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Design and Implementation of a Protection System Against Coronavirus

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Abstract. This work aims to design and implement a protection system against Coronavirus. This system changes the manual method to a systemized and more efficient way. Our proposed system can be used to monitor the temperature of people entering hospitals, airports, railways, or shops. This is like a security system that scans the temperature of a person. If the temperature is normal, it will open the door to allow the person to enter the place and the person will be sprayed with sterilizers. If the temperature is abnormal, the system will not allow people to enter the location, it will sound an alarm, and transmit the data to the owner or the person in charge. The system will also monitor the number of people entering and prevent people from entering if a specific number is reached to achieve social distancing. It is completely different from existing solutions because we do not need to rely on a person to complete the work. This system is very useful because there is less human contact during the whole process.

Keywords: COVID-19, Sterilization gate, Protection system, Temperature detection.

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1. Introduction

The world is facing a pandemic, the COVID-19 virus. It is spreading exponentially around the world [1]. This virus started in Wuhan, China in probably December 2019, but the spread started in January, and it was first identified on January 22, 2020. Since then, it has quickly spread from China to Europe, the United States, Australia and other countries. This virus started in the Chinese city of Wuhan [2], although its propagation began in January [3], and it was first discovered on 22/1/2020. It has spread fast from China to other countries since then. In Europe, America, Australia, etc.

Due to human-to-human transmission, the virus spreads rapidly. To prevent the spread of viruses from one country to another, some governments have closed their borders. Countries have locked down their cities, so people have stayed home and left the spread under control. People who have been infected with COVID-19 are quarantined to allow their immune systems to combat the virus [4-5].

COVID-19's defeat will be contingent on the vaccination, according to specialists. This, however, implies that a sufficient number of people will receive a vaccination to develop herd immunity [6]. Existing vaccines, such as those against measles, are already facing substantial resistance, with some parents refusing to vaccinate their children. This vaccine opposition led to an increase in the number of cases in the 2019 measles outbreak in the United States and abroad [7]. COVID-19 vaccine also face similar opposition. Vaccine opponents (anti-vax) have used online social media platforms to gather and exchange health misinformation. Misinformation like this can put people's health and safety at jeopardy [8-9]. Social media companies are struggling to contain health misinformation on Facebook, Twitter and Instagram. The number of fake stories being posted online is increasing due to the popularity of social media sites like Facebook and Twitter [10-11].

According to WHO (World Human Organization) fever (high body temperature) is the most prevalent COVID-19 symptom [12-15]. Now, let us consider the case of temperature scanning in public places such as airports, hospitals or railways. We cannot always rely on people to complete this work. People who check the temperature are also likely to be affected by COVID19, which may lead to social spreading. Another situation is that, considering a store, people have started to go to the store. The store owner cannot monitor the temperature of customers, and sometimes when the number of customers in the store exceeds the limit, he will not be able to restrict customers. In addition, there are switches that everyone can touch, which can increase the spread of the virus. Although the vaccine is now available, the person remains vulnerable to infection with the Corona virus.

This paper aims to design and implement a sterilization gate to measure people’s temperatures, protect them from viruses and microbes, identify the infected people from the healthy ones, and achieve social distance to help hospitals, medical centres, malls, universities, etc. to limit the spread of the virus.

2. Related Work

As we mentioned earlier, fever is the most prevalent COVID-19 symptom. Therefore, many studies have dealt with this aspect. According to [16], authors proposed wearable sensors can identify diseases by continuously measuring fever levels. Another work in which critical physiological parameters such as, respiratory rate, temperature, heart rate, and blood oxygen saturation have considered. Information is being gathered using sensors and processed using Arduino. The system has an auto alert feature that sends warnings through the Internet and SMS to the concerned local health ministry depending on threshold levels [17].

Recently, many fogging devices have appeared with various specifications and features that they offer with the aim of providing something that touches the development of this world and resists diseases well. In [18], Yash Nayak designed a tunnel for disinfection and sanitation. This tunnel is designed to sterilize individuals within 15 seconds from any germs. NaOCl and H2O are combined to create the disinfection solution. The tunnel cost was about 400$.

In [19], authors designed a PIR motion sensor-based automatic sterilization gate. The study in [20] presents an autonomous disinfection tunnel to disinfect external surfaces of COVID-19 virus such as clothing and open body parts in public areas. The tunnel has two chambers. The first chamber sprays a disinfecting solution on the individual. Any authorized chemical or Ayurvedic/herbal disinfectant can be used in this solution. Within seconds after entering the second chamber, an individual will be exposed to heated air at 70 °C and far-ultraviolet C rays (207–222nm). Each chamber operates independently and uses the ultrasonic sensors to detect the presence of people.

3. Methodology

In this section we shall discuss the design of the system and the mechanism of work.

3.1. System Design

To design our system, we needed many components such as: Arduino UNO, mlx90614 infrared temperature sensor, buzzer, PIR sensor, servo motors, etc. All the components are shown in Fig.1. Below are the steps needed to implement the system.

1. Making the gate structure: The gate is made of aluminum, with a height of 200 cm, a width of 80 cm, and a length of 70cm.
2. Motion detecting: Two motion sensors (PIR) were connected to the Arduino, then one of the sensors was placed at the top of the front side of the entry gate. The other sensor was placed at the top of the exit gate.
3. Monitoring temperature: We connected the MLX90614 IR temperature sensor to the Arduino UNO board, we used LCD to display the temperature values. The LCD was attached to the Arduino through I2C.
4. Alarming: A buzzer and GSM were connected to the Arduino. Fig. 2 shows how to connect SIM800L GSM to Arduino. As an aside, it should be noted that while the Arduino UNO uses 5V level logic, the SIM800 only operates at 3.3v and is not 5V capable. In order to prevent damage to the SIM800, the Arduino UNO's TX signal (D9) must be stepped down to 3.3V. For the most straightforward solution, a simple resistor divider will suffice (1.69k for the top resistor, and 3.3k for the bottom resistor is a good choice).
5. Entry Permit: It is worth to mention that there are two servo motors fixed on the sides of the gate one at each side. These motors are responsible for moving metal plates that would allow or prevent people from entering.
6. Sterilization: This part consists of transformer, pump, hose, plastic tank contains 20 liters of sterilization solution (Fig. 3), Three fogger nozzles, and relay to control the operation of the pump. Fig. 4 shows how the fogger nozzles are distributed inside the gate.

The diagram for the complete connection of the protection system is illustrated in Fig. 5. While Fig. 6 shows the entry gate in the real environment.

3.2. How to Work

As we mentioned earlier, there are two PIR sensors. One is placed at the top of the front side of the gate, while the other sensor is placed at the top of the exit gate. When the first PIR senses there is someone near the entry gate, the number of people inside will be checked. If it is less than the maximum number of people allowed to be inside, the person will be asked to put his finger close to the temperature sensor, otherwise he has to wait till someone departures the place. Now, in the case of the person temperature is normal, the motors will open the metal plates, the sterilization pump will be turned on, and the counter that keeps track of the number of people inside will be increased by one. When the sterilization pump is activated, the person will be sprayed with the sterile material consisting of 70% ethyl alcohol. Back to the case when the person temperature is high, the person will not be allowed to go inside, a buzzer will be turned on, and a message will be sent to the person in charge through the GSM. When the PIR

on the exit senses there is someone leaving the place, the counter of the number of people inside will be decreased by one.

Fig. 1. The main components used in system design.

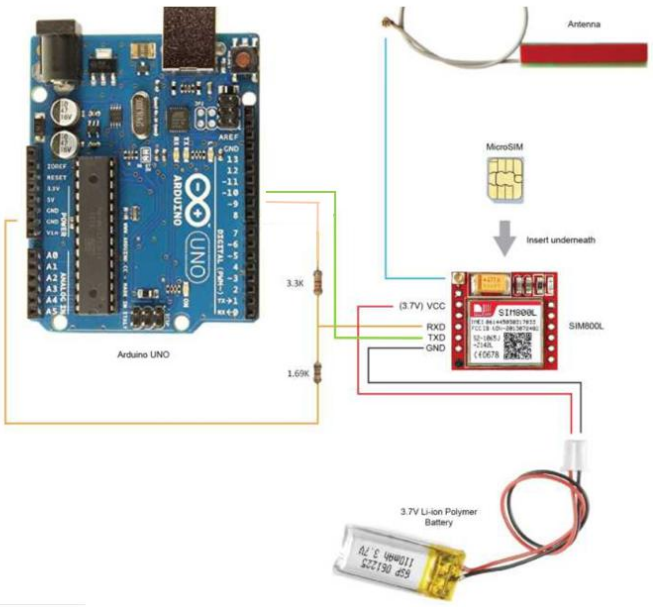

Fig. 2. Arduino UNO and SIM800 basic connections.

Fig. 3. transformer, pump, hose, and plastic tank contains sterilization solution.

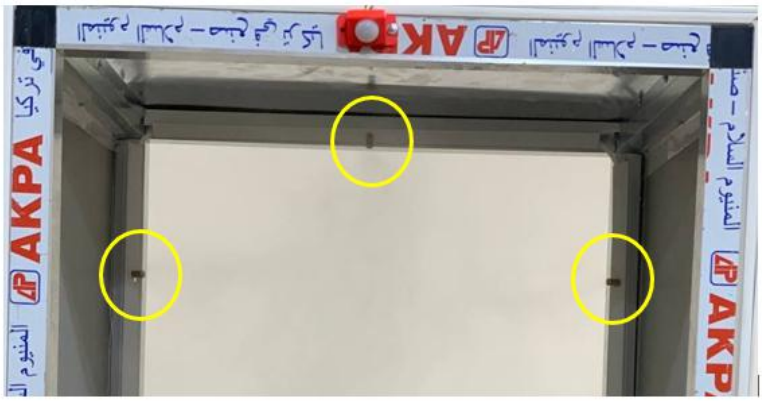

Fig. 4. Distributing the nozzles inside the gate

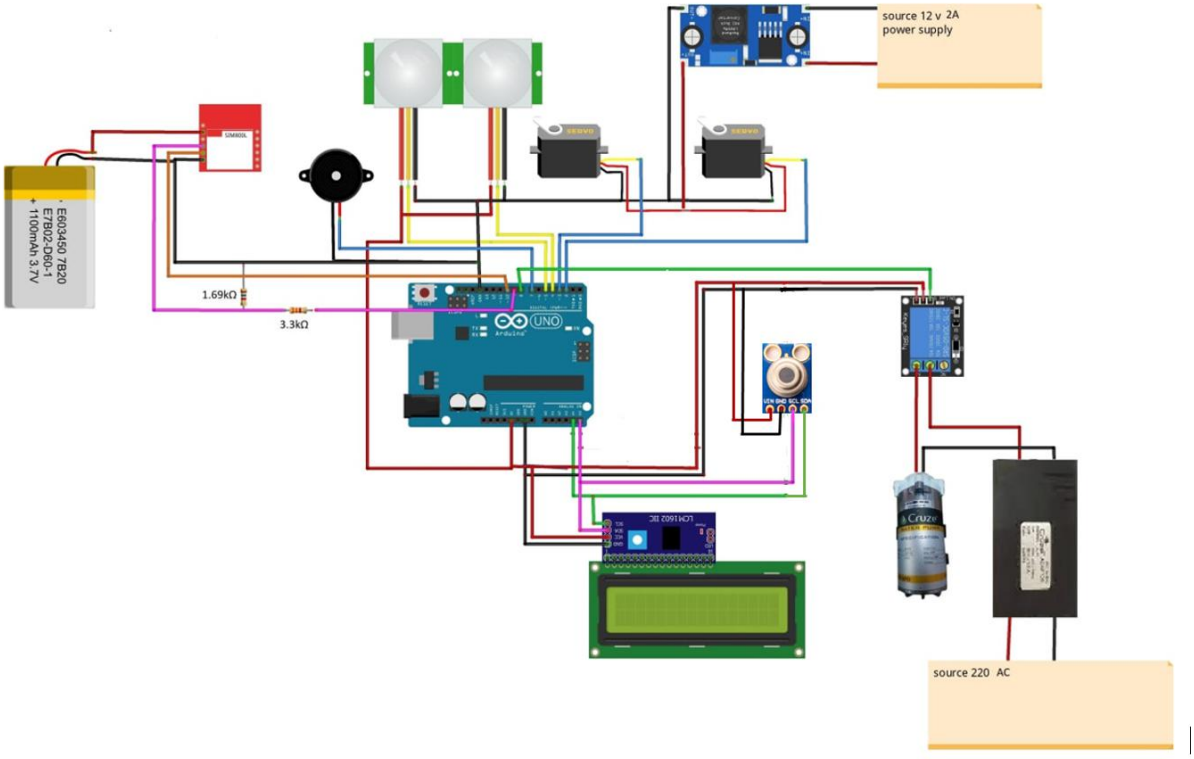

Fig. 5. Complete system diagram

Fig. 6. The entry gate in the real environment

4. Experimental Results

This section includes the results obtained from implementing the system practically. The system was tested on many people. Fig. 7 shows that when the PIR sensor senses the presence of someone in front of the entry gate and the number of people inside the place does not exceed the limit, then the person will be asked to put his finger close to the temperature sensor. In Fig. 8, the person puts his finger near the temperature sensor. If the person's temperature is normal, the temperature will be displayed on the screen as shown in Fig. 9. The motors will open the metal plates to allow the person to go inside, and the counter will be increased by one as illustrated in Fig. 10. Finally, in Fig.11, the person is being sprayed with the sterile material consisting of 70% ethyl alcohol.

5. Conclusion

We designed and implemented a protection system against coronavirus using a group of simple electronic devices such as sensors and pumps, and do not forget the mastermind (Arduino UNO). The electronic sterilization gate is designed to measure the temperature of people and prevent people who suffer from high temperatures from entering the place. In addition, the system allows the entry of a specified number of people depending on the space of the place in order to achieve social distancing. We have tested this system in some places and tried it on a number of people. The device performed well after being tested and checked. It presents something different from other devices and does not require manpower to carry out these tasks that require great effort. We hope that this system mimics the evolution of this world and will be developed in the future to improve it.

Fig. 7. The person is being asked to put his finger near the temperature sensor

Fig. 8. The person put his finger near the temperature sensor

Fig. 9. The person's temperature is normal

Fig. 10. The metal plates are opened

Fig. 11. The person is being sprayed by the sterile material

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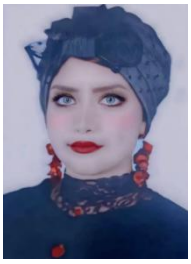

Ola A. Hasan was born in Iraq. She received the B.S. degree in computer engineering from the University of Basra in 2013 and the M.S. degree in electrical engineering also from the University of Basra in 2017.
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مجلة كلية العراق الجامعة للهندسة والعلوم التطبيقية

تصميم وتنفيذ نظام حماية ضد فيروس كورونا

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الملخص . يهدف هذا العمل إلى تصميم وتنفيذ نظام حماية ضد فيروس كورونا. يغير هذا النظام الطريقة اليدوية إلى طريقة منهجية وأكثر كفاءة. يمكن استخدام نظامنا المقترح لمراقبة درجة حرارة الأشخاص الذين يدخلون المستشفيات أو المطارات أو السكك الحديدية أو المتاجر. هذا مثل نظام الأمان الذي يقوم بمسح درجة حرارة الشخص. إذا كانت درجة الحرارة طبيعية ، سيفتح الباب للسماح للشخص بدخول المكان وسيتم رش الشخص بالمُعقمات. إذا كانت درجة الحرارة غير طبيعية ، فلن يسمح النظام للأشخاص بالدخول إلى الموقع ، وسيطلق إنذارًا ، وينقل البيانات إلى المالك أو الشخص المسؤول. سيقوم النظام أيضًا بمراقبة عدد الأشخاص الذين يدخلون ومنع الأشخاص من الدخول إذا تم الوصول إلى رقم معين لتحقيق التباعد الاجتماعي. إنه مختلف تمامًا عن الحلول الحالية لأننا لا نحتاج إلى الاعتماد على شخص لإكمال العمل. هذا النظام مفيد للغاية لأنه يوجد اتصال بشري أقل أثناء العملية برمتها.