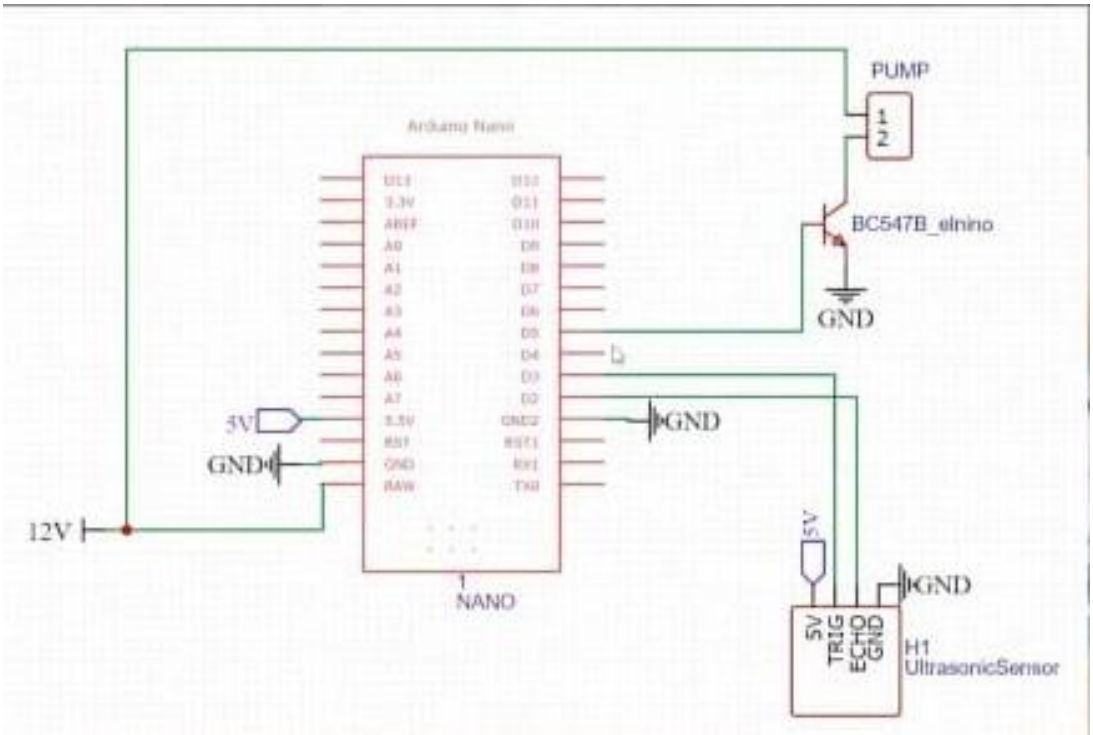


Figure 9. Arduino Nano, ultrasonic sensor HCSR04, 5V pump, pnp transistor BC547

The circuit in this research has two systems that can work simultaneously.

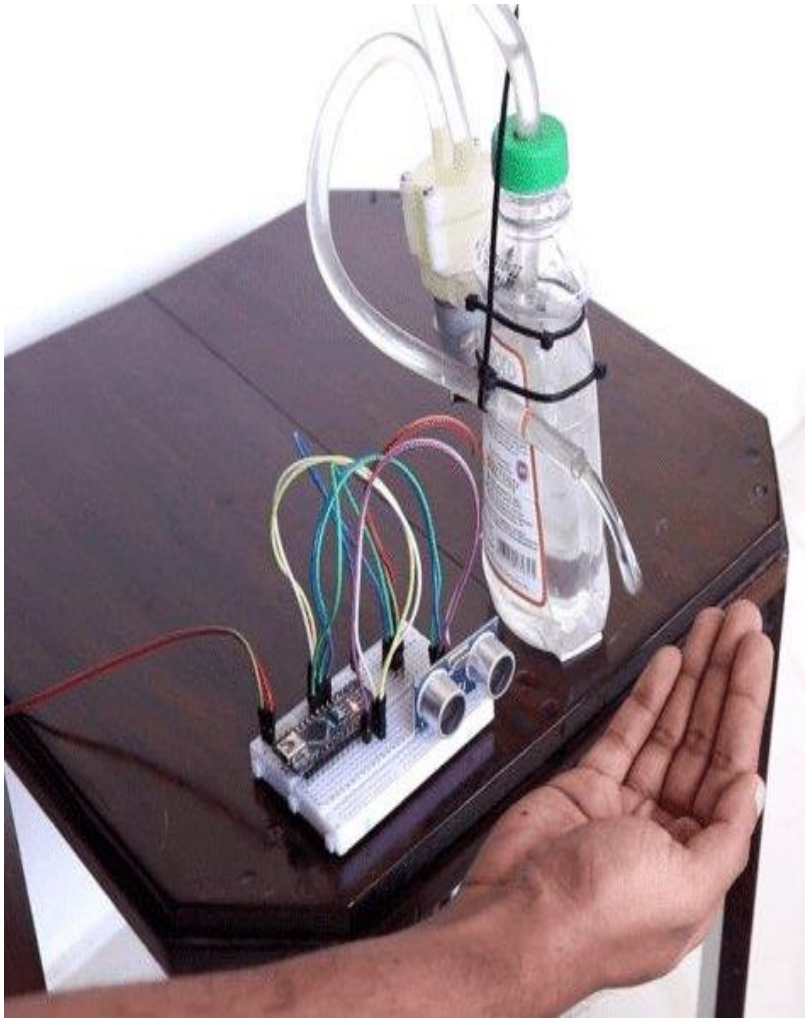


Figure 10. Ultrasonic sensor senses the distance of object

The sensor connected to the Arduino will start working when the device is activated. The ultrasonic sensor in this circuit is used to detect the distance to an object. The circuit in **Figure 10** works when the distance is less than 8 (<=7 cm) cm, the ultrasonic sensor will send data to the Arduino Nano so that it can activate the 5V pump through the pnp transistor(BC547) and the cleaner reaches the hand through a small pipe.

CHAPTER 7

(WORKING PRINCIPLE)

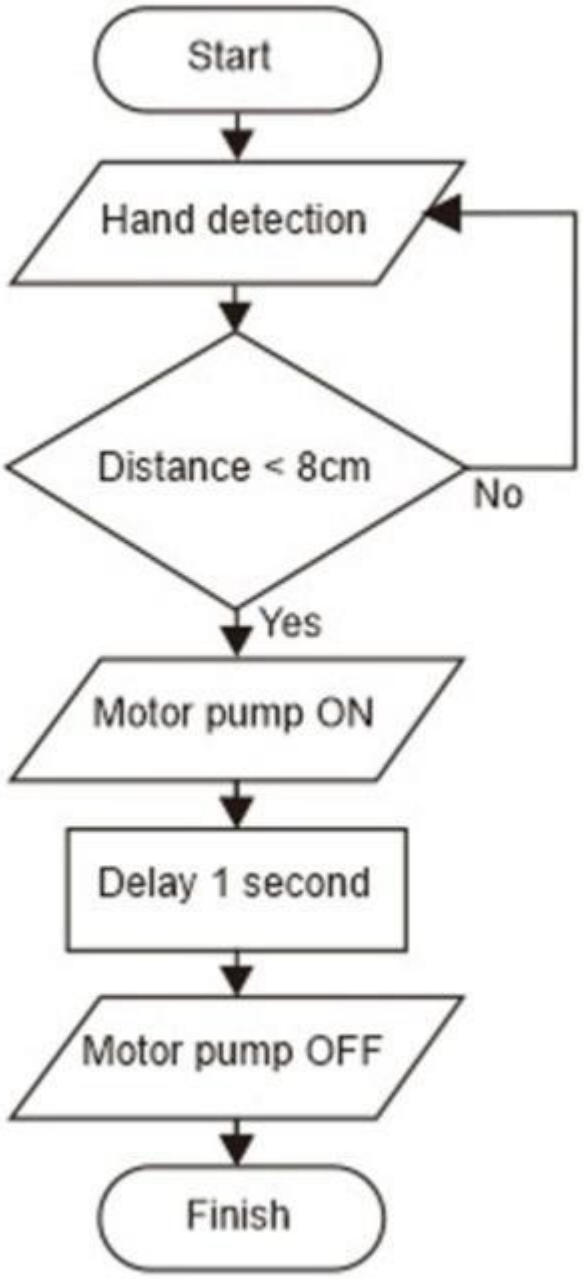
Working Principle

(with flowchart)

At first, the device should be plugged in using a 12 V AC-DC adapter. Then the process will automatically start to run without any human interaction. The functionality of this dispenser device is simple. Whenever the user puts his/her hand at a distance less than 3 cm, the ultrasonic sensor detects it. The signal from the ultrasonic sensor is then processed and obtained in the Arduino Microcontroller. After that, Arduino will send an output signal to the motor driver. The motor driver is used to turn on the pump motor when getting commands from the microcontroller. The motor driver is used because the microcontroller cannot directly turn on the pump motor.

After the pump motor runs for pre-programmed time of 1 (one) second, it turns off automatically and stops the flow of sanitizer. The hand sanitizer is equipped with a safety device in the form of hand detection which must be more than 1 (one) second in order not to waste the hand sanitizer unnecessarily. One time filling of hand sanitizer liquid can be used up to approximately 400 times.

Here is the flowchart as follows:


Start
Hand detection
Distance < 8cm
No
Yes
Motor pump ON
Delay 1 second
Motor pump OFF
Finish

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<=7)
  {
    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);
}
```

CHAPTER 8

(RESULT & DISCUSSIONS)

Result & Discussions :

Testing of automatic hand sanitizer tools is carried out by testing the performance of automatic hand sanitizer. Testing of the automatic hand sanitizer tool is in the form of testing the success rate of the tool. In the above paper, Arduino is used as a microcontroller for calculating the distance between the sensor and the hand placed below it. If it is less than 7cm, 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. Testing is done by testing the ultrasonic sensor by placing your hands at a certain distance, namely 5 cm, 7 cm, and 10 cm. The test was carried out on 10 people with 10 detections for each person and the distance between the hands and the sensor.

Table 2. The Success Rate of Automatic Handsanitizer

Respondent	The Success Tool		
	5 cm	7 cm	10 cm
Respondent 1	100%	100%	0%
Respondent 2	100%	100%	0%
Respondent 3	100%	100%	0%
Respondent 4	100%	100%	0%
Respondent 5	100%	100%	0%
Respondent 6	90%	100%	0%
Respondent 7	100%	100%	0%
Respondent 8	100%	100%	0%
Respondent 9	100%	100%	0%
Respondent 10	100%	100%	0%
Respondent 11	100%	100%	0%

Based on Table, it shows that the automatic hand sanitizer sensor will work properly when the hand is at a distance of 7 cm. The successful discharge rate of hand sanitizer reaches 100%. The success rate of automatic hand sanitizer with a hand distance of 5 cm from the sensor reaches 90%. While the success rate of automatic hand sanitizer with a hand distance of 10 cm from the sensor reaches 10 cm. This is because the program is set at 7 cm to match the hand sanitizer fluid discharge pipe. The program distance can be adjusted via the Arduino program.

CHAPTER 9

(CONCLUSIONS)

CONCLUSIONS

The paper says that non contact dispensing is very important to prevent pathogen spreading and finally, hand hygiene is most important and must be part of our daily life. In this study, a novel design of an automated hand sanitizer dispenser was demonstrated. The components needed for the device fabrication were described in detail. The circuit diagram was discussed, which clarifies the connection between the components with the microcontroller circuit (Arduino Nano). The piping conditions were shown and described accordingly. The relevant diagrams and components of the original device were presented in sequential order for a better understanding. Arduino Nano was used to input the program into the microcontroller. The algorithm used in this device was described with a flowchart to depict the functionality of the dispenser. 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 7 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 can be active for approximately 20 hours and one time filling of the hand sanitizer liquid can be used up to 400 times.

CHAPTER 10

(REFERENCES)

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