Zero Contact Hand Sanitizer Dispenser

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***Abstract*—In this paper, we dive into the concept of the Internet of Things and its various applications, one of which is a hands-free solution for the hand sanitizer dispenser. Using Internet of Things, and some of the components provided by it, we will see how a zero-contact hand sanitizer dispenser system can be created at a marginally low cost. We will also see how the various components can be used in this proposed structure of the system.**

Keywords—Internet of Things, Microcontroller, Hand Sanitizer, Modules, Covid-19.

I. INTRODUCTION

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. [9]. Social distancing, also called "physical distancing," means keeping a safe space between yourself and other people who are not from your household. Usually the safe permittable distance is of 6 feet, but the more the better. Hand Sanitizer has become a crucial part of our lives due to the fact that our hands have the highest probability of being exposed to the virus. The world is facing a medical crisis amid the Covid-19 pandemic and the role of adequate hygiene and hand sanitizers is inevitable in controlling the spread of infection in public places and healthcare institutions.[3] Proper hand hygiene is the single biggest defense against spread of diseases.[4] So, people nowadays are using hand sanitizers on a large scale to disinfect their hands and avoid the spread of the virus. Many public places and facilities have special staff employed for manually dispensing hand sanitizers and checking temperatures of the people who are entering their premises. This poses some amount of risk to the public, if not much, of virus spreading if an infected person comes in contact with the volunteers. The Zero Contact Hand Sanitizer Dispenser (ZCHSD) aims at encouraging automation and social distancing by creating an automatic hand sanitizer dispenser with the help of the components provided by IoT. Ultrasonic sensor used in this ZCHSD helps in maintaining zero touch with the hand sanitizer cap and effectively dispensing the sanitizer liquid to the user. [1] Networking is also used in this ZCHSD for the purpose of fetching live Covid-19 statistics from the internet and displaying it to the end user.

In this current scenario of global outbreak, it is advisable by the World Health Organization (WHO) to maintain healthy hand wash and sanitization habits. The main problem in health hand wash is the way we do it, especially in public places, wherein we physically touch the bottle cap. This poses some of the risk factors, where there might be a possibility that an infected person might have come in contact with the sanitizer dispenser. If proper care is not taken, this might prove dangerous for other people as the virus is known to spread via physical contact. Therefore, it is of utmost importance to develop and implement measures to reduce any of the physical contact possible. It is also highly encouraged to implement automation using the various provisions provided by the Internet of Things in this particular problem scenario.

II. HARDWARE REQUIREMENTS

The research was done for various components, their uses, and their simulations on various electronic circuit simulation software. The hardware components and working of the prototype are given below.

- Arduino UNO
- LCD 16X2
- HC-SR04 Ultrasonic Sensor
- MG995 Metal Gear Servo Motor
- Generic Hand Sanitizer Bottle with a dispenser cap

A. *Arduino UNO*

Arduino Uno is a microcontroller. It is a board based on 8-bit ATmega328P microcontroller. Along with ATmega328P, it consists other components such as crystal oscillator, serial communication, voltage regulator, etc. to support the microcontroller. Arduino Uno has 14 digital input/output pins (out of which 6 can be used as PWM outputs), 6 analog input pins, a USB connection, A Power barrel jack, an ICSP header and a reset button. (Fig 1).

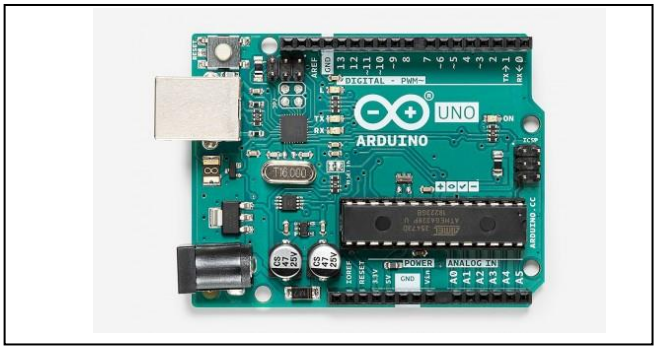

Fig 1 - Arduino UNO Microcontroller [7]

Following are the specifications for the chosen microcontroller:

Microcontroller	ATmega328P – 8-bit AVR family microcontroller
Recommended Input Voltage	7-12V
Operating Voltage	5V
Analog Input Pins	6(A0 – A5)
Input voltage limits	6 – 20V
Digital I/O Pins	14 (Out of which 6 provide PWM output)
DC Current on I/O Pins	40 mA
DC Current on 3.3V Pin	50mA
SRAM	520kB
EEPROM	1Kb
Frequency (Clock Speed)	16MHz
Bluetooth	V4.2-Supports BLE and Classic Bluetooth
Flash memory	32 KB (0.5 KB is used for Bootloader

Table 1 – Arduino UNO Specifications [8]

B. *HC-SR04 Ultrasonic Sensor*

HC-SR04 Ultrasonic sensor is a 4-pin module, whose pin names are Vcc, Trigger, Echo and Ground individually. This sensor is a mainstream sensor utilized in numerous applications where estimating separation or detecting objects are required. The module has two eyes like activities in the front which frames the Ultrasonic transmitter and Receiver (Fig 2). The sensor works with the simple high school formula that

$$Distance = Speed \times Time$$

The Ultrasonic transmitter sends a ultrasonic wave, this wave goes in air and when it gets protested by any material it gets reflected back toward the sensor this reflected wave is seen by the Ultrasonic collector module.

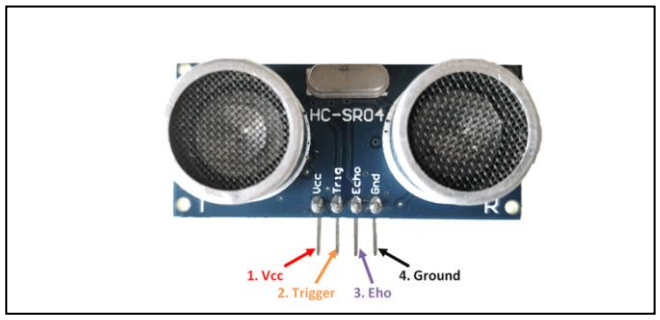

Fig 2 - HC-SR04 Ultrasonic Sensor [8]

Following are the features of the HC-SR04:

- Operating voltage: +5V
- Theoretical Measuring Distance: 2cm to 450cm
- Practical Measuring Distance: 2cm to 80cm
- Accuracy: 3mm
- Measuring angle covered: <15°
- Operating Current: <15mA
- Operating Frequency: 40Hz. [8]

C. *MG995 Metal Gear Servo Motor*

A servomotor is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity and acceleration. It consist of a suitable motor coupled to sensor for position feedback. (Fig 3) The servo is suited for designing robotic arm in which wear and tear of motor is high.

Being metal outfitted, the servo has long life and can be introduced on framework like mechanical arm were engine work is gigantic. Servomotors are utilized in application, for example, advanced mechanics, CNC hardware or robotized producing.

Fig 3 - MG995 Servo Motor [8]

Following are its features and characteristics:

- Metal geared servo for more life
- Stable and shock proof double ball bearing design
- High speed rotation for quick response
- Fast control response
- Constant torque throughout the servo travel range
- Excellent holding power
- Weight: 55 g
- Dimension: 40.7×19.7×42.9mm
- Operating voltage range: 4.8 V to 7.2 V
- Stall torque: 9.4kg/cm (4.8v); 11kg/cm (6v)
- Operating speed: 0.2 s/60º (4.8 V), 0.16 s/60º (6 V)
- Rotational degree: 180º
- Dead band width: 5 µs
- Operating temperature range: 0ºC to +55ºC
- Current draw at idle: 10mA
- No load operating current draw: 170mA
- Current at maximum load: 1200mA [8]

D. *LCD 16X2*

LCD modules are very commonly used in most embedded projects, the reason being its cheap price, availability and programmer friendly. 16×2 LCD is named so because; it has 16 Columns and 2 Rows (Fig 4). So, it will have (16×2=32) 32 characters in total and each character will be made of 5×8 Pixel Dots.

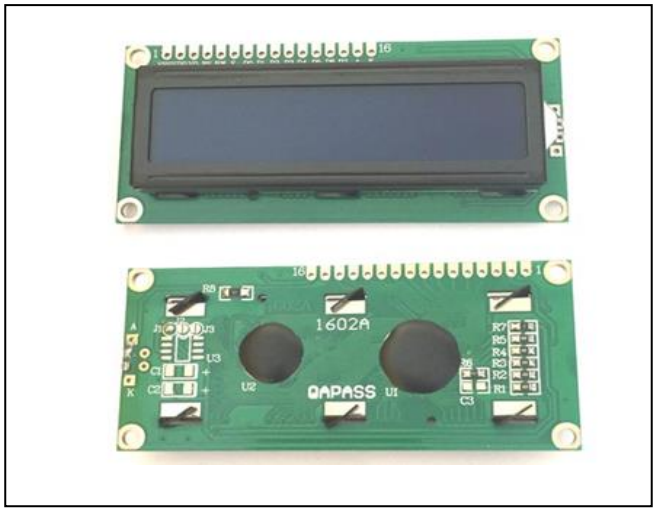

Fig 4 - LCD 16X2 [8]

Features of LCD 16x2 module:

- Operating Voltage is 4.7V to 5.3V
- Current consumption is 1mA without backlight
- Alphanumeric LCD display module, meaning can display alphabets and numbers
- Consists of two rows and each row can print 16 characters.
- Each character is built by a 5×8-pixel box
- Can work on both 8-bit and 4-bit mode
- It can also display any custom generated characters
- Available in Green and Blue Backlight.[8]

E. ESP8266 WiFi Module:

The ESP8266 is a very user friendly and low-cost device to provide internet connectivity to your projects. The module can work both as a access point (can create hotspot) and as a station (can connect to Wi-Fi), hence it can easily fetch data and upload it to the internet making Internet of Things as easy as possible. It can likewise get information from web utilizing API's henceforth your undertaking could get to any data that is accessible in the web, in this manner making it more brilliant. Another energizing element of this module is that it tends to be customized utilizing the Arduino IDE which makes it much more easy to use.

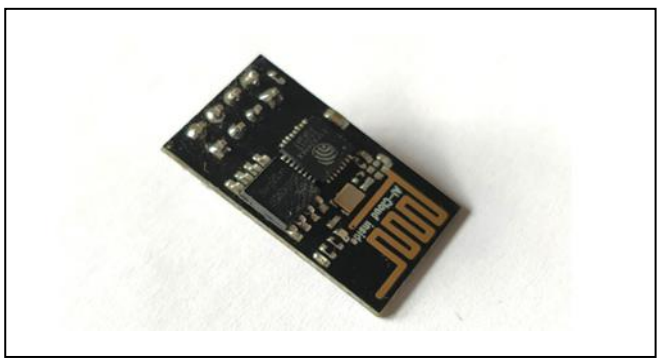

Fig 5 - ESP8266 Wi-Fi Module [8]

Following are its applications:

- • IOT Projects
- • Access Point Portals
- • Wireless Data logging
- • Smart Home Automation
- • Learn basics of networking
- • Portable Electronics
- • Smart bulbs and Sockets [8]

III. PROTOTYPE

The following are the objectives of this ZCHSD:

- The most important objective in this problem statement solution is the maintaining of social distancing. The hands-free approach in this solution not only maintains social distancing but also makes it more convenient to effectively use hand sanitizers. On top of that, manpower is required and more automation is created.
- This ZCHSD includes the provisions to educate users about the intensity of Covid-19 cases in their area, with the help of Wi-Fi connectivity and an API endpoint. The users can easily check the live statistics through a small LCD screen mounted on the apparatus.
- Due to the use of some IoT specific sensors, more automation is introduced into the project, requiring less man power and thus less possibility of physical contact. The device once implemented should also require the least amount of servicing possible, with the only exception of changing the hand sanitizer bottles.
- It is also important to maintain the cost efficiency of the device so that it can be used on a large scale, even in remote regions, with the only crucial requirement of electricity, which can be provided with either power lines or batteries, and if possible, Wi-Fi access points.

This ZCHSD will use Arduino UNO, HC-SR04 Ultrasonic Sensor, 16x2 LCD Module, MG995 Metal Gear Servo Motor, and Hand Sanitizer.[2] The proposed structure is given in Fig 6. An ultrasonic sensor is used to check the presence of hands below the outlet of the sanitizer machine. It will continuously calculate the distance between the sanitizer outlet and itself and tells the ESP to rotate the servo motor to 180 degree from up to down. This will cause the dispenser cap to be pressed for a small amount of time and liquid will be dispensed.

A vertical column houses the Arduino UNO and the servo motor. The hand sanitizer bottle is kept in such a way that the servo motor gear is directly above the dispenser cap and using a suitable connector for the gear, the cap will be pressed when the motor is activated. The Ultrasonic sensor is kept under the beam above the housing column for the microcontroller and is placed in such a way that it reads the distance between itself and the base of the apparatus, just near the dispenser cap so that when the user brings their hands near the cap, the sensor senses it and sends signal to the microcontroller. The LCD in the meanwhile displays the

count of Covid-19 cases and the statistics, and when the servo motor retracts to its normal position, displays a suitable message to the user to take care and wash their hands regularly

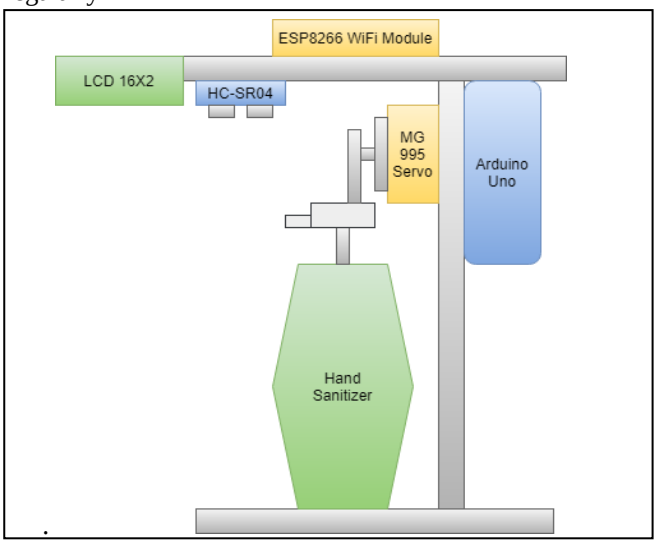

Fig 6 – Block Diagram of the ZCHSD

For the Covid-19 statistics, the GET request is sent to the chosen API and the JSON object is received as a response. This JSON is parsed and the needed data is sent to the LCD to display. The location is set in the API query URL parameters, and can be modified as per the owner's needs.

Fig 7 shows the proposed circuit diagram for the project. Apart from the IoT components, various electrical components are also required. These components include a 220 Ohm, 440 Ohm and a 1K Ohm resistor, and a potentiometer. The circuit was designed on an online circuit designer application and all the necessary connections to the various ports are shown.

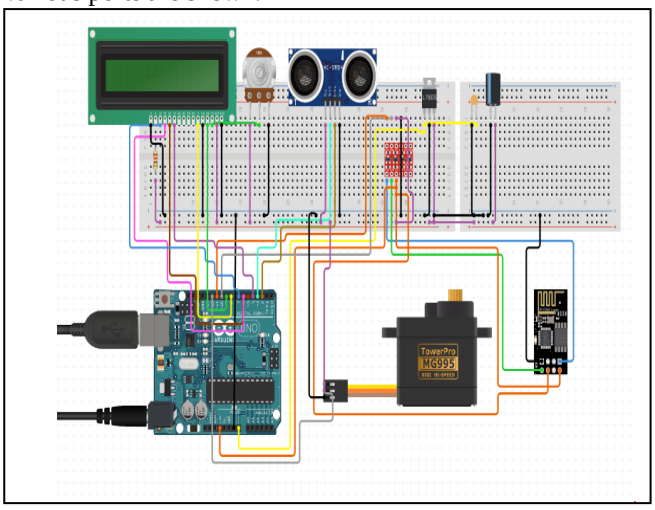

Fig 7 – Circuit Diagram of the ZCHSD

The programming for the Arduino UNO microcontroller is done on the Arduino IDE software, which used the C programming language which is then compiled and converted into the machine language.

IV. Future Scope

Due to the on-going COVID pandemic, people's perception regarding health hygiene has seen a positive change thereby raising the health care expenditure and high investments by companies in the health sector. This ZCHSD is cost-effective with lower maintenance costs and most importantly user-friendly which ultimately will result in the growth of the automatic hand sanitizer dispenser market soon. If the budget is not the concern, then a thermal sensor can also be installed which will display the body temperature of the user and eventually alert the user if any abnormal symptoms are seen. This is possible with the help of ESP8266 Wi-Fi shield module explicitly connected to Arduino Uno. So, to accommodate the ultrasonic sensor as well as the infrared heat sensor, the Arduino Uno microcontroller is used which has a 6 analog pin support, which means it can support more than one analog sensor.

V. Conclusion

The COVID-19 pandemic is the characterizing worldwide wellbeing emergency and the best test we have looked since World War-II. It is unleashing destruction on the planet. Since its rise in Asia toward the end of last year, the infection has spread to each conceivable landmass on the planet. World Health Organization (WHO) has just declared it as pandemic sickness and suggested liquor based hand sanitizers for regular hand cleanliness, which are mostly comprised of ethanol, isopropyl liquor, hydrogen peroxides in various mixes[6]. According to the *Worldometers* statistics, the figures of death rate and people getting affected is increasing rapidly. USA, Brazil, India, Russia are the most affected countries in the entire world. Several countries have announced a lockdown where people can't step out of their homes and are suffering through various aspects of life.

This ZCHSD is thus an attempt to reduce the impact of coronavirus by automation and a hands-free approach of using hand sanitizers at public places. Due to the modern appearance of our system, it can attract the attention of the people which will directly increase the need for automatic hand sanitizer dispensers. Also, our system delivers an adequate amount of dose of hand soap or sanitizer to the user. The key highlight aspect of the system is to have a Zero Contact with the user thereby eliminating the chances of getting affected by the virus through hands. This task is done with the help of MG995 Metal Gear Servo Motor which can rotate at an angle of 180 degrees by pressing the dispenser cap. Taking advantage of the ESP8266 Wi-Fi shield module connected to Arduino Uno, the users are also made aware of the intensity of cases in their area by fetching data through Application Programming Interface(API) and displaying it on the LCD screen embedded with our system. In this manner, the programmed hand sanitizer gadget proposed is required to add to contactless hand sterilization in broad daylight spots and infection disease counteraction [5].

Although, this system might prove effective against germs, but it's not a complete substitute when needing to remove any bodily fluids or dirt from hands. These types of substances need to be completely removed. Hence, this instigates the need to add more features to the ZCHSD which will satisfy the limitation in the near future.

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