Automatic Sanitization Dispenser

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1. Introduction to Automatic Sanitization Dispenser

The idea for the first automated dispenser was submitted by Guey-Chaun Shiau to be patented in 1989. The patent was under the name, "Automatic Cleaning-liquid Dispensing Device". The patent was issued in 1991. The patented device was under the following description: "An automatic cleaning-fluid dispensing device includes: a containing structure for containing cleaning fluid; a sensing device disposed on a base member being installed in the lower portion of said containing structure wherein said base member is provided with an outlet, a sensing circuit disposed on a circuit board, a motor arrangement electrically connected to the sensing circuit, an outlet for passing a light source of the sensing circuit therefrom so as to detect the presence of an external object closing on the light source; and a dispensing mechanism, which is composed of a push structure functionally connected with the driving motor and a pumping structure operatively engaged with the push structure, installed on the base member in connection with the sensing device; whereby when an external object closes to the sensing device, a given amount of the contained cleaning fluid in the containing structure will be automatically supplied for cleaning purposes." The implementation of automatic washroom supplies has increased dramatically. An increasing number of public locations and private institutions have been incorporating touchless technology into their washrooms.

1.1 Problem Definition:

In this COVID-19 pandemic period which is a global outbreak, hand hygiene is the core preventive measure in the spread of the disease as advised by WHO (World Health Organization) which includes washing hands with water and soap regularly, hand sanitizing using hand sanitizers, etc.

Hygiene refers to the practices conducive to maintaining health and preventing disease especially through cleanliness such as washing hands, coughing in the elbow etc. Hand washing helps to prevent any diseases that spread through contact. In order to eliminate most of the germs on the hands, we need to apply a good hand washing practice. In most healthcare settings, alcohol-based hand sanitizers are preferable to hand washing with soap and water because it can be easily tolerated and it is also more effective at reducing bacteria. Hand sanitizer is a liquid, gel, or foam generally used to decrease infectious agents on the hands. A sanitizer is designed to kill germs on skin, objects and surfaces.

The aim of the project is to design and implement a low cost smart hand sanitizer dispenser with door controller. It is based on ARDUINO UNO R3 (Micro-controller), temperature sensor and Ultrasonic Distance sensor (an ultrasonic sensor is used to check the presence of hands below the outlet of the sanitizer machine), that can be placed and implemented at different stations such as bank doors, school gates, hospital gates etc.

In enforcing this hand sanitizing action before letting people in to where ever they intend to enter as some people are not willing to collaborate, some look at it as a wastage of their time

and also sometimes security guards can let some people in without sanitizing and without check body temperature just because they are their friends or family or relatives, which is very risky. Therefore, the smart hand sanitizer is stationed at the entrance door and it is connected to the door in such a way that it controls it. That is to say, when a person(s) wants to access the entrance door, they must first sanitizer their hands and depict a normal temperature after being checked or else the door will remain locked. If you want to enter the premises put your hand under automatic sanitizer then the sanitizer outlet dropping some amount into your hands at that time thermal temp sensor automatically check body temperature, if temperature is normal it commands to the micro-controller to turn on the servo motor assuming it will open the entrance door and allow a person to enter and lighting up a green LED and in the other case if temperature is high the door will remain locked.

With Help of This smart sanitizer no need to touch anything. So it is true to say "TOUCH LESS DO MORE".

1.2 Aim/Objectives:

An automatic soap dispenser is a device that dispenses a controlled amount of soap solution (or a similar liquid such as a hand sanitizer). They are often used in conjunction with automatic faucets in public restrooms. They function to conserve the amount of soap used and stem infectious disease transmission.

This project "Automatic Sanitization Dispenser" aims to design and implement a low cost smart hand sanitizer dispenser with door controller and the sole objective of the project is to reduce the spread of a disease.

1.3 Features:

- Convenient
- It is Easy to Use
- It is Low-Cost
- Enhances the hygiene of a person
- Contactless
- Sanitizes and checks temperature simultaneously

2. System Description:

2.1 Design:

2.1.1 Block Diagram:

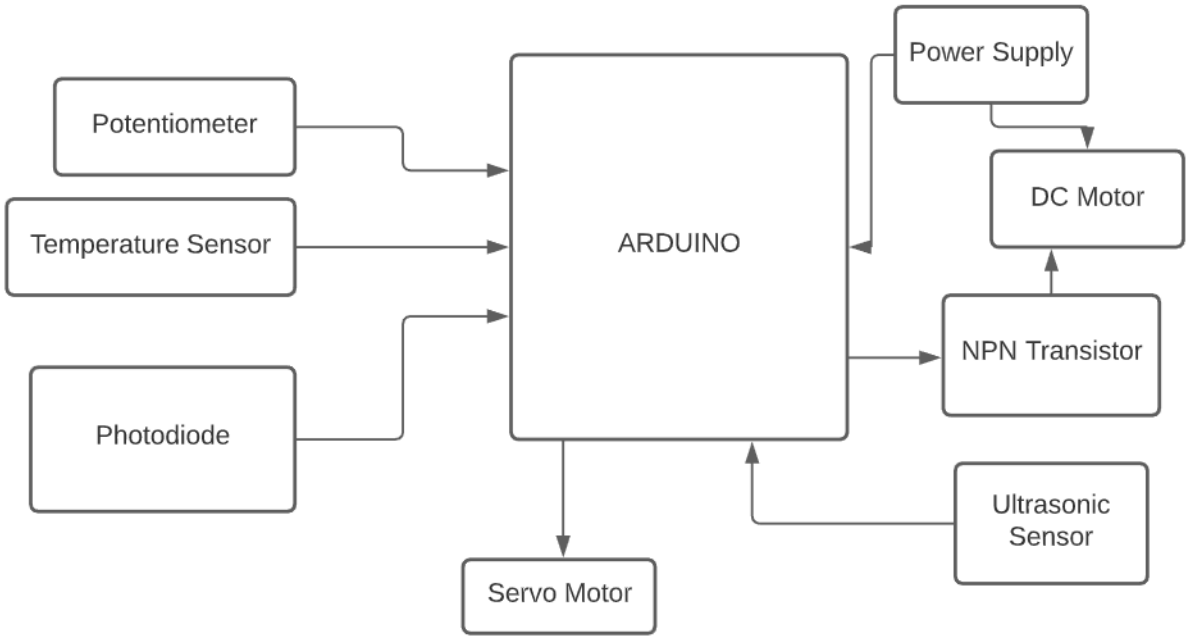

Figure 2.1: Block diagram of Automatic Sanitization Dispenser

2.1.2 Flowchart:

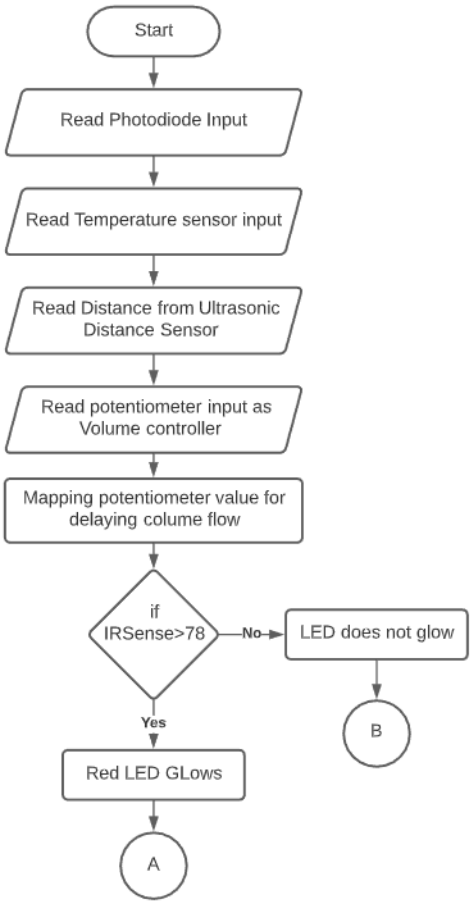

Figure 2.2: Flowchart of Automatic Sanitization Dispenser

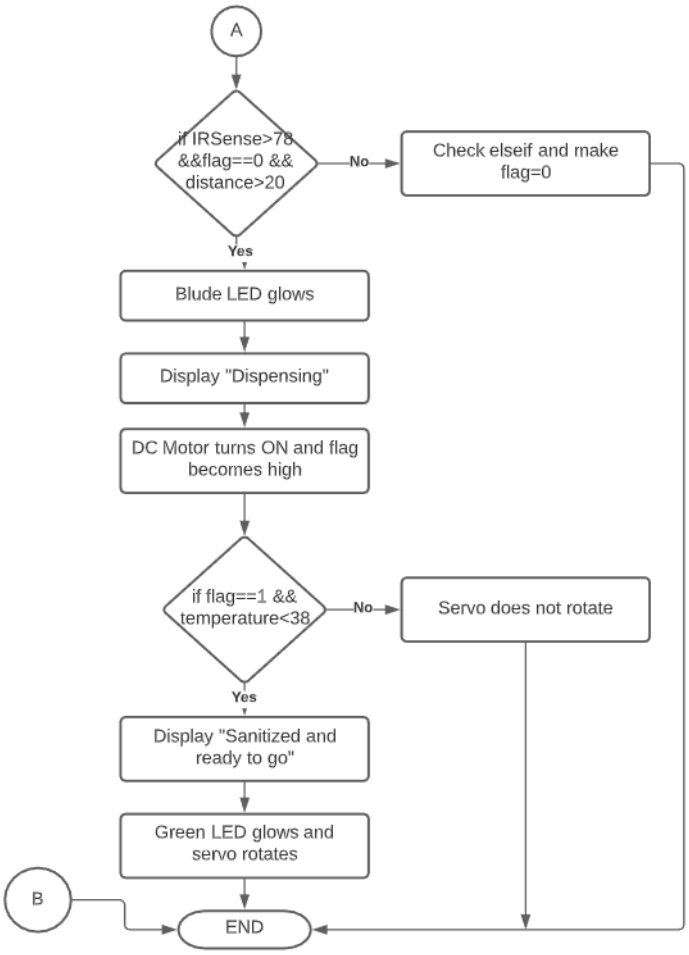

Figure 2.3: Flowchart of Automatic Sanitization Dispenser

2.2 Hardware circuit diagram:

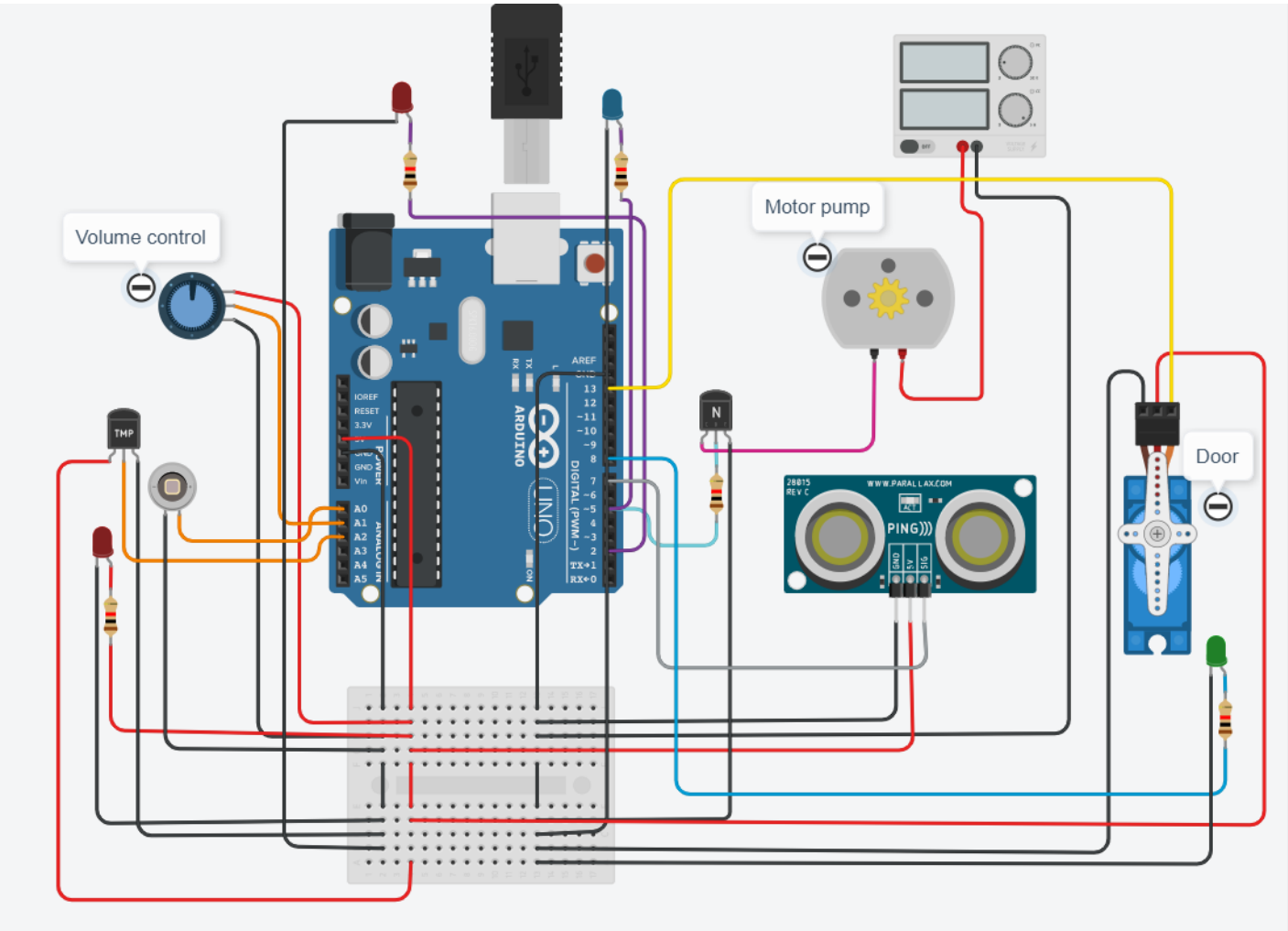

Figure 2.4: Hardware circuit diagram of Automatic Sanitization Dispenser

2.2.1 Components List:

1 Arduino Uno R3
1 Breadboard Mini
1 250k Ω Potentiometer
1 DC Motor
1 NPN Transistor(BJT)
1 Ultrasonic Distance Sensor
1 5,5 Power Supply
1 Blue LED
2 Red LED
1 Green LED
5 1 k Ω Resistor
1 Temperature Sensor[TMP36]

1 Micro Servo
1 Photodiode

2.2.2 Details of components:

1) Arduino Uno R3:
Arduino Uno R3 is one kind of ATmega328P based microcontroller board. It includes the whole thing required to hold up the microcontroller; just attach it to a PC with the help of a USB cable, and give the supply using AC-DC adapter or a battery to get started. The term Uno means "one" in the language of "Italian" and was selected for marking the release of Arduino's IDE 1.0 software. The Arduino Uno R3 pin diagram is shown below. It comprises 14-digit I/O pins. From these pins, 6-pins can be utilized like PWM outputs. This board includes 14 digital input/output pins, Analog inputs-6, a USB connection, quartz crystal-16 MHz, a power jack, a USB connection, resonator-16Mhz, a power jack, an ICSP header an RST button.

2) Breadboard Mini:
A thin plastic board used to hold electronic components (transistors, resistors, chips, etc.) that are wired together.The breadboard contains spring clip contacts typically arranged in matrices with certain blocks of clips already wired together. The components and jump wires (assorted wire lengths with pins at both ends) are plugged into the clips to create the circuit patterns. The boards also typically include metal strips along the side that are used for common power rails and signal buses.

3) 250k Ω Potentiometer:
A potentiometer (also known as a pot or potmeter) is defined as a 3 terminal variable resistor in which the resistance is manually varied to control the flow of electric current. A potentiometer acts as an adjustable voltage divider.

A potentiometer is a passive electronic component. Potentiometers work by varying the position of a sliding contact across a uniform resistance. In a potentiometer, the entire input voltage is applied across the whole length of the resistor.

A potentiometer has the two terminals of the input source fixed to the end of the resistor. To adjust the output voltage the sliding contact gets moved along the resistor on the output side.

4) DC Motor:
The electric motor operated by DC (direct current) is known as a DC motor (unlike an induction motor that operates via an alternating current). A DC motor converts DC electrical energy into mechanical energy.

When a current-carrying conductor is placed in a magnetic field, it experiences a torque and has a tendency to move. In other words, when a magnetic field and an electric field interact, a mechanical force is produced. The DC motor or direct current motor works on that principle. This is known as motoring action.The direction of rotation of this motor is given by Fleming's left hand rule.

5) NPN Transistor(BJT):
An NPN transistor is the most commonly used bipolar junction transistor, and is constructed by sandwiching a P-type semiconductor between two N-type semiconductors. An NPN transistor has three terminals– a collector, emitter and base. The NPN transistor behaves like two PN junctions

diodes connected back to back.

The construction and terminal voltages for a bipolar NPN transistor are shown above. The voltage between the Base and Emitter (VBE), is positive at the Base and negative at the Emitter because for an NPN transistor, the Base terminal is always positive with respect to the Emitter. Also the Collector supply voltage is positive with respect to the Emitter (VCE). So for a bipolar NPN transistor to conduct the Collector is always more positive with respect to both the Base and the Emitter.

Then the voltage sources are connected to an NPN transistor as shown. The Collector is connected to the supply voltage VCC via the load resistor, RL which also acts to limit the maximum current flowing through the device. The Base supply voltage VB is connected to the Base resistor RB, which again is used to limit the maximum Base current.

So in a NPN Transistor it is the movement of negative current carriers (electrons) through the Base region that constitutes transistor action, since these mobile electrons provide the link between the Collector and Emitter circuits. This link between the input and output circuits is the main feature of transistor action because the transistors amplifying properties come from the consequent control which the Base exerts upon the Collector to Emitter current.

6) Ultrasonic Distance Sensor:

The Parallax PING))) ultrasonic distance sensor provides precise, non-contact distance measurements from about 2 cm (0.8 inches) to 3 meters (3.3 yards). The PING))) sensor works by transmitting an ultrasonic (well above human hearing range) burst and providing an output pulse that corresponds to the time required for the burst echo to return to the sensor. By measuring the echo pulse width the distance to target can easily be calculated.

It detects the distance of the closest object in front of the sensor (from 3 cm up to 400 cm). It works by sending out a burst of ultrasound and listening for the echo when it bounces off of an object. It pings the obstacles with ultrasound. The Arduino or Genuino board sends a short pulse to trigger the detection, then listens for a pulse on the same pin using the pulseIn() function. The duration of this second pulse is equal to the time taken by the ultrasound to travel to the object and back to the sensor. Using the speed of sound, this time can be converted to distance.The 5V pin of the Ultrasonic sensor is connected to the 5V pin on the board, the GND pin is connected to the GND pin, and the SIG (signal) pin is connected to digital pin 7 on the board.

7) 5,5 Power Supply:

A power supply is an electrical device that supplies electric power to an electrical load. The primary function of a power supply is to convert electric current from a source to the correct voltage, current, and frequency to power the load. As a result, power supplies are sometimes referred to as electric power converters. Some power supplies are separate standalone pieces of equipment, while others are built into the load appliances that they power. Examples of the latter include power supplies found in desktop computers and consumer electronics devices. Other functions that power supplies may perform include limiting the current drawn by the load to safe levels, shutting off the current in the event of an electrical fault, power conditioning to prevent electronic noise or voltage surges on the input from reaching the load, power-factor correction, and storing energy so it can continue to power the load in the event of a temporary interruption in the source power (uninterruptible power supply).

A power supply unit (PSU) converts mains AC to low-voltage regulated DC power for the internal components of a computer. Modern personal computers universally use switched-mode power supplies. Some power supplies have a manual switch for selecting input voltage, while others automatically adapt to the mains voltage.

The energy efficiency of a power supply drops significantly at low loads. Therefore, it is important to match the capacity of a power supply to the power needs of the computer. Efficiency generally peaks at about 50–75% load. The curve varies from model to model.

8) LED (Red, Blue, Green):
A light releasing diode is an electric component that emits light when the electric current flows through it. It is a light source based on semiconductors. When current passes through the LED, the electrons recombine with holes emitting light in the process. It is a specific type of diode having similar characteristics as the p-n junction diode. This means that an LED allows the flow of current in its forward direction while it blocks the flow in the reverse direction. Light-emitting diodes are built using a weak layer of heavily doped semiconductor material. Based on the semiconductor material used and the amount of doping, an LED will emit a colored light at a particular spectral wavelength when forward biased.

9) Resistor:
A resistor is a passive two-terminal electrical component that implements electrical resistance as a circuit element. In electronic circuits, resistors are used to reduce current flow, adjust signal levels, to divide voltages, bias active elements, and terminate transmission lines, among other uses. High-power resistors that can dissipate many watts of electrical power as heat, may be used as part of motor controls, in power distribution systems, or as test loads for generators. Fixed resistors have resistances that only change slightly with temperature, time or operating voltage. Variable resistors can be used to adjust circuit elements (such as a volume control or a lamp dimmer), or as sensing devices for heat, light, humidity, force, or chemical activity.

Resistors are common elements of electrical networks and electronic circuits and are ubiquitous in electronic equipment. Practical resistors as discrete components can be composed of various compounds and forms. Resistors are also implemented within integrated circuits.

10)Temperature Sensor[TMP36]:
A temperature sensor is a device, typically, a thermocouple or RTD, that provides for temperature measurement through an electrical signal. A thermocouple (T/C) is made from dissimilar metals that generate electrical voltage in direct proportion to changes in temperature. An RTD (Resistance Temperature Detector) is a variable resistor that will change its electrical resistance in direct proportion to changes in temperature in a precise, repeatable and nearly linear manner.

hese sensors use a solid-state technique to determine the temperature. That is to say, they don't use mercury (like old thermometers), bimetalic strips (like in some home thermometers or stoves), nor do they use thermistors (temperature sensitive resistors). Instead, they use the fact as temperature increases, the voltage across a diode increases at a known rate. (Technically, this is actually the voltage drop between the base and emitter - the Vbe - of a transistor.) By precisely amplifying the voltage change, it is easy to generate an analog signal that is directly proportional to temperature. There have been some improvements on the technique but, essentially that is how temperature is measured.

11) Micro Servo:
Micro Servo Motor SG90 is a tiny and lightweight server motor with high output power. Servo can rotate approximately 180 degrees (90 in each direction), and works just like the standard kinds but smaller. You can use any servo code, hardware or library to control these servos.

Servos are controlled by sending an electrical pulse of variable width, or pulse width modulation (PWM), through the control wire. There is a minimum pulse, a maximum pulse, and a repetition

rate. A servo motor can usually only turn 90° in either direction for a total of 180° movement. The motor's neutral position is defined as the position where the servo has the same amount of potential rotation in the both the clockwise or counter-clockwise direction. The PWM sent to the motor determines position of the shaft, and based on the duration of the pulse sent via the control wire; the rotor will turn to the desired position. The servo motor expects to see a pulse every 20 milliseconds (ms) and the length of the pulse will determine how far the motor turns. For example, a 1.5ms pulse will make the motor turn to the 90° position. Shorter than 1.5ms moves it in the counter clockwise direction toward the 0° position, and any longer than 1.5ms will turn the servo in a clockwise direction toward the 180° position.

When these servos are commanded to move, they will move to the position and hold that position. If an external force pushes against the servo while the servo is holding a position, the servo will resist from moving out of that position. The maximum amount of force the servo can exert is called the torque rating of the servo. Servos will not hold their position forever though; the position pulse must be repeated to instruct the servo to stay in position.

12) Photodiode:
A photodiode is a semiconductor device that converts light into an electrical current. The current is generated when photons are absorbed in the photodiode. Photodiodes may contain optical filters, built-in lenses, and may have large or small surface areas. Photodiodes usually have a slower response time as their surface area increases. The common, traditional solar cell used to generate electric solar power is a large area photodiode.

Photodiodes are similar to regular semiconductor diodes except that they may be either exposed (to detect vacuum UV or X-rays) or packaged with a window or optical fiber connection to allow light to reach the sensitive part of the device. Many diodes designed for use specially as a photodiode use a PIN junction rather than a p–n junction, to increase the speed of response. A photodiode is designed to operate in reverse bias.

A photodiode is a PIN structure or p–n junction. When a photon of sufficient energy strikes the diode, it creates an electron–hole pair. This mechanism is also known as the inner photoelectric effect. If the absorption occurs in the junction's depletion region, or one diffusion length away from it, these carriers are swept from the junction by the built-in electric field of the depletion region. Thus holes move toward the anode, and electrons toward the cathode, and a photocurrent is produced. The total current through the photodiode is the sum of the dark current (current that is generated in the absence of light) and the photocurrent, so the dark current must be minimized to maximize the sensitivity of the device. To first order, for a given spectral distribution, the photocurrent is linearly proportional to the irradiance.

2.3 Implementation Methodology:

Steps:

- Step 1: Take one Arduino UNO R3 and the components that are listed in the component list.
- Step 2: Connect the components to the Arduino as per the diagram.
- Step 3: The working is such that ,after the machine starts it checks the Photodiode value i.e if any person is detected or not.

- Step 4: Then it checks whether the person places the hand right below the sanitizer machine or not with the help of ultrasonic sensor. If the ultrasonic sensor value is less than 20 inches the sanitizer dispenses out an amount of sanitizer and the amount is decided using potentiometer.
- Step 5: Next it checks the body temperature of the person ,if it is normal (less than 38.00 degree celsius) the machine displays a message saying "Sanitized and ready to go" and the servo motor rotates(i.e. the door opens and green LED turns ON).Otherwise either you are not sanitized or your body temperature is higher than the permissible amount the door remains closed.

2.4 Code:

```
#include < Servo.h >
Servo servo1;
int pos=0;

int onOffTime;
int IRSense;
int autoOffTrigger = 0;
int temppin=2;
const int pingPin = 7;

void setup()
{
pinMode(A2, INPUT);
pinMode(5, OUTPUT);
pinMode(2, OUTPUT);
pinMode(8, OUTPUT);
servo1.attach(13);
Serial.begin(9600);
}
void loop()
{
long duration, inches, cm;
int IRSense = analogRead(A0);
int onOffTime = analogRead(A1);

int reading = analogRead(temppin);
float voltage = reading*4.68;
voltage /= 1024.0;
float tempC = (voltage-0.5)*100;
Serial.println(String(tempC) + " deg celsius" );

pinMode(pingPin, OUTPUT);
digitalWrite(pingPin, LOW);
delayMicroseconds(2);
digitalWrite(pingPin, HIGH);
delayMicroseconds(5);
```

```
digitalWrite(pingPin, LOW);
pinMode(pingPin, INPUT);
duration = pulseIn(pingPin, HIGH);
// convert the time into a distance
inches = microsecondsToInches(duration);
cm = microsecondsToCentimeters(duration);

Serial.println("Distance: "+String(inches)+"in, "+String(cm)+"cm");

int time = map(onOffTime,0,1023,0,10);
Serial.println("IR: "+String(IRSense));
Serial.println("Pot Volume: "+String(onOffTime)+ ": "+String(time));

if(IRSense > 78)
{
digitalWrite(2,1);
}
else
{
digitalWrite(2,0);
}
if(IRSense > 78 && autoOffTrigger==0 && inches < 20)
{
digitalWrite(5,1);
delay(time*1000);
digitalWrite(5,0);
autoOffTrigger=1;
Serial.println("Dispensing...");
delay(1000);
if(autoOffTrigger==1 && tempC < 38.00)
{
Serial.println("Well sanitized and ready to go");
digitalWrite(8,1);
delay(1000);
digitalWrite(8,0);
for(pos=90;pos <=180;pos++)
{
servo1.write(pos);
delay(15);
}
delay(3000);
for(pos=180;pos > =90;pos–)
{
servo1.write(pos);
delay(15);
}
}
}
```

```
else if(IRSense < 78)
{
autoOffTrigger=0;
}
delay(2000);
}

long microsecondsToInches(long microseconds)
{
return microseconds / 74 / 2;
}

long microsecondsToCentimeters(long microseconds)
{
return microseconds / 29 / 2;
}
```

2.5 Results:

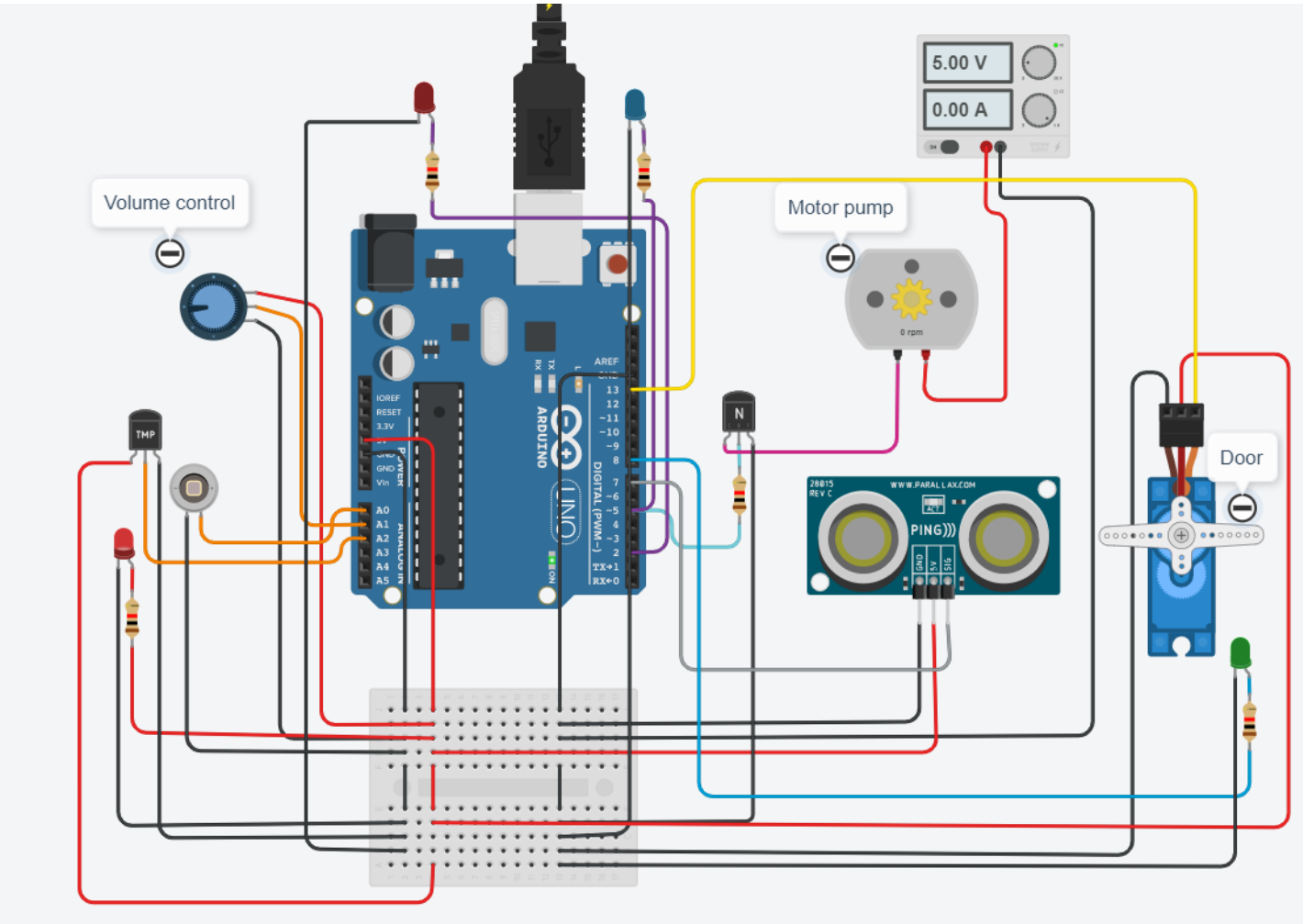

Figure 2.5: Automatic Sanitization Dispenser machine starts, indicated by the glowing of Red LED in the left

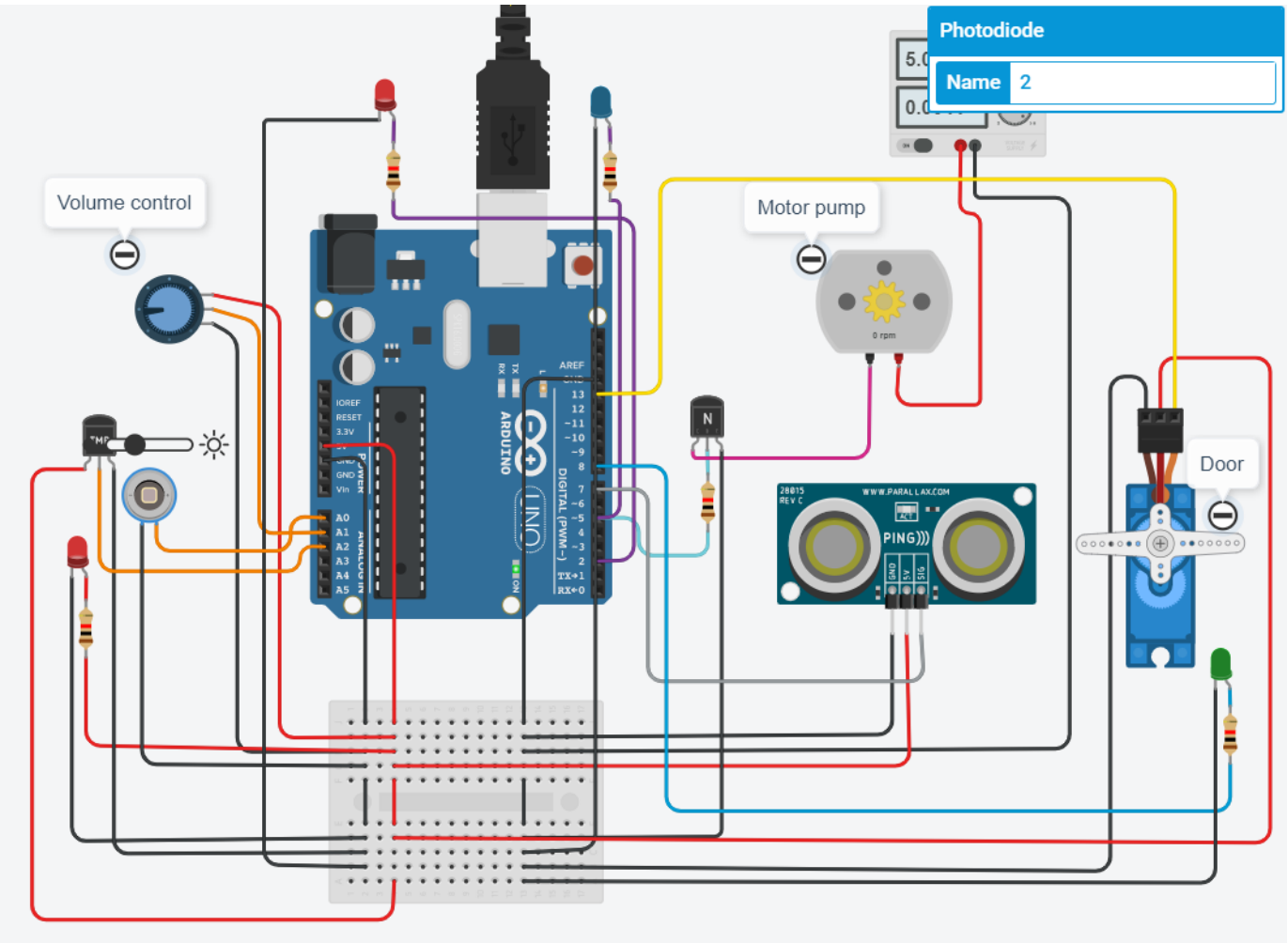

Figure 2.6: Photodiode value greater than 78 depicting that a person's hand is placed in the proximity of the sensor, if yes Red LED above Arduino glows

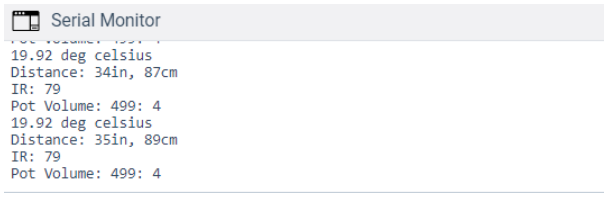

Figure 2.7: Serial Monitor showing the values of photodiode

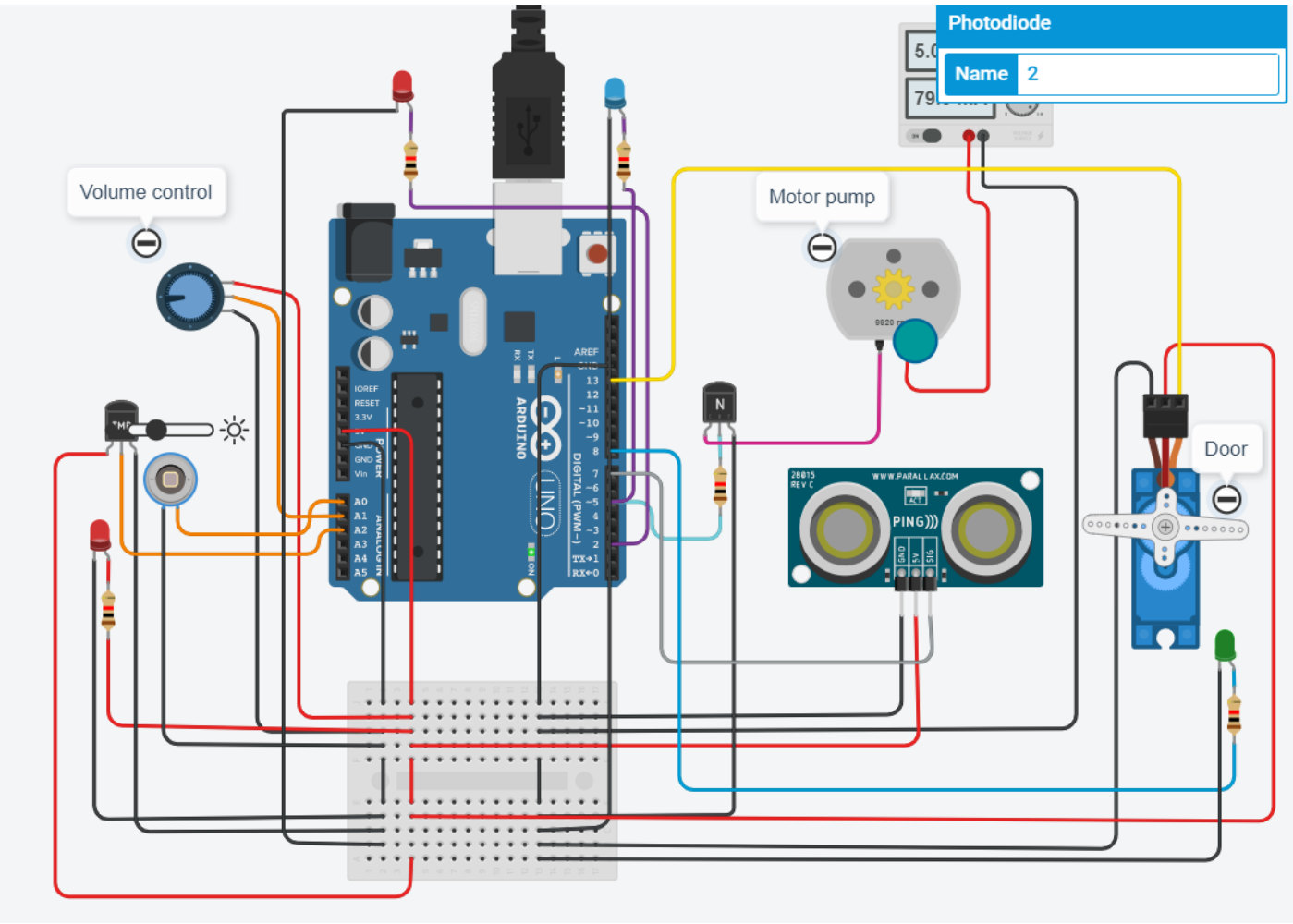

Figure 2.8: Ultrasonic sensor value less than 20 inches for dispensing to start,i.e hands should be close to the machine,if yes Blue LED glows

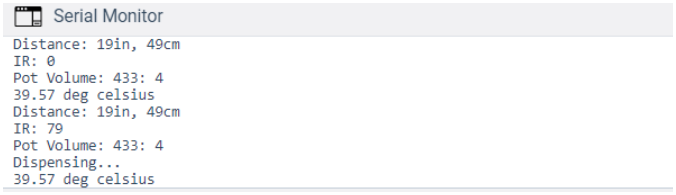

Figure 2.9: Serial Monitor showing the values of ultrasonice sensor(19 inches 49 cm i.e less than 20 inches) and dispensing starts

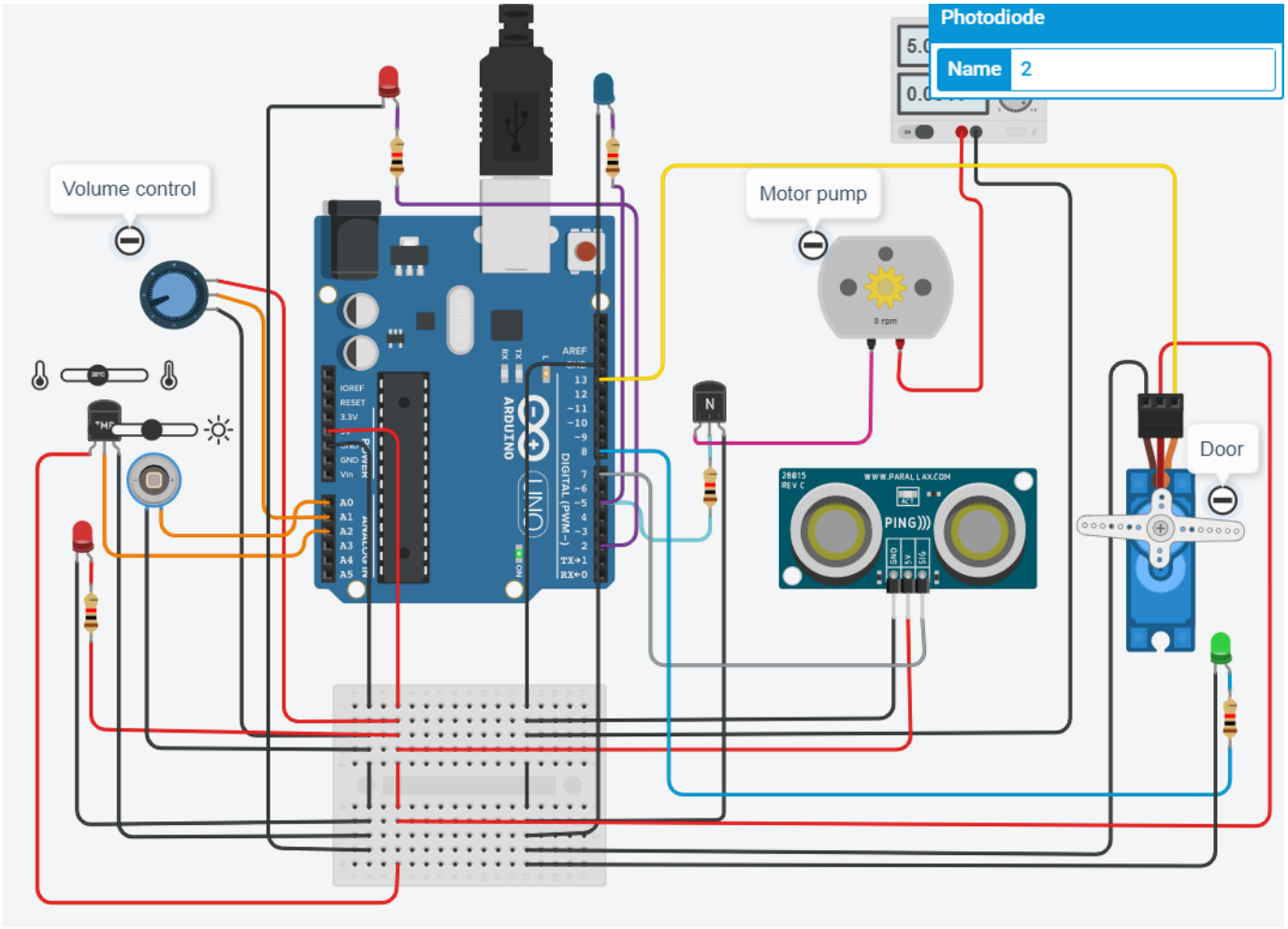

Figure 2.10: If Temperature of the person is normal (¡38 degree celsius) then the green LED in the light glows showing success

```
IR: 73
Pot Volume: 433: 4
23.12 deg celsius
Distance: 19in, 49cm
IR: 80
Pot Volume: 433: 4
Dispensing...
Well sanitized and ready to go
```

Figure 2.11: Serial Monitor showing the success message after temperature check comes out right

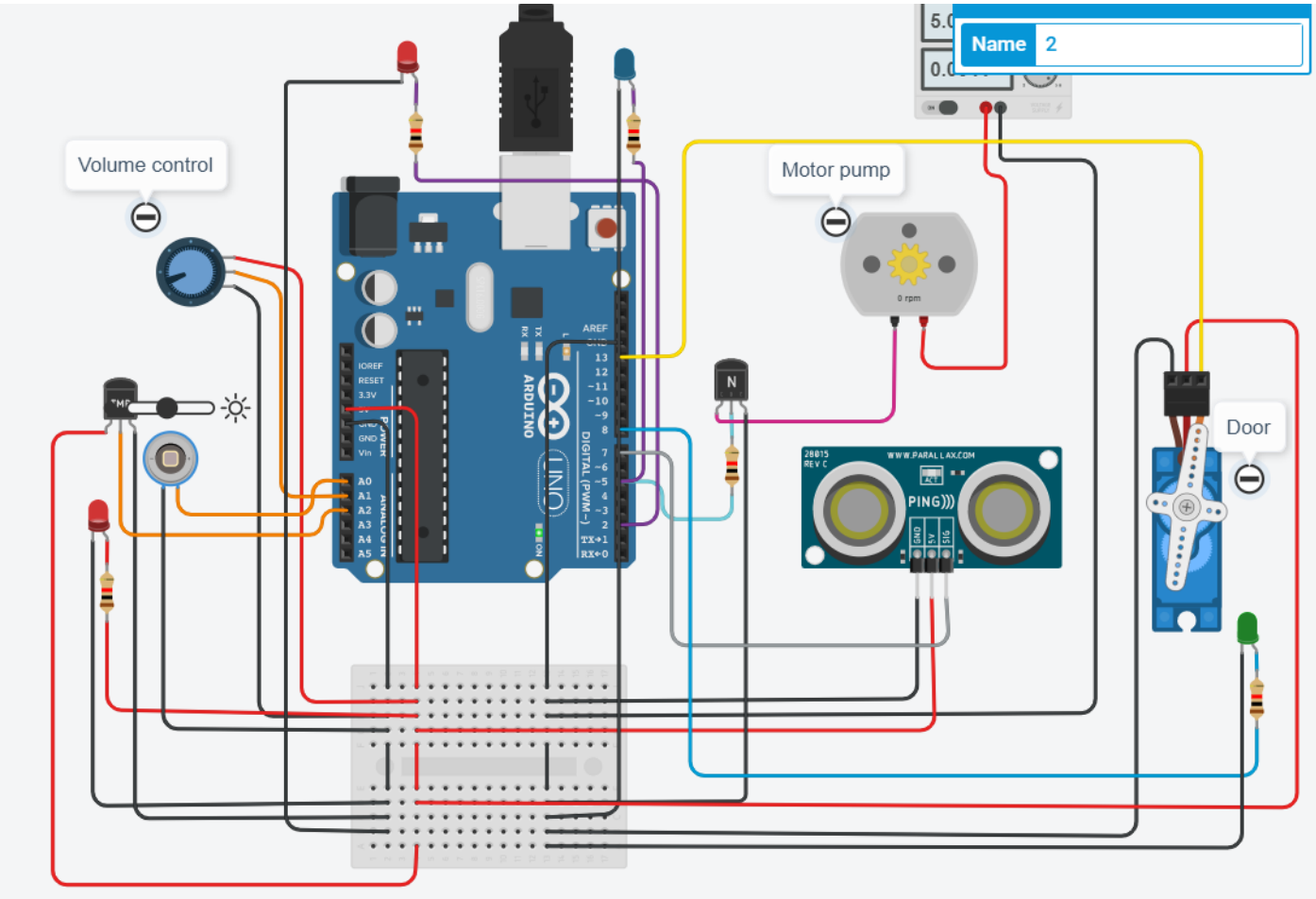

Figure 2.12: Success message is printed and then the servo motor rotates by 90 degrees indicating the door is opened

2.6 Conclusion:

Thus, we have successfully implemented and showed the working of our Automatic Sanitization Dispenser with the help of various components and sensors like Photodiode, Ultrasonic Distance sensor, Temperature sensor and other components. Automatic hand sanitizer machinethus helps in non contact dispensing which is again important to prevent pathogen spreading and finally, hand hygiene is most important and must be part of our daily life, and this is done by making connections of the components and arduino coding is done accordingly.

3. References:

1. https://www.arduino.cc/
2. https://smartnode.in/products/automatic-hand-sanitizer-dispenser/
3. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7438695/