Smart Hand washing Machine for Community Service During the COVID-19 Pandemic: A Cost Effective Approach for Robust Hand Hygiene

Davinder Singh Rathee^a

^aSchool of Electrical and Computing, Adama Science & Technology University, jerryrathee@gmail.com

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Abstract: Hand hygiene is most important practices to prevent the spreading of COVID-19, and other infection for communicable diseases, corona , trachoma, scabies, pneumonia, cholera and eye infections and dysentery, as per the recommendations by World Health Organization (WHO). Several guidelines are recommended for cleaning hand thoroughly which mainly consist of six steps. Mostly used system in surrounding is foot based/mechanical are not ease of use as well as may not suitable for all kind of people. This work presents designing of smart electrical system/touch less as well as designing of physical structure for robust hand washing system, which may be used at public places like restaurants, bus stands, students area and places of food selling etc. This system based on sensor for detecting the presence object. The inbuilt receiver inside sensor detects the reflected 38Khz IR signal in the presence of obstacle and activates the tap valve and facilitates the water flow.

Keywords:

1. Introduction

The hand washing with soap is also a most effective and efficient method for regulating the spread of COVID-19. In Many countries hand washing adopted as initial step before taking meal but now a days its mandatory part of day today routine, but attention must be given for proper hand washing habit. Ignaz et al in 1992 made first observations which lead to hand washing practice [1]. Dr Semmelweis keenly observed the problems of hygiene and published problem faced by medical students and triggered the importance of hand washing [2].

Also in the present scenario Global health crises has been increased drastically due to COVID-19 [3] in order to stop the further spreading and dangerous virus serious hand hygiene may be the best control mechanism and cost effective method [4-5]. Latest era of technology like sensors, sensors, timers, Internet of Things (IoT) enabled smart electronics components [6,7] can help us in developing smarts hand washing system, allowing user washing hands without touching.

The necessity of hand washing was observed 5 decades ago, so researchers are dedicated to develop effective system to achieve the target. Firstly By Johan in US developed manual machine with heading "hand washing and drying equipment unit" under U.S PAT. No 55 22, 411. Later David proposed good control on washing as well as rinsing of hand entitled "HAND WASHING DEVICE" with patent file no 4, 606, 085.

Presently such machines must be the part must for community, hotels, homes, hospitals, executive offices, restaurants, schools etc for preventing the COVID-19 and for robust hygiene.

By considering this as social responsibility we have developed very cheap, affordable, transportable and handy ready to replace manual hand washing system to automatic smart system. The washbasin taps work automatically when you put your hands just below the water tap outlet. This smart washbasin tap controller system detects any obstacle by Ultrasonic sensor by hands and water/soap automatically starts flowing out of the tap for particular interval of time which according to guideline of WHO. This work promotes a prototype which supplies soap and water by respecting WHO guideline for hand washing during COVID-19. Also these guideline for hand washing will remain continue in future also for respecting the hygiene rules prescribed by medical agencies.

In this work we developed a cost effective smart hand washing system by considering WHO guidelines inducing, Rooftop

It is the protective support for the hand washing machine from the rain and sun light .

1. Mirror

Mirror visulaize the proper washing of hand with aesthetic look of the face.

2. Wooden support base

The wooden base is the backbone of the machine which supports the components of the machine

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3. Mica coating

It protects the components from the water contacts during rainy season.

4. Water tap

It is meant for to flow the water from the tap when the sensor sense the hand.

5. Wash basin

It is meant to collect the washed water to the out let.

2. Methods For Smart Hand Washing System Development



Fig.1 Detailed diagram of the hand washing machine

1. Support base

It supports the complete machine as a stand.

2. Water outlet

The washed water is collected from the outlet and send it back to the drain system.

3. Soap container

Soap container is connected to the submersible pump to collect soap, when the sensor sense the hand of the human being.

4. IR sensor for soap outlet

IR Sensor is connected to sense the hand for outletting of the soap.

5. Ardiuno

It is the heart of the project which acts as controller for the other machines.

6. Battery for ardiuno Power Supply

4. Detailed Description Of The Machine

To addressing the hindrances like scarcity of drinking water and limited resources for manufacturing, a novel approach has been adopted for the design of automatic, feasible and affordable smart hand washing machine for the customers. The proposed design can be attached with any kind water locally used water reservoir i.e Jerry Can, roto (local name), Tank or with running water. The final product provided to customer is touch less hand washing system.

i. This machine mainly has two portions and rectangular in shape with the dimensions of 60×40 Cms as shown in Fig-1. Top hosing portion of 40×40 Cms containing mirror and hot air mechanism. The lower structure 20×20 Cms comprising of soap and water injections system.

ii. The lower portion comprises a Tapered box shaped structure consisting of Electrical circuit as shown in Fig-2 and sensors for sensing the customer hands.

iii. The system further attached with wash basin with drainage pipes from which used water and soap pass through. The ultrasonic sensor behaves as control eye for the detection of hands. As the sensor observed the object its commands for micro controller to energize the motors connected with soap and water respectively.

iv. Two different reservoirs are used for water and liquid soap

v. Each reservoir holding one small submersible pump for the delivery of soap and water.

5. Working Of Smart Hand Washing Machine

Circuit mainly implemented with Ardiuno, SR-04 Sensors, Motor Driver Ic-293D and Submersible Pump as shown in Figure-2. Then we installed the circuit in wooden structure as shown in Figure-4. When IR rays falling on the receiver are interrupted from water section on the unit, the sensor output goes low momentarily to trigger the pulse on Ardiuno. The output of the Ardiuno activates for defined time in coding. Also give command for motor driver IC to start the pump. Similar action will be performed by the soap dispenser section installed on washbasin unit. The final designed unit testing has been done several times in lab. Finally it was demonstrated at Adama Science and Technology University.

5.1 Circuit Implementation



Fig. 2: Component level Diagram for hand washing system



Fig. 3: Circuit Diagram for hand washing system



Fig. 4: Implemented Smart hand washing system

6. Results

This fully automatic hand washing machine designed and developed in ASTU then deployed in front of Admin block for one Month during the COVID-19 pandemic as well as presented in JIMMA University, Ethiopia. The circuit remains fully operational during transportation from one university to another as well field test. Further University Research and Community office approved this machine for the distribution in community.

7. Conclusion

This work successfully demonstrated and implemented in university may further be able to be extended for community services. It has been checked in field consistently and found to be maintenance free. The mirrors on the machine also encourage the customers in order to increase the rate of hand washing. This project can be deployed at any required place in community, and especially an intensive care unit (ICUs) in hospital as well as airport in this dangerous time of COVID- 19.

References

- 1. Adama, D. J. Gagge. M. (1992). A clinical Evaluation of Glove Washing and Re-use in Detail practice. J. Hosp. Infect. [CrossRef] [Medline]
- 2. Altermeter, W. A. (1983), Surgical Antiseptics in Disinfection and Sterilization. [CrossRef] [Medline]
- Cohen MS, Corey L. Combination prevention for COVID-19. Science 2020 May 08;368(6491):551. [CrossRef] [Medline]
- 4. Graves N, Page K, Martin E, Brain D, Hall L, Campbell M, et al. Cost-Effectiveness of a National Initiative to Improve Hand Hygiene Compliance Using the Outcome of Healthcare Associated Staphylococcus aureus Bacteraemia. PLoS One 2016;11(2):e0148190 [FREE Full text] [CrossRef] [Medline]
- 5. Kwok YLA, Gralton J, McLaws M. Face touching: a frequent habit that has implications for hand hygiene. Am J Infect Control 2015 Feb;43(2):112-114 [FREE Full text] [CrossRef] [Medline]
- Aiello AE, Coulborn RM, Perez V, Larson EL. Effect of hand hygiene on infectious disease risk in the community setting: a meta-analysis. Am J Public Health 2008 Aug;98(8):1372-1381. [CrossRef] [Medline]
- Ward MA, Schweizer ML, Polgreen PM, Gupta K, Reisinger HS, Perencevich EN. Automated and electronically assisted hand hygiene monitoring systems: a systematic review. Am J Infect Control 2014 May;42(5):472-478. [CrossRef] [Medline]
- Yamashita Y, Iwasaki H, Muroi Y, Hida M, Shigemi H. Development of In-Hospital Infection Management Using IoT. Stud Health Technol Inform 2019 Aug 21;264:1817-1818. [CrossRef] [Medline]

- 9. Khurmi, R. S. and Gupta, J. K. A Textbook of Machine Design, 14th Revised Edition, Eurasia Publishing House (P VT) Ltd New Delhi. (2005).
- 10. Mohanty, A.K. (1994) Fluid Mechanics. Prentice-Hall of India Private Limited New Delhi.
- 11. Peter Snyder O. A. "Safe Hands" Hand wash program for Retail Food Operations.
- 12. Rajput, R. K. (2005). Heat and Mass Transfer. S. Chand Company Limited.
- 13. Yildiz Bayaztoglu, M. Necaji Ozisit Mechanical Engineering Series McGraw Hill International Edition.
- 14. Shigley J. E. (2006) Shigley's Mechanical Engineering Design, Eighth Edition McGraw-Hill Companies Inc.