

# Effective Health Care Hand Hygiene Station Using Internet of Things

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**ABSTRACT:** Infection prevention is one of crucial factor in case of medical field. For avoiding infections monitoring of health care worker is needed. This Paper presents a prototype model of the hand hygiene adherence system using wireless sensor network. The proposed system is designed for hospitals, in which hand hygiene stations are located in each ward or floor. The dispenser unit consists of two units, soap and water unit. The IR sensors are used for hand detection. The controlling of soap and water dispenser activity is done by using PIC16f877a microcontroller. The EM-18 RFID reader is used for user identification. As RFID tag is shown to RFID reader, session of the user is started. And when the usage of soap and water activity of user is done then for ending session, user require to show RFID tag to RFID reader. The record related to user name, time and level of soap and water is stored in the web server. The LCD display is used to display user name.

**KEYWORDS:** Buzzer, Dispenser unit, Infection, Web server.

## I. INTRODUCTION

Now a day, preventing infections in the hospitals is challenging and important task. Every hospital is having dispenser units in each wards or floors. And monitoring of hand hygiene activity is done at some hospital and also not done. They use method for monitoring are manual method, direct observation, self-reporting method. These methods are time consuming and require human effort.

The direct observation method is used in many hospitals for monitoring hand hygiene activity of health care worker. In which they carried out monitoring of data by using surveys.

The self-reporting method is used in many hospitals for monitoring hand hygiene compliance of worker. This method requires human effort.

In many hospitals manually monitoring is done, means there is not record is kept for any hand hygiene activity of worker.

The present study proposes hand hygiene adherence system for monitoring hand hygiene activity of health care worker. Proteus software has been used for programming of the devices such as IR sensor, RFID reader and Wi-Fi.

In this paper, the level sensing circuit is also designed for sensing the level of soap and water. The data related to user name of worker, time and level is either sufficient or low is stored in web server.

This paper is arranged into six sections. Section II describes existing theories and practices. Section III describes hardware used for the system design. Section IV contains proposed block diagram of the dispenser system. Section V shows the result. The conclusion is deliberated in section VI.

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### II. LITERATURE REVIEW

Mert Bal and Reza Abrishambaf, had proposed prototype model of the system. They described cloud based hand hygiene monitoring system by using IoT technology. They have used zigbee as wireless network. They have construct hand hygiene station in the hospital, and they monitor usage of hand hygiene activity. And data of activity is stored in data center. [1]

J. M. Al Salman et al., had presented system for measuring compliance of health care worker and also they provide the hand washing guidelines for preventing infections. They have designed software for storing data of the user. This software helps them to view the compliance rate. [2]

Malak Beslyman et al., had described two approaches time-based and activation-based. They have developed real-time notification system for the health care worker. They designed system, which gives the notification to the health care worker when they missed hand hygiene activity. [3]

Amrith Poonacha M et al., had designed prototype model of liquid dispenser system. They have used arduino for controlling the operation of the system. They have used solenoid valves for dispensing the liquid from the tank. They have designed low power and low cost system. [4]

M. H. Muhammad Sidik and S. A. Che Ghani, had proposed prototype model for liquid filling machine. They have used ultrasonic sensor to measure volume of water. They have used solenoid valve for controlling flow of the water. [5]

Angelo A. Beltran Jr et al., had presented prototype model for the pets. They have used GSM technology for sending messages. The solenoid valves were used for controlling flow of the water. They have used servo motor for the food transportation purpose. [6]

Rhowel Dellosa et al., had designed prototype model of wastewater management system. They have used 24V relay driver for switching on and for controlling activities of the system. [7]

### III. DESIGN AND IMPLEMENTATION

Fig. 1 shows the front view of the designed PCB. The PCB of the circuit contains mainly four sections.

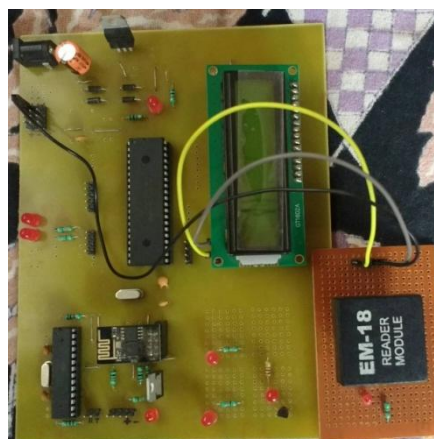


Fig. 1 Front view of the PCB

The first section is power supply section. The 12V adaptor is used to give supply to this circuit. The 5V power supply unit is designed by using rectifier, filter and regulator. The 1n4007 diodes are used to design bridge rectifier. The capacitor is used for filtering purpose. And 7805 regulator is used to give constant DC voltage of 5V.

The second section is LCD display section, in which the LCD 16x2 is interfaced with PIC16f877a microcontroller. The D4 to D7 data pins of LCD display are connected to 35 to 38 pins of microcontroller.

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The third section is Wi-Fi section. The Wi-Fi module used in this system is ESP8266. The Wi-Fi is interfaced with PIC microcontroller. The Wi-Fi module requires 3.3V supply. LM317 is used for converting 5V to 3.3V.

The fourth section is RFID section. The RFID reader module is used in this system is EM-18. The EM-18 RFID reader is interfaced with PIC microcontroller. The transmitter, receiver pins of RFID reader and PIC microcontroller are used for serial communication.

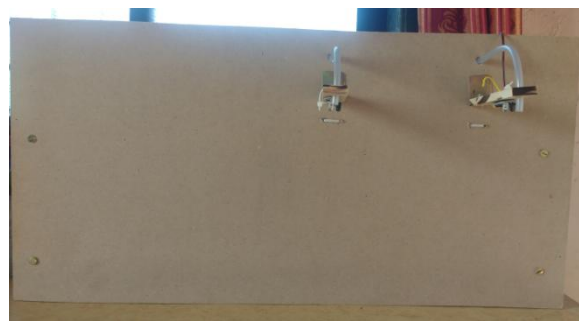


Fig. 2 Dispenser unit (Front View)

The prototype model of the dispenser unit is as shown in Fig. 2. In this prototype model, two slots are designed for the IR sensors. One slot is for soap and other for the water. After detecting hand, either soap or water is out from the outlet. And the back side of the dispenser unit contains two containers. One container is for soap and other for the water. And two submersible pumps are placed in these containers.

#### IV. BLOCK DIAGRAM

Fig. 3 shows hardware setup of proposed dispenser system. The Em-18 RFID reader is having distance measuring range upto 10cm and used for scanning the user. When user is scanned at RFID reader, the data of user is stored in web server.

##### 1. LCD Display:

The LCD display is used in this system is 16x2. The use of this display is to display name of the user, who uses soap and water of the dispenser unit.

##### 2. RFID Tag:

The user identification number and name of the user is stored in RFID tag.

##### 3. RFID Reader:

In this system EM-18 RFID reader is used. RFID reader is used to register the user.

##### 4. IR Sensor:

The MH sensor series flying fish IR sensor is used in this system. It is used for detecting the hand of the user.

##### 5. Controller:

PIC16f877a microcontroller is used in this system. This microcontroller is used for detecting the activities of the soap and water.

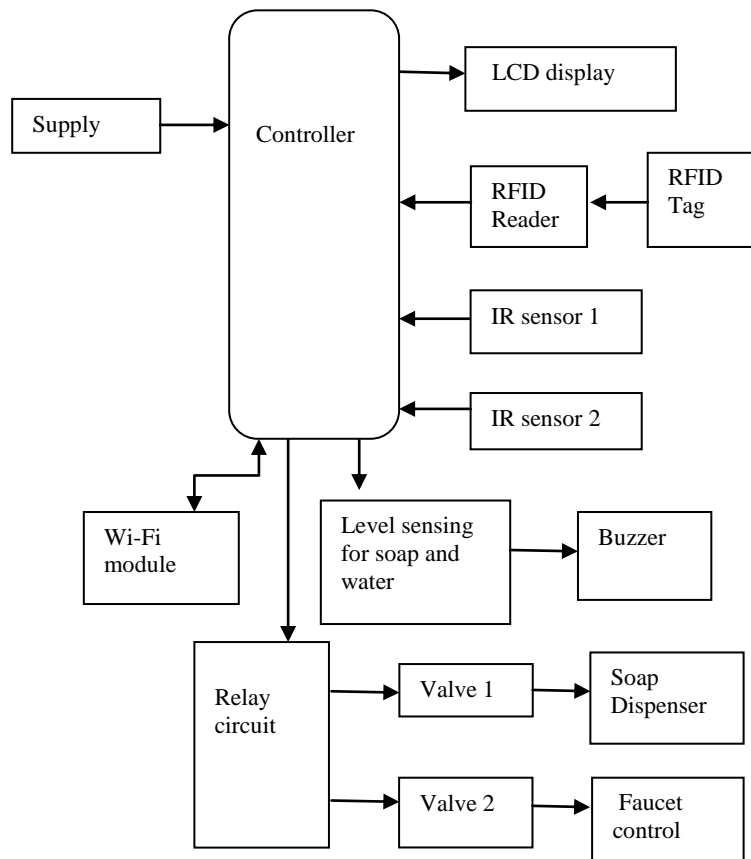


Fig. 3 Proposed Block Diagram

#### 6. Wi-Fi Module:

The Wi-Fi module used in this system is ESP8266. This module is used to upload hand hygiene activity related data at web server.

#### 7. Level Sensing Circuit:

For checking the levels of soap and water level sensing circuit is designed. When the quantity of soap and water is below predefined level, buzzer will be sounded.

#### 8. Relay Circuit:

The relay circuit is used to switch on and off the soap and water dispenser units.

### V. RESULTS

Results obtained by the proposed system are as shown below. Fig. 4 shows the RFID output of the system. The session of the user is started when he show RFID tag to RFID reader. And when the usage of soap and water activity of user is done, then for ending session user will require to show RFID tag again to RFID reader.

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Fig. 4 RFID output

Fig. 5 shows IR detected output of the system. As hand is detected below the outlet, IR sensor gives low signal. And IR detected output is displayed on LCD display.

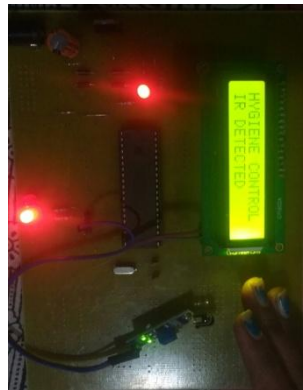


Fig. 5 IR detected output

Fig. 6 shows IR not detected output. As hand is not detected below the outlet, IR sensor gives high signal. And IR not detected output is displayed on LCD display.



Fig. 6 IR not detected output

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The level sensing circuit consists of two wires which are placed in the tank. When the quantity of soap and water is above threshold level, two wires will be short and it will display normal level. And when the quantity of soap and water is below threshold level, two wires will be open and it will display low level.



Fig. 7 Low level output

Fig. 7 shows low level output. As the quantity of soap and water is below threshold level, two wires are open and low level output is displayed on LCD display.



Fig. 8 Level output

Fig. 8 shows level output. As the quantity of soap and water is above threshold level, two wires are short and level output is displayed on LCD display.

Fig. 9 shows web server data of the user, who uses the dispenser unit. The data uploaded on the web server contains name of the user along with time of the hand hygiene activity of that user.

1	Time, Name
2	Chaitanya Devale, 2018-10-24 13:09:41.041877
3	Chaitanya Devale, 2018-10-24 13:09:58.893315
4	Chaitanya Devale, 2018-10-24 13:09:59.117563
5	Chaitanya Devale, 2018-10-24 13:09:59.329656
6	Chaitanya Devale, 2018-10-24 13:09:59.518273
7	Chaitanya Devale, 2018-10-24 13:09:59.690974
8	Chaitanya Devale, 2018-10-24 13:09:59.827843
9	Chaitanya Devale, 2018-10-24 13:10:00.044239
10	Chaitanya Devale, 2018-10-24 13:10:00.516924

Fig. 9 web server data

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The Table 1 show the monthly data report of usage of dispenser unit by the health care worker. From the above table we can see that each worker is having its individual and different data record.

Table 1 User name v/s usage of dispenser unit

User Name	Usage of Dispenser unit
Chaitanya Devale	15
Ajinkya Patil	25
Poonam Kumbhar	10
Ragini Jadhav	27
Swapnil Deshmukh	23

Fig. 10 shows graph of user name v/s usage of dispenser unit. This graph is drawn by using observations in Table I. Each health care worker is having its monthly data record depending upon utilization of dispenser unit. From the above graph we can see that ragini jadhav is using high dispenser unit while poonam kumbhar is using less dispenser unit.

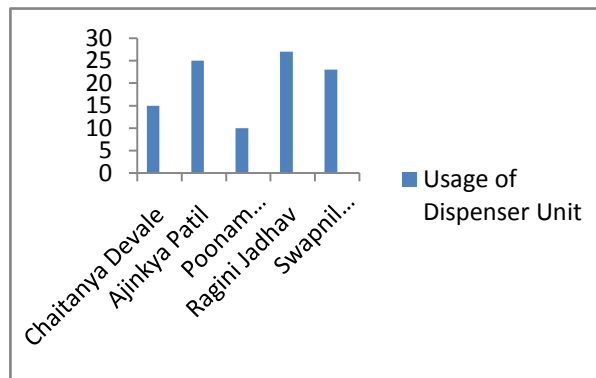


Fig. 10 Graph of user name v/s usage of dispenser unit

### VI. CONCLUSION

The proposed system is designed for hospitals, in which hand hygiene stations are located in each ward or floor. This system uses RFID reader for identification of the user. The session of the user is started as RFID tag is shown to RFID reader. And after utilizing required amount of soap and water, user requires to show RFID tag again to RFID reader. The data of utilization of soap and water dispenser unit record is stored at the web server. In future system performance will be improved by adding face detection for the health care worker.



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