Use QR Code and IoT Mobile Devices to Prevent the Spread of an Epidemic (COVID-19)

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Abstract—The spread of new pandemic novel Corona-Virus (COVID-19) brought violent changes in livelihood. It was difficult to control and cause Curfew in many countries, disrupted life, Imposing conditions for social distancing, masks because of unavailable of drugs, and treatments. The aim of this paper is using QR code and IoT for prevention transmission of COVID-19 by making electronic medical register for each human stored in cloud database included periodic Corona-Virus test and generate unique QR code for each one on the other side two software applications designed one for monitoring and update information of the medical register in the cloud and the second software read QR code and control the gates of public locations via IoT, as the results only healthy people can travel among public locations (markets, malls, Universities, Subways,…etc) and the infected persons can be monitored.

1 Introduction

COVID-19 is a virus which impacting and infecting the respiratory system of people. It was outbreak in china in 2019 [1]. According to the World Health Organization (WHO) as of February 2021, there are at least three platforms of vaccines, but the infected people increase reached 110,384,747 cases included 2,446,008 of deaths as shown in Figure 1 [2]. Because of noncompliance of instructions such as social distancing, while the social distancing reduce a 60% of infection transmission [3]. It became necessary to take necessary measures such as health care monitoring system, IoT controlling, electronic learning, electronic identification methods,…etc. Health care monitoring system that able to monitor patients outside of hospitals [4], electronic learning where knowledge, education, and skills can transferred to huge number of students around the world with reduce of cost and time saving [5]. IoT architecture consist of sensors, smart devices, programs, smart objects connected together and data transfer among them. The number of connected devices to IoT increased after break out COVID-19, it was reached more than 30 billion devices and expected will up to more than 75 billion devices at 2025 as shown in Figure 2 [6]. Using biometric and

non-biometric identification methods for attendance and authentication system, finger print biometric system is not compatible with pandemic COVID-19 because of the fingerprint sensor needs contact of user's finger to it, and Corona-Virus can transfer with contact, the another method can be used is eye print biometric and face recognition [7].
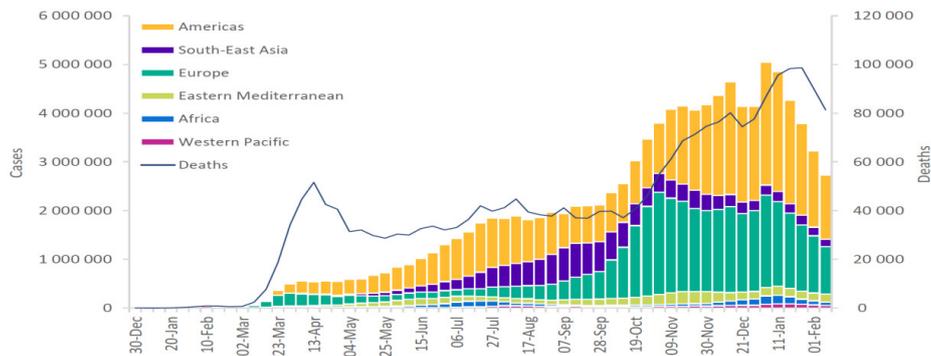

Fig. 1. COVID-19 cases reported weekly by WHO Region, and global deaths, as of 14 February 2021
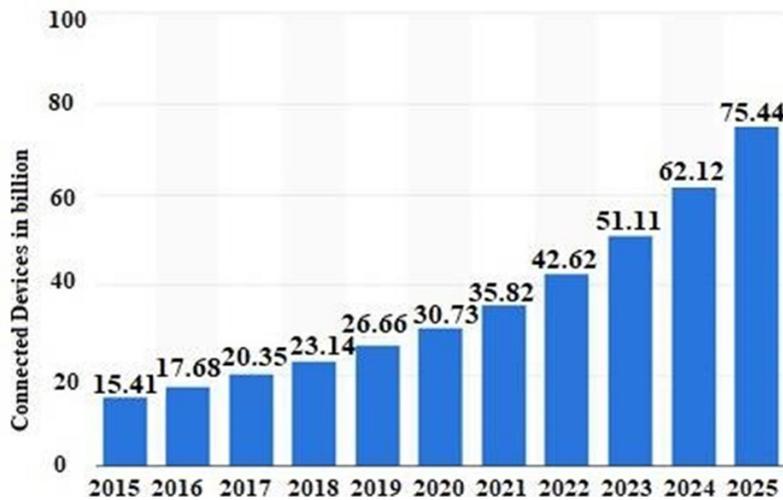

Fig. 2. Number of smart devices using IoT

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The non-biometric method where each human has a unique identifying based on a sign such as QR code, and barcode or frequency such as NFC, and RFID system [8], the market of electronic identification increased after break out COVID-19 as shown in Figure 3. In this paper QR code verification method and Internet of things technology has been used together for reduce spread of new pandemic novel COVID-19.
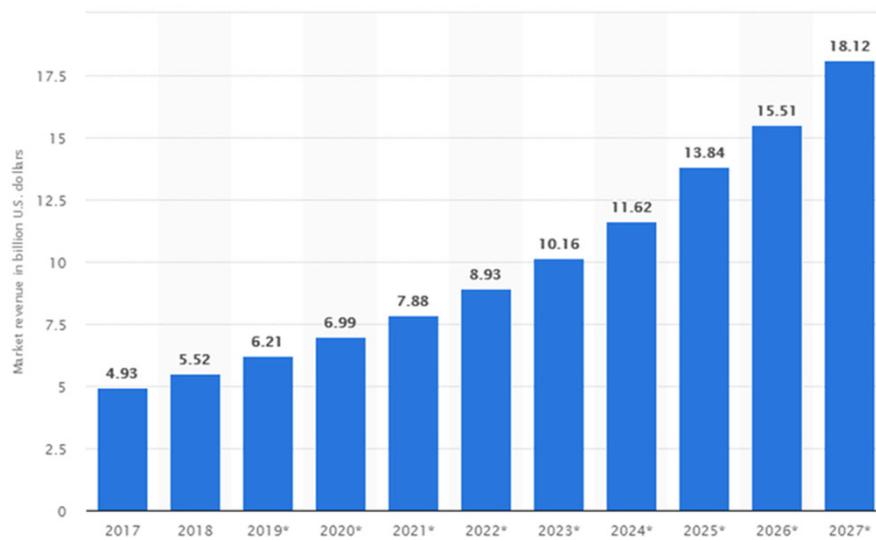

Fig. 3. Identity verification market from 2017 to 2027

2 Related works

Corona-Virus (COVID-19) first detected on December 2019 in china (Wuhan city) and fast spread to many countries the most research and papers focused on two parameters the detection of disease and prevent spreading COVID-19. There are many methods and technologies been used for Achieve the targets (focused parameters) depending on symptoms of the disease.

(M. N. Mohammed, et al.) Proposed study for design a system can detect COVID-19 automatically by using thermal image with smart helmet connected with IoT for real time monitoring system [9], but this system complex in design and expensive.

(Imran Ahmed, et al.) use Internet of medical things (IoMT) by using deep learning neural network for CT and X-Ray medical images to detect COVID-19 based on IoT, by comparing multi on line resources of positive COVID-19 CT and X-Ray images with X-Ray of patient under test, this system assist radiologist and medical expert and early detected of COVID-19 [10].

(LALIT GARG, et al.) Proposed system consists of both IoT and RFID technologies and mobile phone application for detected the movement infected patient [11], but this system required cost for each notification message.

(Thangamani M., et al.) Proposed using IoT and set of sensors detect temperature, blood pressure, and humidity if the sensors have normal reads the patient is healthy the calculated data sent to the doctor or health care center via GSM/GPRS [12].

(Sarah Jaafari, et al.) Proposed system used IoT and set of sensors for real time measurement parameters of patient, this system consist of three parameters patient, sensor measurement collection and processing, the GPS and ECG sensors connected to the patient and measured data stored in local database and send to the sever for telling doctor about the status of patient after analysis of data from sensors [13].

(Kaaviya Baskaran, et al.) Proposed attendance system for staff by using QR code and make individual daily temperature checking if the human exceeded the threshold temperature a notification will sent to authorities in addition a face detection used for checking the face wearing a mask [14].

3   Proposed system

The proposed system for prevent the spread of an epidemic (COVID-19) has two targets the first create electronic health registration for each human consist of health information Vaccines, disease, drugs that taken, and the basic measurements (temperature, pulse rate, blood pressure,..etc) and finally COVID-19 test included, these information stored in cloud database as shown in Figure 4, and each human has a registration provided by unique QR code for access and update health information by health center or hospital as shown in Figure 5, when the registered patient has an accident or attack disease the QR code used for quick access of health information then Take the necessary matters.

The second target related to COVID-19 test and traveling of people among public locations (markets, malls, Universities, Subways,…etc). Health authority determine the periodic test such as every two weeks and update the health registration only the people have negative test can entrance the public locations, where both QR code and IoT technologies operated as integrated system for detecting COVID-19 test and controlling the gates entrance of public locations as shown in Figure 6.
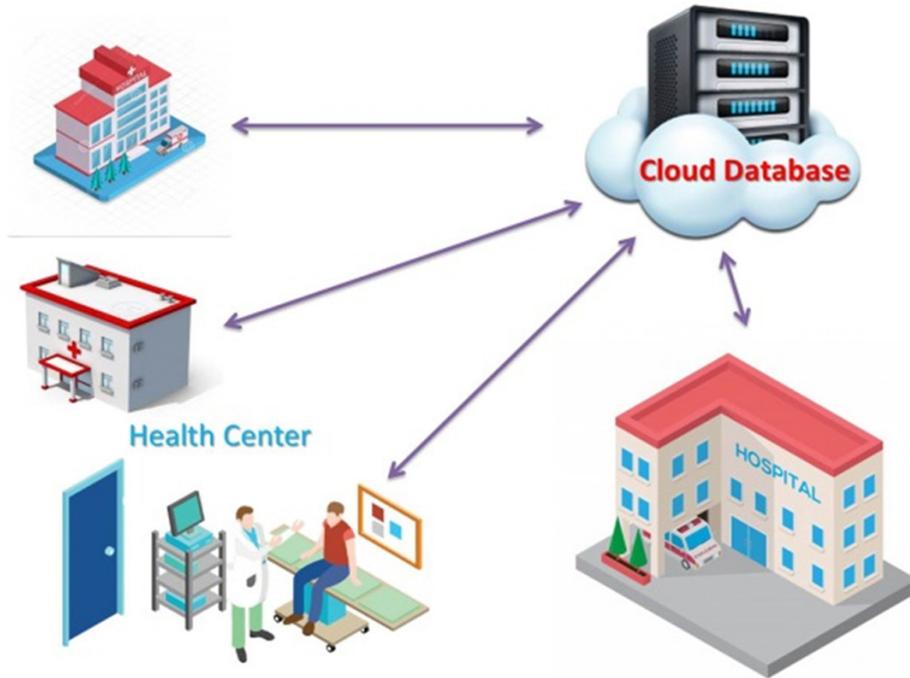
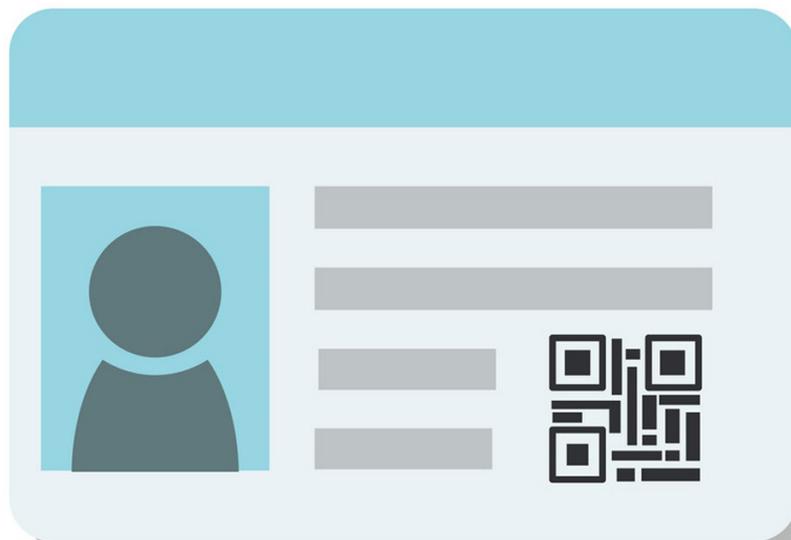**Fig. 4.** Health registration can accessed and update by hospitals or heath centers

Fig. 5. QR code consist of human information

Fig. 6. Controlling the gates entrance of public locations

4   Hardware design

The hardware system located at the entrance gate of public locations. The hardware system consist of smart phone or tablet, and microcontroller board for processing information and control the gate of entrance. The purpose of using smart device for connecting with cloud database in addition to operate as QR reader and IoT device for controlling the gates via microcontroller board. The smart device read the QR code of the human, and process the reading information by comparing data with cloud database finally display required message and send a specific data to microcontroller for gate and alarm controlling depending on specific algorithm. The proposed hardware system circuit shown in Figures 7 and 8.
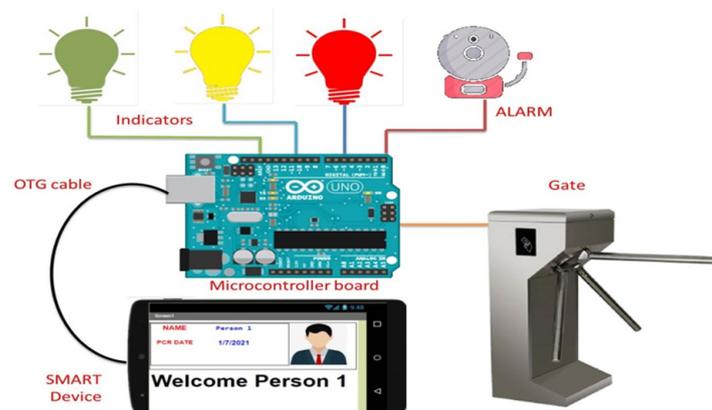

Fig. 7. Proposed hardware system of COVID19 prevent
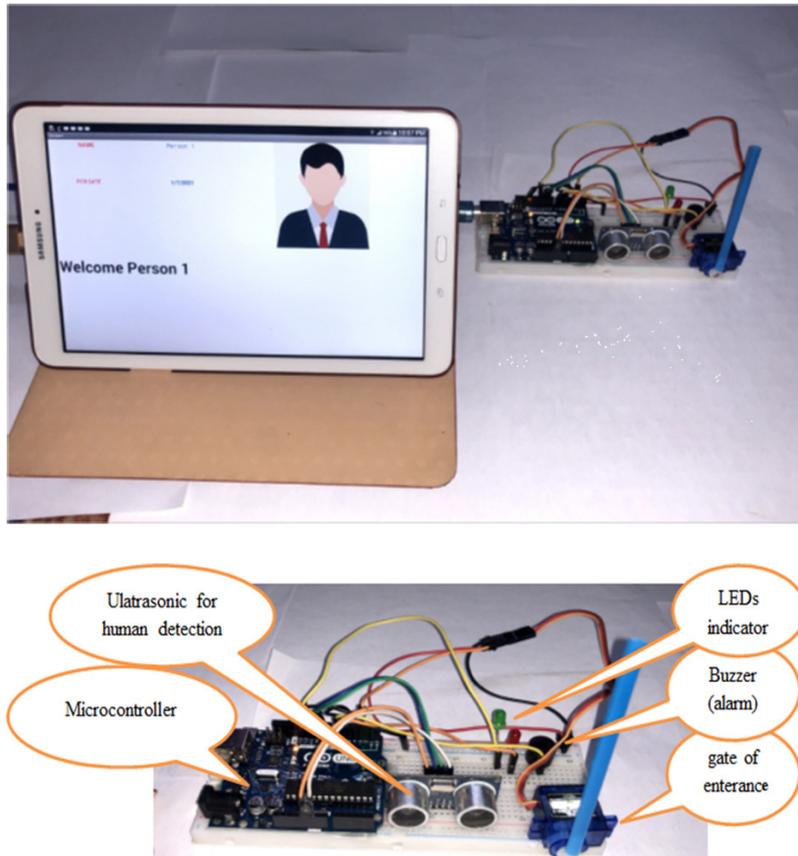
Fig. 8. (a) Prototype of proposed COVID19 prevent system; (b) Gate controlling circuit

5 Software design

The proposed system consist of two software applications one used by hospitals and health centers for create, read, and update register of patient's health information, this software is an android application capable of reading QR code and connect with cloud database for create registration and update information of human in cloud database as shown Figure 9.
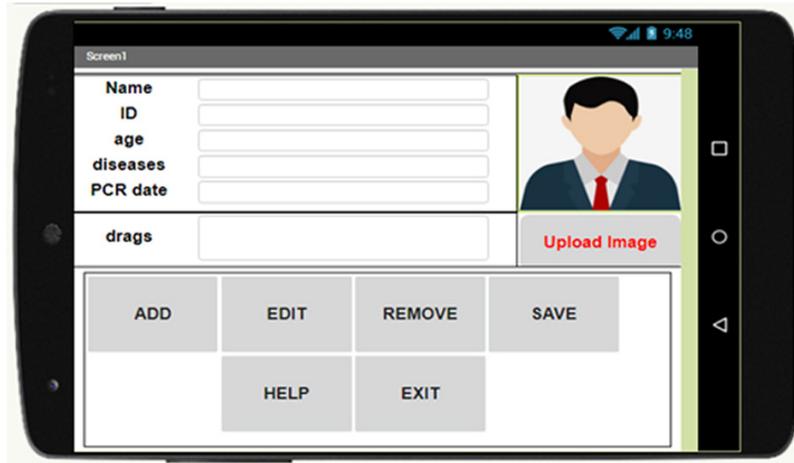
Fig. 9. GUI of Health center android application for human registration and update information

The second software is an android application used in public locations for controlling the gates via microcontroller as shown in Figure 10. This application used for reading the corona virus test from cloud database, if the human has negative COVID-19 test and the period of test not expired then the human can enter the public location and the gate opened with green light indicator, while if the human has negative test but the period of test is expired a message displayed on screen telling human for update his test and the gate remain closed with yellow light indicator, but if the human has positive test a warning message display and emergency alarm turn- on with red light indicator that telling the people for distance from infected person, the flowchart algorithm of application software shown in Figure 11, in this case only healthy people can grouped in public locations and prevent spread of pandemic COVID-19 and the life step by step back to the normal activity.
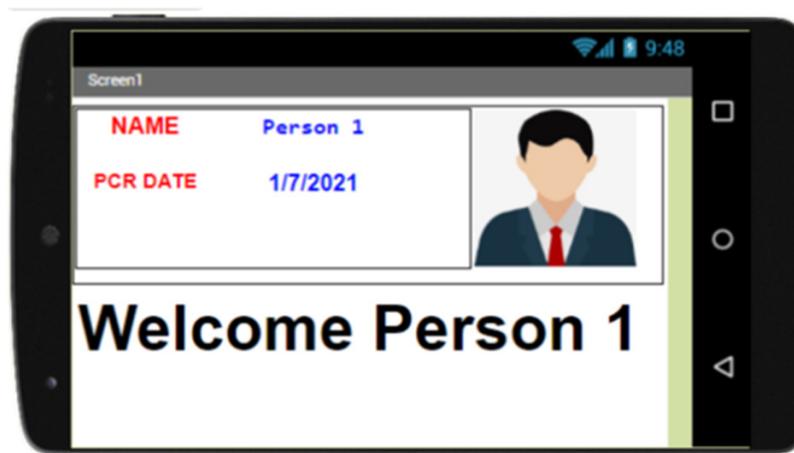

Fig. 10. GUI of public locations android application for human registration
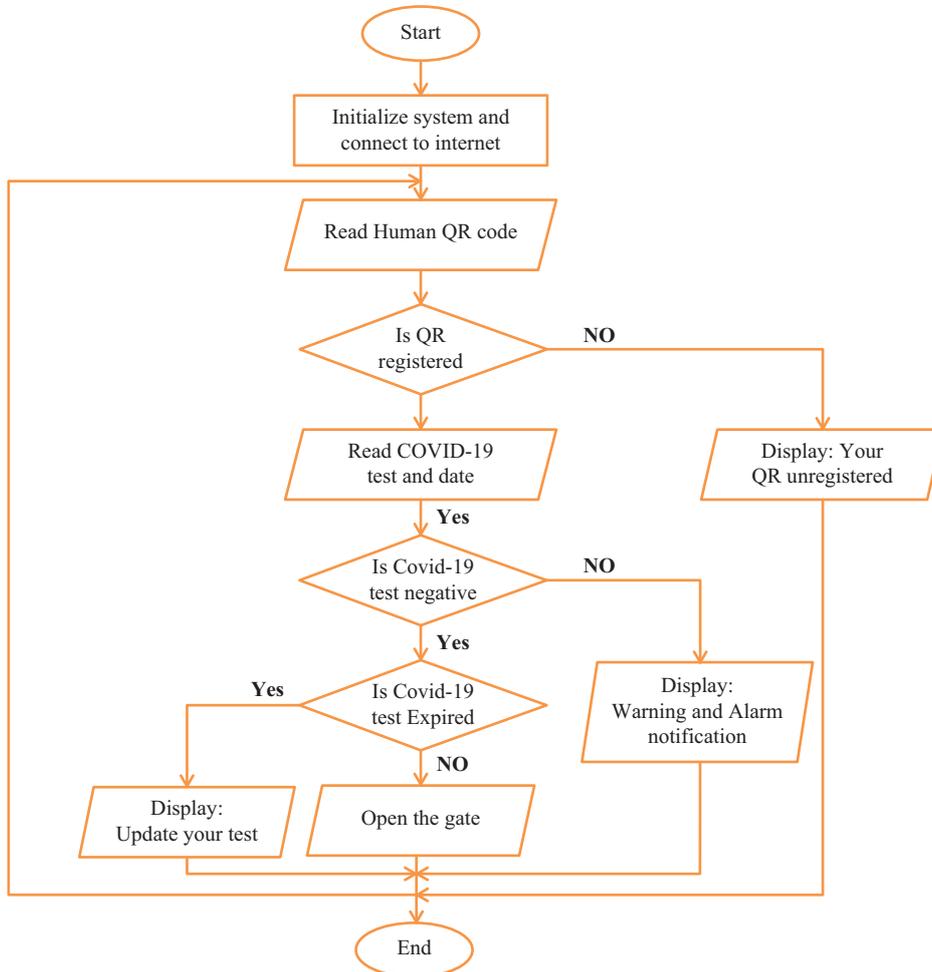and update information

Fig. 11. Flowchart algorithm of public locations android application for COVID19 prevent

6 Conclusion

Since separation of pandemic COVID19, all the world fights the epidemic with different technologies. The proposed system used three technologies for fighting the pandemic QR identification, cloud database, and IoT technologies that the operated as integrated system for reduce the spreading the epidemic by allowing only healthy people for entrance public locations. The proposed system is characterized by inexpensive and fast response in addition to its flexibility for using in different applications such as healthcare monitoring system or tracking system.

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