ITSU3008

Project 2

Final Report

Submitted To:
Arash Fereidouni
Unit Coordinator
BITS

Submitted By:
Sushant Kumar Jaiswal
Student ID: 40468
Date: 24/10/2020

Automatic sanitizer dispenser machine based on ultrasonic sensor

Sushant Kumar Jaiswal

Abstract: *Viruses such 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. In this paper we propose a novel design of touch-less sanitizer machine to reduce the risk due to contact. The system can sense the proximity with the help of ultrasonic sensor and sends signal to microcontroller. The controller processes the sensor data & actuates the pump and solenoid valve. The sanitizer liquid dispenses through mist nozzle.*

Keywords: **automatic dispenser, ultrasonic proximity sensor, sanitizer machine, pump, mist nozzle.**

1. 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 Center 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 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.

The need of touch-less automatic dispenser is identified after observing that it is the point of contact for contamination. In this paper we present a novel design of automatic hand sanitizer dispenser. 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.

2. PROPOSED SYSTEM

We have designed a sanitizer dispensing machine in a plastic cabinet as shown in figure 1. The system consists of proximity sensor based on ultrasonic principle. The sensor used in the system is SR04 to sense the hands are under the machine or not. The cabinet design was originally fabricated for water RO system and has been modified for the purpose of sanitizer dispensing action. The sanitizer storage section is on the front side upper region. Filters have been removed and the water dispensing tap has also been removed. Mist nozzle has been added at the bottom side of the cabinet. The pump is used to suck the sanitizer and pump it with a pressure to the nozzle. The solenoid valve has also been used to control the opening of nozzle and to facilitate to control the dispensing of liquid sanitizer. Pipes and attachments helped to make it easy to fabricate.

Figure 1: Original image of the proposed design in plastic cabinet

2.1 Hardware & Software

Atmega-328 is an AVR family microcontroller with 28 pin DIP. It has 6 analogue inputs and 13 digital input/output pins. A high-performance Microchip power in pico-watts 8-bit AVR RISC-based microcontroller combines 32KB ISP flash memory with read-while-write capabilities. It has a 1024B EEPROM, 2KB SRAM, 23 general-purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts. It also has a serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, a 6-channel 10-bit A/D converter (8-channels in TQFP and QFN/MLF packages), programmable watchdog timer with internal oscillator, and five software selectable power saving modes. The device operates between 1.8-5.5 volts.

HC-SR04 Specifications

- Working Voltage: DC 5V
- Working Current: 15mA
- Working Frequency: 40Hz
- Max Range: 4m
- Min Range: 2cm

- Measuring Angle: 15 degree
- Trigger Input Signal: 10µS TTL pulse
- Echo Output Signal Input TTL lever signal and the range in proportion
- Dimension 45 * 20 * 15mm

The Timing diagram is shown below in figure 2.

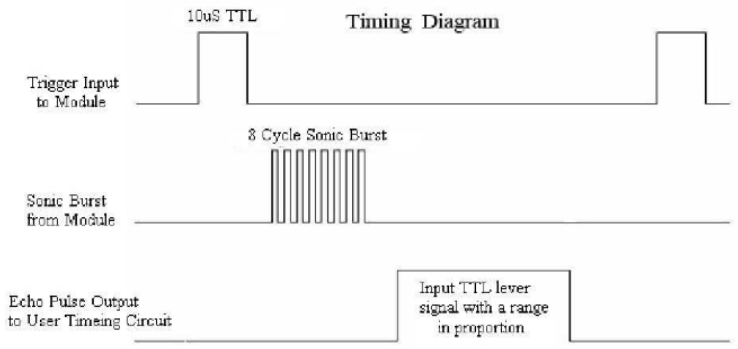

Figure 2: Timing diagram for ultrasonic sensor SR04 (datasheet)

You only need to supply a short 10uS pulse to the trigger input to start the ranging, and then the module will send out an 8 cycle burst of ultrasound at 40 kHz and raise its echo. The Echo is a distance object that is pulse width and the range in proportion .You can calculate the range through the time interval between sending trigger signal and receiving echo signal. Formula: uS / 58 = centimeters or uS / 148 =inch; or: the range = high level time * velocity (340M/S) / 2; we suggest to use over 60ms measurement cycle, in order to

prevent trigger signal to the echo signal.

A booster pump increases low water pressure and flow. It provides the extra boost needed to bring your water pressure to the desired level. A water booster pump provides pressure to move water from a storage tank or throughout a whole house or commercial

facility. Most water booster pump, no matter who the manufacturer contain the same core

Figure 3.Schematic of the sanitizer dispensing machine circuit.

components:

- Motor
- Impellers
- Inlet and outlet
- Pressure or flow sensing device

Booster pumps have an impeller that moves water that comes in through the inlet and exits through the outlet. A motor makes the impellers spin. Booster pumps differ according to how they suck water in and push it out. Some water booster pumps use a spinning propeller, while others use an oscillating diaphragm. Pumps with oscillating diaphragms propel water using two oscillating or rotating plates— one with cups and one with indentations. As the plates roll together, they compress the cups and force the water out. As the plates roll open, more water is sucked in.

Solenoid Valve only operates when it is supplied with DC Voltage. This is a 2 way Solenoid Valve. So, it has has 2 connections, one of them is liquid inlet and other is outlet. It accepts DC voltage of 24V. It also works on 12V DC. When there is input voltage on the Solenoid Terminals, it operates, and opens up, allowing the liquid to flow from inlet to outlet. The Solenoid has push fit connectors on each side. So, this connector will allow us to directly push the pipe or nozzle into the solenoid without worrying of leaking.

Specifications:
Operating Voltage: 12V / 24V DC
Current Requirement: 400 mA
Connections: Push Fit Type
Nozzle Diameter: 6.3 mm
Normally Closed Valve

Solenoid valve function involves either opening or closing an orifice in a valve body, which either allows or prevents flow through the valve. When the solenoid coil is energized in a normally open valve position, the plunger seals off the orifice, which in turn prevents flow. 12 volt solenoid valve with 15 watt coil will draw 1.25 amps and if connected to a battery will have a significant power drain and will need topping up according to the power usage. Amps (current consumption) = watts (power consumption of coil) divided by 12 volts.

All misting systems are comprised of a series of nozzles placed in a line. When attached to high-pressure pumps, water is forced through nozzles, forming droplets which evaporate into mist when they reach the outdoor air.

Arduino IDE has been used initially to program the atmega-328p. The integrated development environment of Arduino IDE provides varies libraries to be used for programming. The functions of the libraries are easy to use and doesnot require to address individual register of microcontroller in the programming. The printed circuit board is designed using eagle software for PCB design. The simulation of the circuit has been done in proteus simulation software.

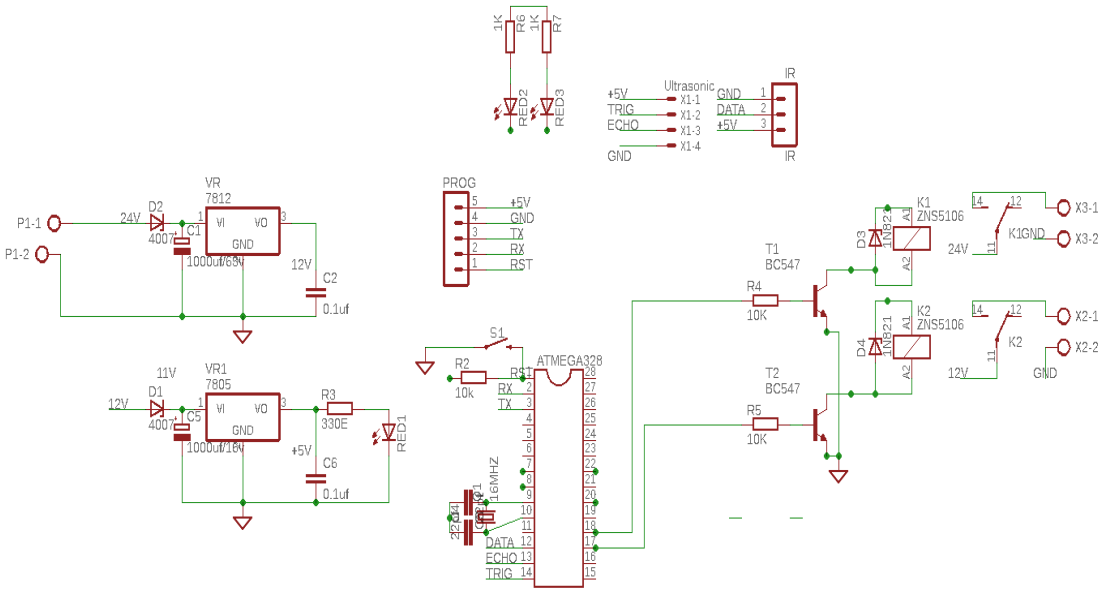

Figure 4 .Schematic of the sanitizer dispensing machine circuit

3. WORKING OF PROPOSED SYSTEM

Block diagram of the system is as shown in fig.5 The sensor senses the proximity of hands when placed under the machine. It works on ultrasonic waves reflection principle. Ultrasonic ranging module HC - SR04 provides 2cm - 400cm non-contact measurement function, the ranging accuracy can reach to 3mm. The modules includes ultrasonic transmitters, receiver and control circuit. The basic principle of work:

(1) Using IO trigger for at least 10us high level signal,

(2) The Module automatically sends eight 40 kHz and detect whether there is a pulse signal back.

(3) If the signal back, through high level, time of high output IO duration is the time from sending ultrasonic to returning. Test distance = (high level time×velocity of sound (340M/S) / 2.

As the controller receive High signal from the sensor module it triggers the pump to pull water from storage area and send to the nozzle in mist form. The program runs the pump for 3 seconds. It has been seen during testing 3 seconds are sufficient to sanitize the hands with mist spray. Even we can change the time as per user need through program.

4. RESULT & CONCLUSION

An automatic sanitizer dispensing machine designed and developed. The machine is wall mount at entrance gates of society, schools, colleges or any commercial building. It can spray 40 times with 100 ml liquid and is effective in optimize use of liquid sanitizer. The machine is tested for 24hour operation for more than a week and is working fine. It helped to reduce the contact for getting sanitizer and also reduce man power employed to spray sanitizer with a spray bottle.

The power consumption is very low. For each spray the maximum current consumption is 2 Ampere at 24 V. It consumes 48W if run continuously for 1 hour. The control circuit is small in size and low cost as compared to available controllers. The power

consumption is low and the system can help to achieve contactless sanitizer dispenser. It reduces the risk of community transmission of the virus.

5. ACKNOWLEDGEMENT

The. Author would like to thank Mr. Rakesh Gupta, Mr. Anoop Pandey, Mr. Ravi and Mr. Neeraj for helping and providing moral support. They have extended support while installing pump and making attachments. Testing was done and the sanitizer dispenser machine worked successfully.

REFERENCES

[1] *Guide to implementation of the WHO multimodal hand hygiene improvement strategy. Available from: http://www.who.int/patientsafety/en/ , accessed on August 24, 2010.*

[2] *WHO Guidelines on Hand Hygiene in Health Care. First Global Patient Safety Challenge. Clean Care is Safer Care. Available from: http://www.who.int/patientsafety/en/ , accessed on August 24, 2010.*

[3] *Boyce JM, Pittet D. Guideline for Hand Hygiene in Health-Care Settings. Recommendations of the Healthcare Infection Control Practices Advisory Committee and the HICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force. PubMed, Google Scholar, Morb Mortal Wkly Rep. 2002;51:1–44.*

[4] *Kampf G, Kramer A. Epidemiologic background of Hand Hygiene and evaluation of the most important agents for scrubs and rubs. Clin Microbiol Rev. 2004;17:863–93.*

[5] *Daniels IR, Rees BI. Handwashing: simple, but effective. Ann R Coll Surg Engl. 1999;81:117–8.*

[6] *Sickbert-Bennett EE, DiBiase LM, Willis TM, Wolak ES, Weber DJ, Rutala WA. Reduction of Healthcare-Associated Infections by Exceeding High Compliance with Hand Hygiene Practices. Emerging Infect. Dis. 2016 Sep;22(9):1628-30.*

[7] *Knighton, 2013, Patent, google patent search.*