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Novel Automatic Multipurpose Liquid Dispenser

Shahera S.Patel*

Professor, Department of Electronics, Sardar Patel University, V.V. Nagar, Gujarat, India.

*Corresponding Author: shahera9924938076@gmail.com

Abstract

Pandemic situation has underscored the critical importance of Hand Hygiene in preventing the spread of infectious disease. Hand washing with soap/sanitizer has received considerable attention to prevent spread of the disease or killing most germs and viruses. As advised by WHO(World Health Organization)[1] and CDC(Centre for Disease Control and Prevention)[2] washing hands with soap and water several times a day, reduces germs, microbes and bacteria which are present in hands. Soap dispenser helps in killing most of the germs present on hands. The fundamental problem is that we do the Hand washing by the physical touch to the bottle/container which does not serve the purpose because current evidence indicates that the virus is transmitted through contact. Also, in washroom the soap is needed. Traditional soap dispensers require physical contact, which poses a risk of virus transmission through contaminated surfaces. This paper highlights the efficacy of automatic touchless hand soap dispensers as a solution to enhance hand hygiene while minimizing the risk of direct contact. The use of automatic touch less hand soap dispenser is best solution for hand hygiene. In this context we have developed automatic touch less Soap Dispenser based on Microcontroller ATMEGA328P. Ultrasonic Sensor (HC-SR04) is used to detect the presence of Hands. Microcontroller receives the signal from the sensor and Based on detection, gives signal to relay to switch ON the pressure pump. Suitable Nozzle arrangement is used to pour spray/droplets of the liquid soap on the hand for 1 second. This time period can be changed by suitably changing the program in microcontroller. Different color LEDS are used to indicate Power ON condition and Pump ON condition. The developed model is robust, handy and easily movable as and when required.

Keywords: Ultrasonic Sensor, Liquid Soap Dispenser, Microcontroller, Pump.

Introduction

To protect human health during all infectious diseases, requirements of proper hygienic conditions/ sanitization is extremely necessary. Sanitization means sterilizing or cleaning any objects or whole body or a part of body like hands etc [3]. All over the world, Millions of people were affected by the ominous virus during covid pandemic situation. For human health, hand hygiene is a prime requirement. If proper procedures of hand hygiene are not taken care of or implemented, always there is a chance and risk of emerging infectious diseases[4-7]. To ensure consistency in washing hands at a regular interval of time for those living near universities, schools, market places, shopping malls, banks, prisons, and health care hospitals will help to prevent human-to-human transmission of virus. Latest updates indicate that many viruses are transmitted through respiratory droplets or contact. When our contaminated hands touch the eyes or nose or the mouth, contact transmission is possible. Also, indirect contact transmission occurs by hands, touching from one surface to another surface[8-10]. Thus hands are the medium for spread of the virus. Hence, hand hygiene and sanitization of hands is extremely important. This reduces the transmission of other bacteria and viruses which causes diseases like flu, pneumonia, and cold. Different methods are used for hand sanitization which includes: (1) Bleach Sanitization (2) UV Sanitization (3) Soap and Alcohol Sanitization, etc. Out of these methods, mostly soap and alcohol mixed with other fluids is used because it is not harmful on surface of the skin, kills most of the bacteria and viruses and it easily removes dirt from the hands.

As we all are aware, the covid pandemic condition has changed the lifestyle of all human beings in all over the world. The WHO (World Health Organization) has directed to keep up the healthy sanitizing habits. The proper hand wash with liquid soap/sanitizers is very important. Touching Soap/sanitizer dispensers or alcohol containers with infected hands can increase the risk of spreading the virus to the other person and does not fulfill the purpose[11-13].

Objectives

The main purpose of this research paper is the Design and Development of Novel Automatic Soap Dispenser for washing hands. The hardware includes Ultrasonic Sensor, Microcontroller Atmega328P (NANO), relay and pump with control circuit, Nozzle, Power Supply, LEDs, Bottle filled with Liquid Soap etc.

Block Diagram

Fig. 1 shows the block diagram of Automatic touch less hand sanitizer dispenser.

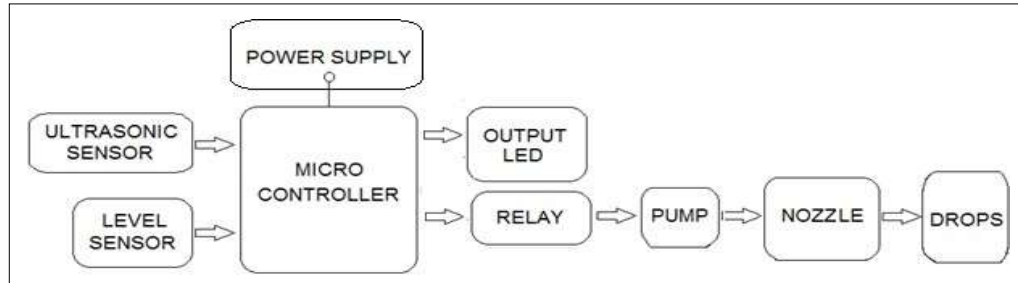


Fig. 1 Block diagram of Automatic Soap Dispenser

Detail Description

In this developed soap dispenser, presence of hand is detected by ultrasonic sensor (HC-SR 04)[14]. The ultrasonic sensor has a trigger and echo pins which are transmitter and receiver respectively. The sensor triggers within the distance range of 13 cm which can be adjusted through programming. When the hand is placed within the trigger distance, the sensor gives signal to the Microcontroller (Atmega328P NANO) Circuit. Then the Microcontroller (Atmega328P NANO)[15] sends signal to 12V Relay which is energized, switching the pump of dispenser in order to pour the liquid in hand through proper nozzle arrangement. Suitable programming is done to get time delay of 1sec. By changing the program, the delay time to pour the soap liquid can be modified.

Facility is also provided to check the liquid level. If the liquid level is OK, then only the system becomes ON which is indicated by RED LED. The pump ON condition is indicated by BLUE LED.

The +5V and + 12 V DC power source is used to operate the Microcontroller and Pump respectively.

The complete system hardware is very simple which includes,

- Ultrasonic Sensor (HC-SR 04)
- Power Supply (+ 12 V, + 5 V)
- Resistors(1K Ω), Capacitors (100 nF), Diodes (1N4148)
- LEDs (Red, Blue)
- Transistors (BC 547)
- Relay (+12V)
- Pump
- Arduino IDE is used for programming.

The Flow Diagram of Automatic Liquid Soap Dispenser is shown in Fig.2

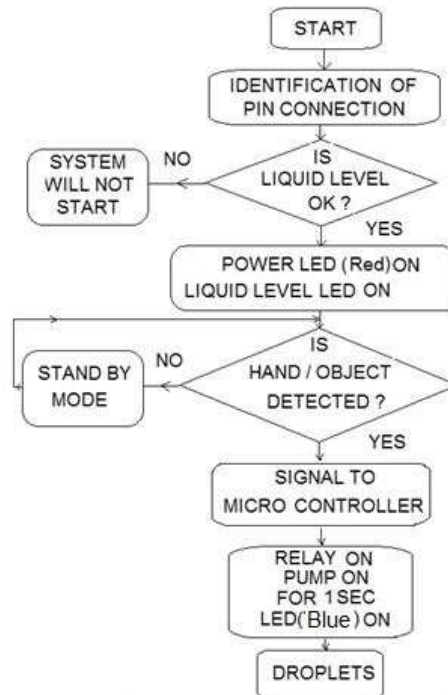


Fig.2 Flow Diagram of Automatic Liquid Soap Dispenser.

Results and Discussions

Fig. 3 shows the complete circuit diagram of Automatic liquid Soap Dispenser

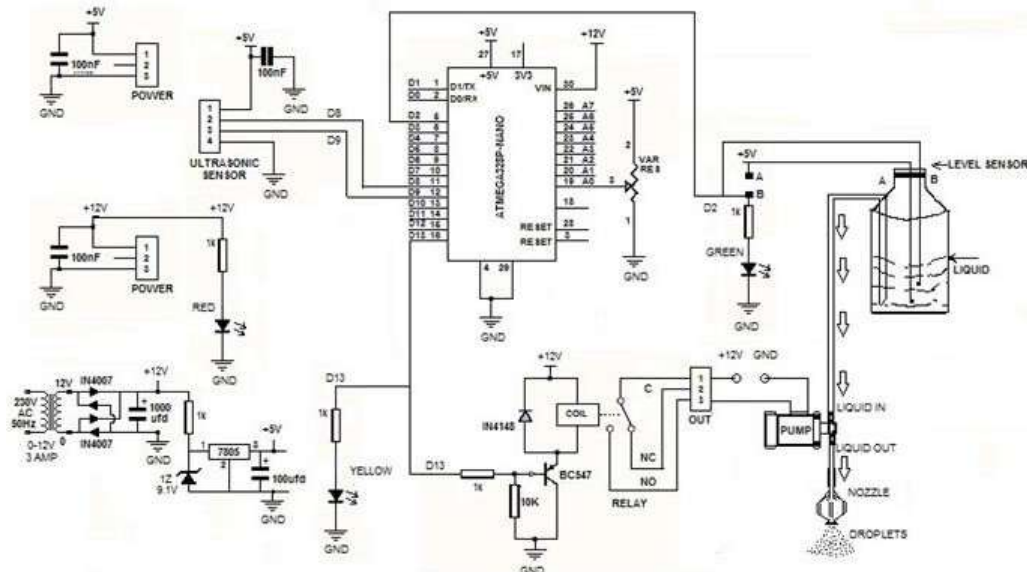


Fig. 3: Schematic diagram of Automatic Liquid Soap Dispenser

In developing Automatic Liquid Soap dispenser we have used Microcontroller ATMEGA328P Nano to control the pumping action and provide suitable time delay. When the Hands/Object is detected by Ultrasonic Sensor, pump starts through relay and runs for 1 sec.

Fig. 4 Photographs of various components of developed Automatic Liquid Soap Dispenser.

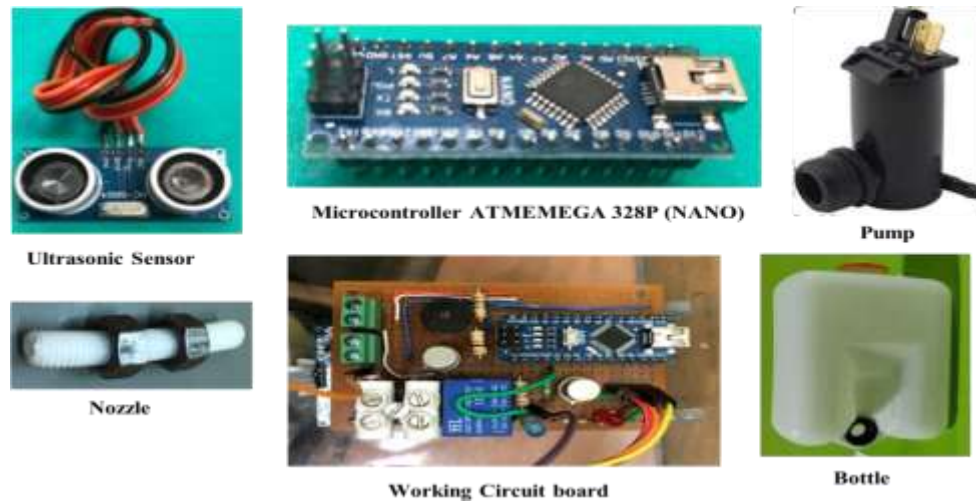


Fig. 4: Different Parts of developed Automatic Liquid Soap Dispenser



Figure 5: Working Model of developed Automatic Liquid Soap Dispenser with QR code

Applications

This type of Automatic Liquid Soap dispensers can be widely used for Hand Hygiene purpose in public/work places like – Colleges, Universities, Hospitals, Banks, Offices, Shopping Centres, Police Station, Cafeteria – Food Zones. Even One can also use it at home.

Conclusion

Use of Liquid Soap Dispenser at key locations whether it is workplace, home, malls or hospitals is essential to fight against harmful bacteria and viruses particularly during any Pandemic situation. By eliminating the need for physical interaction with dispenser mechanisms, these devices significantly reduce the potential for cross-contamination in both private and public washroom settings. The developed Automatic Liquid Soap dispenser definitely fulfils the requirement of Hand Hygiene for personal safety. Since this is a non contact dispensing, it prevents pathogen spreading, thus minimizing chances/ risks of emerging infectious diseases. It can be concluded here that the product has been successfully implemented and working well. The findings suggest that widespread adoption of touchless dispensers can play a pivotal role in improving hand hygiene practices and safeguarding public health.

The Prototype models are installed at Materials Science Department, M.B.Patel Education College, Statistics Department of S.P.University.

NOTE : This prototype model is patented under Design Registration Category.

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