Smart Recording of Hand Washing by Hospital Staff

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Abstract*—There is a lack of hand hygiene, and it is considered to be the single largest cause of healthcare-acquired infections (HAI). It is found that millions of people around the world are getting contact with new diseases when they visit hospitals to cure their illnesses. Proper hand hygiene practices can be a part of safer health care goals for the future. A cost-effective and efficient hand hygiene compliance system is of paramount importance to ensure hand hygiene compliance among the staff in a health care institution. The proposed contactlesssystem monitors and records the hand hygiene practices of the staff using image processing. The data can be exported to an Excel file, making it easy to operate using any programming language. This approach is found economical as it can install with the existing system in hospitals.*

KEYWORDS **— Healthcare, Image processing, Contactless, Character segmentation algorithm**

I. INTRODUCTION

Millions of Patients die worldwide because of Hospital Acquired Infection. In the United States alone, more than 270 people die each day from an infection contracted while at the hospital. Healthcare-associated infections (HAIs) exact a tremendous toll, resulting in increased morbidity, mortality, and adding from $28 billion to $40 billion each year. Studies indicate that many HAIs are directly related to pathogens transmitted from patient to patient via the hands of healthcare workers, which occurs when workers fail to follow the Centers for Disease Control and Prevention (CDC) guidelines for hand hygiene. This is one of the significant issues in hospitals forthe prevention of cross infections among healthcare workers and patients. It has been reported that more than half of the health care attendants do not change their gloves or do not wash their hands after post-patient care, and they are more concerned only about their own health. Especially during this pandemic period, hygiene is important to stay safe and healthy.Hence a reliable compliance system is the need of the hour and in this work, a system has been developed to track the hand hygiene habits of health care attendants. This uses code recognition and license plate recognition to identify staff using code provided.

II. LITERATURE REVIEW

Wu, Fan, et al propose the automatic hand hygiene system in which various sensors are used to prevent the hospital staff from the hospital-associated infections. In this paper the various IOT devices used like hybrid router, gateway, cloud server in order to track the activities of hand hygiene. They test the system in the mock ward of hospital and in that they get the accuracy of 88%. Later the recorded data is given to the cloud server through the gateway for storing the data.[1]

Sagar, Parimi Rama Shiva, and R. Hari Krishnan, in this paper they build the smart hygiene system which is based on the radio frequency identification method. Also, the system can be installed in the hospital at near patient bed and hand wash area which is used by the hospital staff. The system monitors the hand hygiene of the hospital staff. Also, this recorded data can be stored in the excel files for simplicity purpose.[2]

Lee, Younkwan, et al, proposed a system which can detect the license plate number of vehicles by using various image processing algorithms like character segmentation, edge detection, feature extraction. Also, the system uses the Use YOLO detector for

Neural Networks for character segmentation.[3]

Zhao Xu, Xu Baojie, Wu Guoxin, in this they introduce the canniest edge detection algorithms which is largely used. In this paper they get accuracy of edge detection of orange fruit image is 90 %.[4]

Zhang, Peng, et al, this propose the machine learning algorithm for predict the hand hygiene characteristics.Also, they use the Naive Bayes, Support vector machine learning algorithms. This paper analyzes two months of real-time location dataand handwashing dispenser activation events for the careproviders in a 30-bed intensive care unit (ICU). Here Classification of entry and exit compliance using a variety of machine learning algorithms is carried out. [5]

Fagert, Jonathon, et al, in this paper they use the structural vibration method in order to monitor the hand washing practices. Also, they use support vector algorithm in the system. In this system they monitor and identify the sequence of hand washing activities using the structural vibration link and also, they got the accuracy of 95.4%.[6]

Bal, Mert, and Reza Abrishambaf, they introduce the Internet of things and radio frequency method-based hand hygiene system for monitoring the hand hygiene activities of hospital staff which help in avoiding the hospital associated infections. In the system Wireless Sensor Networks (WSN) and Internet-of-Things (IoT) are used for monitoring the hand hygiene compliance rate. Also,IR sensor is used to detect present of hand and after that soap dispenser start delivering soap and recording of handwashing is saved in cloud.[7]

Adarsh, S., et al, in this paper author compare the ultrasonic and infrared sensor for obstacles and various material to check which sensor is work better. The obstacles like different type of materials such ascardboard, paper, sponge, wood, plastic, rubber and tile. Also,Various technical specifications like range, beam pattern, frequency are used for performance analysis.[8]

Baharuddin Mustapha, AladinZayegh, Rezaul K. BeggIn this papers they analyse the performance of the IR sensor and ultrasonic sensor for distance obstacle is placed beyond the range of US and IR sensor then it will not detect the obstacle and accuracy is 95 % to 99%.[9]

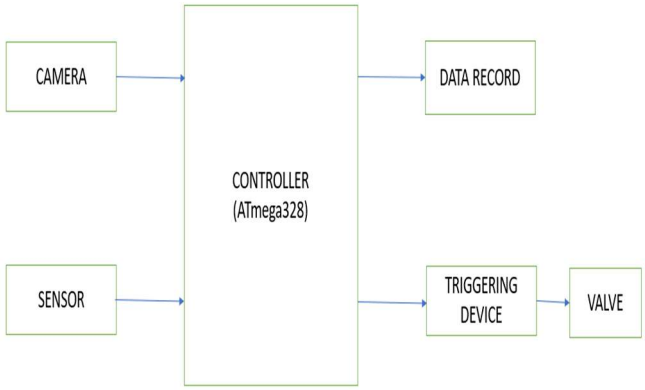
Ashraf, Ahmed, and Babak Taati, they propose the system which analysis the video of hand washing hygiene to analyze the hand washing of the adults. Due to this they try to overcome the hospital associated infection which is spread in hospitals.[10]

III. METHODOLOGY

In this proposed methodology, the contactless method is proposed to keep the record of handwashing by hospital detection for hospitals. This system helps hospitals to keep records and maintain hygiene in such pandemic situations.

Fig.1. Block Diagram of Smart Hand Washing System

Fig.1 shows the block diagram of the system having



a combination of two things image processing and electronic system.The system uses code recognition for identification.

A. IMAGE PROCESSING

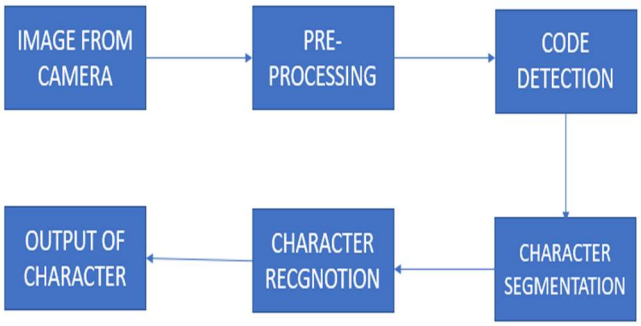


Fig.2 Image processing flowchart

operations on an image, to get an enhanced image, or to extract some useful information from it. This uses a number license plate recognition to identify the staff using code recognition.LPR algorithm consists of the following three processing steps: 1) Numberplate detection, 2) Character segmentation, and 3) Characterrecognition.

Number plate detection- The input image from the camera is taken. After capturing of image, preprocessing is the next step.In preprocessing the background noise is eliminated. Basically, in preprocessing there are two processes:

Resize- In resizing imageshave to change the size of the object according to our requirements.

Convert Color space-In this section, the raw image or image is converted into a grayscale image.

After the pre-processing, the area around the code from the image is cropped. The next step is to detect code from the cropped image using image segmentation.

Character segmentation- It is an operation that seeks to decompose an image of a sequence of characters into sub-images of individual symbols. It is one of the decision processes in a system for optical character recognition characters segmentation of the image is carried out in which we separate the induvialcharacter present in the image. Due to character segmentation, staff id detection will be easy.

Character recognition- The most important part of this system is extracting the character present in the hospital id like id.Character recognition is a process that allows computers to recognize written or printed characters such as numbers or letters and to change them into a form that the computer can use. By using the character segmentation algorithm, the staff id no from their id is extracted which is help in identifying which hospital staff member, washes the hand in that time, and keeps the record of that.

B. SYSTEM FLOW

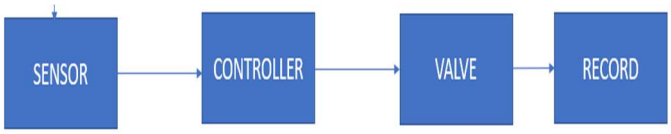


Fig.3 IR system

After the successful recognition of hospital staff members, the system checks whether the hand is under the hand wash area or not. For the detection of hand, the IR Proximity sensor is used. So, the sensor gives the signal to the controller which gives the command to the solenoid valve to start for sanitization.
After a successful operation, all data will be get recorded in an excel file for analysis.

IV. RESULT

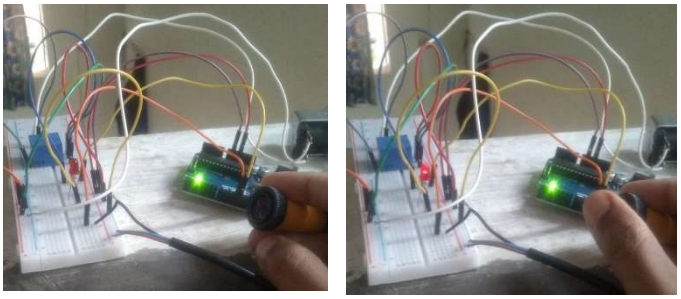


Fig.4 System Result

Fig.4 shows the operation of the valve after successful detection and recognition of staff using image processing. Image processing helps toidentify staff using code recognition method and provide a contactless system for handwashing, also monitor, and keep a record of handwashing. IR sensor connected detects the presence of staff under the valve and operates as per the control signal from controller command.This system gives better performance compared to the other image processing system. But this system also has some restrictions like if the hospital member idis not clearly visible or some characters present on the id card are not present due to that there is a chance that the system fails in the detection of the hospital staff record. This issue can be overcome by hospital management to continuously check the all-staff ides that they are in good condition or giving the new id cards.

Hand hygiene has long been regarded as the most effective method to prevent healthcare-associated infections. It provides the first line of defence in the control of healthcare-associated infections. The Hand Hygiene Recording System is the first and most comprehensive tool to definitively monitor adherence to hand hygiene protocols. The system can be used not only in hospitals and clinics but also in other environments such as schools and restaurants.

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