

DESIGN AND REALIZATION OF PANDEMIC COUNSELLING AND DISINFECTION CHAMBER: A CASE STUDY FOR COVID-19 OUTBREAK.

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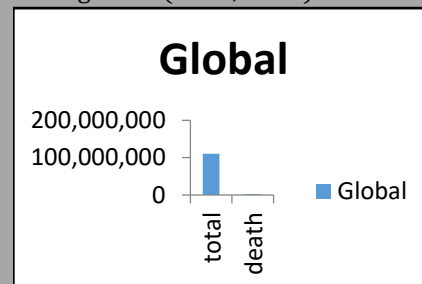
ABSTRACT

The inadequacy of trained personnel and testing facilities presents challenge in the management of Coronavirus outbreak or any pandemic, especially in institutions of learning and remote areas. Counselling and laboratory testing in order to identify individuals who are asymptomatic has played an important role in the management of the outbreak but have the potential to serve as a source of the viral transmission. This research presents a detailed design procedure of a smart disinfection tunnel that provide counseling and disinfection of surfaces. The system consists of an ultrasonic sensor to detect the presents of an individual within the vicinity of 30 cm, a microcontroller that was programmed to carry out counseling of the individual regarding his covid-9 status and a sanitizer spraying system that disinfect the individual. The system is powered by a solar cell during the daytime, but switched to a solar power-bank power mode during nighttime. The experimental results validate the effective performance of the mechanism of the presented system, it was able to disinfect a person in a time span of just 5 seconds and was considered to be very helpful in tackling the covid-19 pandemic during the unlock period when all the businesses and shops are open for the general public. This system will serve as a preventive measure as well as a practical module

Introduction:

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) pandemic is one of the biggest public health issues in the year 2020. The virus belongs to the coronavirus family that causes a severe acute respiratory syndrome defends as COVID-19 disease and was declared by the WHO as a public health emergency of international concern. (Alva-Araujo, 2020)

As at today 10th February 2021, the WHO reported more than a hundred million confirmed cases and more than two million confirmed deaths around the world. United States America has the highest number of confirmed cases and deaths while Vanuatu has the least. The infection rate in the year 2020 is described in the Figure 1. (WHO, 2020)



when implemented where students will see how to use technology in solving societal problems.

KEYWORDS; *Coronavirus, Counselling, testing, sanitizer*

Figure 1: Global covid-19 infection rate in 2020.

The Nigerian centre for disease control (NCDC) reported the distribution of covid-19 related issues as shown in the figure below with Lagos and Ekiti at the top and bottom of the distribution.

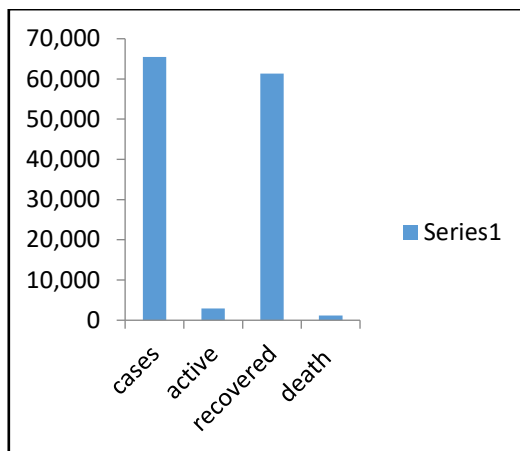


Figure 2: Nigeria's Covid-19 second wave (WHO, 2020)

Early diagnosis is essential for an appropriate patient care and infection control, so laboratory where molecular tests are held plays a main role. However, laboratory facilities for testing are limited especially in rural areas. Therefore, it is important to have an effective and practical Point-of-Care (POCs) diagnostic system in order to be implemented in developing countries with limited energy access. (Costanzo, 2020;)

The POCs will serve as good alternative to combat COVID-19 in economically vulnerable areas, being used near the site of patient presentation. These tests provide results in a very short time, which contributes to an immediate diagnosis of infectious diseases. To guarantee a good performance of these diagnostic systems, autonomous and stable energy is required, especially considering the limited electricity supply.

This article presents a comprehensive report on the design and implementation process of a modular embedded system that automatically scans the temperature of a person, provides counselling to the scanned person and recommend the necessary line of action. It is an off-grid system and also has the ability to provide digital readout, and audio outputs. Apart from the wireless sensors, microcontroller and communication protocols, the designed system comprises of other respondents such as ventilating, lighting and disinfection systems. (Mohammed, 2020)

Related works

Vijay Kumar Burugari et al. presented a paper that describes the design and development procedure of an IoT based Automatic Sanitizing Machine that would be used to disinfect pocket sized objects such as keys, mobiles etc. which are carried everywhere. This machine mainly

consists of automatic sensors in the first section for recognizing the device and afterward starts the process of sanitizing and cleaning. (Burugari, 2021)

Rosepreet Kaur Bhogal et al. proposed a disinfectant tunnel that focuses on reducing the manual presence in public places to check face masks, to measure the body temperature, and to sanitize the people. The system consists of a novel face mask detector using deep learning with various pre-trained deep learning models and an IR temperature sensor which detects the fever of a person. The system ensures that the people and front-end workers can stay safe in these unprecedented times and ensures that everyone follows the guidelines which are provided by the government. (Bhogal, 2021)

Sharnil Pandya et al, presented an IoT based sensor-fusion assistive technology for COVID-19 disinfection termed as "Smart epidemic tunnel". The system is design to detect the presence of a human being using an ultrasonic sensor from the height of 1.5 feet and disinfects him/her using an automatic sanitizer spray system. Google Fire-base. Is provided Google Fire-base is incorporated where daily, weekly and monthly reports of the counts of individuals, along with in-out timestamps and power usage can be generated and analysed. (Pandya, 2020)

Ibrahim M. Alfadli et al design and develop an IoT based system for disinfection using drone technology. The proposed system gives the details of utilized Antiseptics-Disinfectants as well as denaturation that was adopted in this task. Furthermore, the drone was provided with an optical camera and wireless speaker in order to give alerts and notifications

Ashish Shrivastava et al, presents a low-cost sanitation disinfection tunnel and monitoring system to disinfect a fully grown person from head to toe in a time span of just 15 seconds using locally available components. The solution used as the disinfectant is a combination of sodium hypochlorite (NaOCl) and water (H₂O) is completely harmless. The system employs an embedded microcontroller with connectivity for access and control. (Shrivastava, 2020)

Materials

The figures shown in Figure 3-6 were the major devices used in the implementation of the system. The choice of these devices was based on there properties the have given on their data sheet which makes them suitable for the intended application.

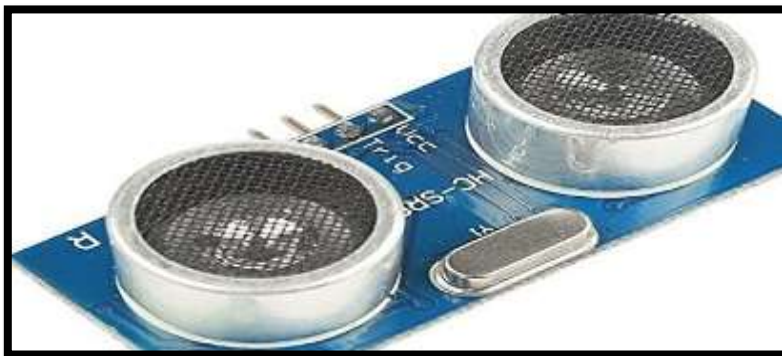


Figure 3: Ultrasonic sensor HC-SR04



Figure 4: Infrared thermometer



Figure 5: Arduino UNO



Figure 6: Liquid Crystal Display (LCD)



Figure 7: Voice Module



Figure 8: DC pump

Methodology

The main components to be used to incorporate the device were sensors and microcontroller. Drivers and display were auxiliary devices used; Figure 9 shows the block diagram for the control mechanism of the greenhouse.

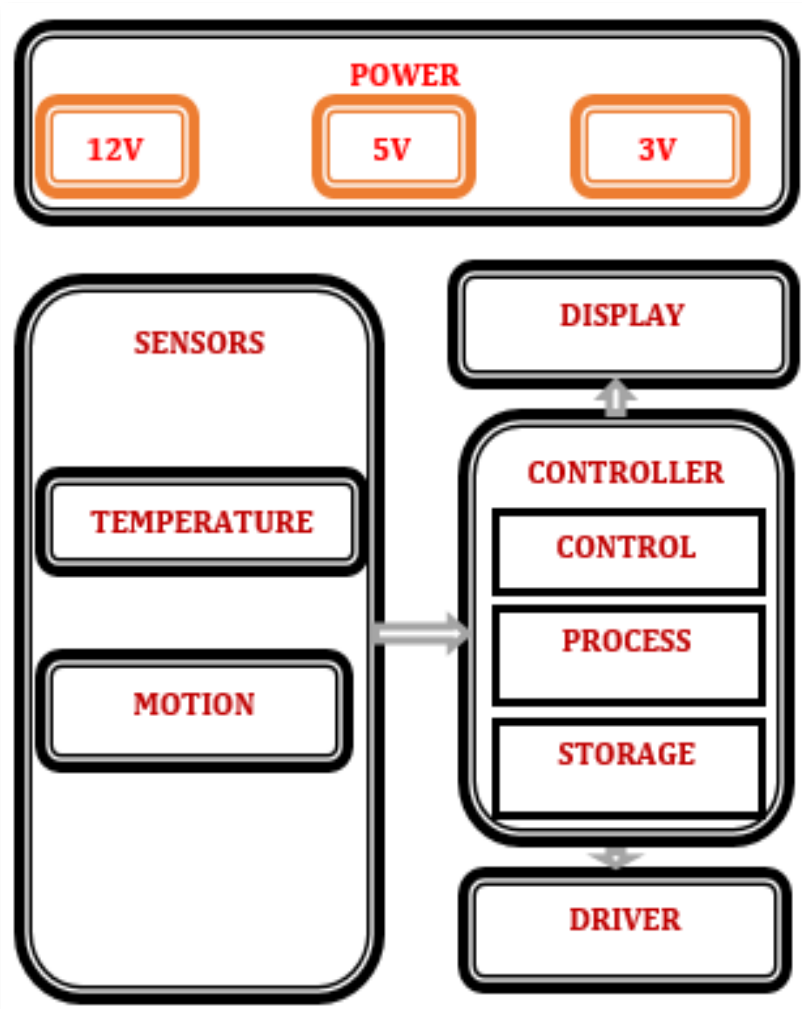


Figure 9: System Block Diagram

A. Power unit

The unit provides direct current voltage to internal computer components. It is connected to pin 7 (Vcc) of the microcontroller, this provides the 5V voltage supply required by the microcontroller to operate. Pins, 1 (Reset), 20 (AVcc) and 21 (ARef) are also connected to the output of the power supply circuit. Pin 20 (AVcc) of the microcontroller is connected to the out of the power supply because Analogue Digital Converter (ADC) of the microcontroller requires its own power supply to operate.

B. Input unit

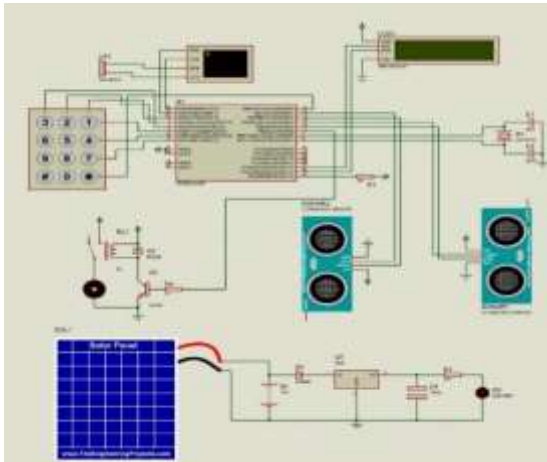
The input unit consists of the device as follows; Ultrasonic sensor, Infrared thermometer and Keypad Module which were used to detect the presence of an individual, measure temperature and for receiving response from the user as per the default set of instructions codes respectively. Two Ultrasonic sensor were used, one to automatically trigger the counselling session and the other to trigger the pump for the purpose of disinfection.

C. Control unit

This unit is responsible for the coordination of all the activities of the system. It direct both the input and output units. Atmega 328 was used in this unit.

D. Output unit

The output unit consist of Liquid Crystal Display (LCD), an Audio Playback Module and a dc pump. These devices are powered by 12v dc with the exception of the audio module that is powered by 5v.

Circuit Diagram

The figure below shows the complete circuit diagram of the system.

Figure 10: **Circuit diagram of the control system**

Principle of operation

The System is typically a screening mechanism that can sense the presence and body temperature of a person. The system was design to carry out Covid-19 screening through simple questions and the result will be used to recommend the status of the person. Actuators will also be integrated such

as pump for disinfection, voice message for precautionary measures and alarm for positive case. The principle of operation of the system is explained by the flowchart shown in figure 12 below.

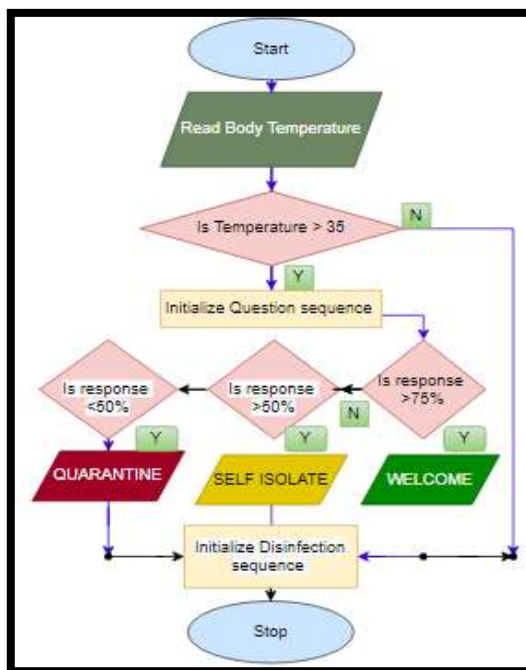


Figure 11: **Principle of operation of the System**

When energized, the system automatically senses the presence of a being in the chamber. The installed infrared temperature sensor of the chamber will detect the body temperature and displays it. The system will then compare the measured body temperature with some threshold value and notifies the person within the chamber. Peradventure the temperature is above the threshold value; the system will interact with the person in other to evaluate his status. If the temperature is below the threshold value, the system will display a green light to indicate a negative status. Regardless of the outcome of the procedure, the system will apply

disinfectants to the incumbent as a safety precaution.

Results and discussion

In addition to the preliminary results obtained during construction of the system, experimentation on the prototype was also carried out on ten individuals. Figure 13 shows the result obtained during the experiment based on the following questions

1. Have you been to a covid-19 area in the last two weeks?
2. Are experiencing any covid 19 symptoms

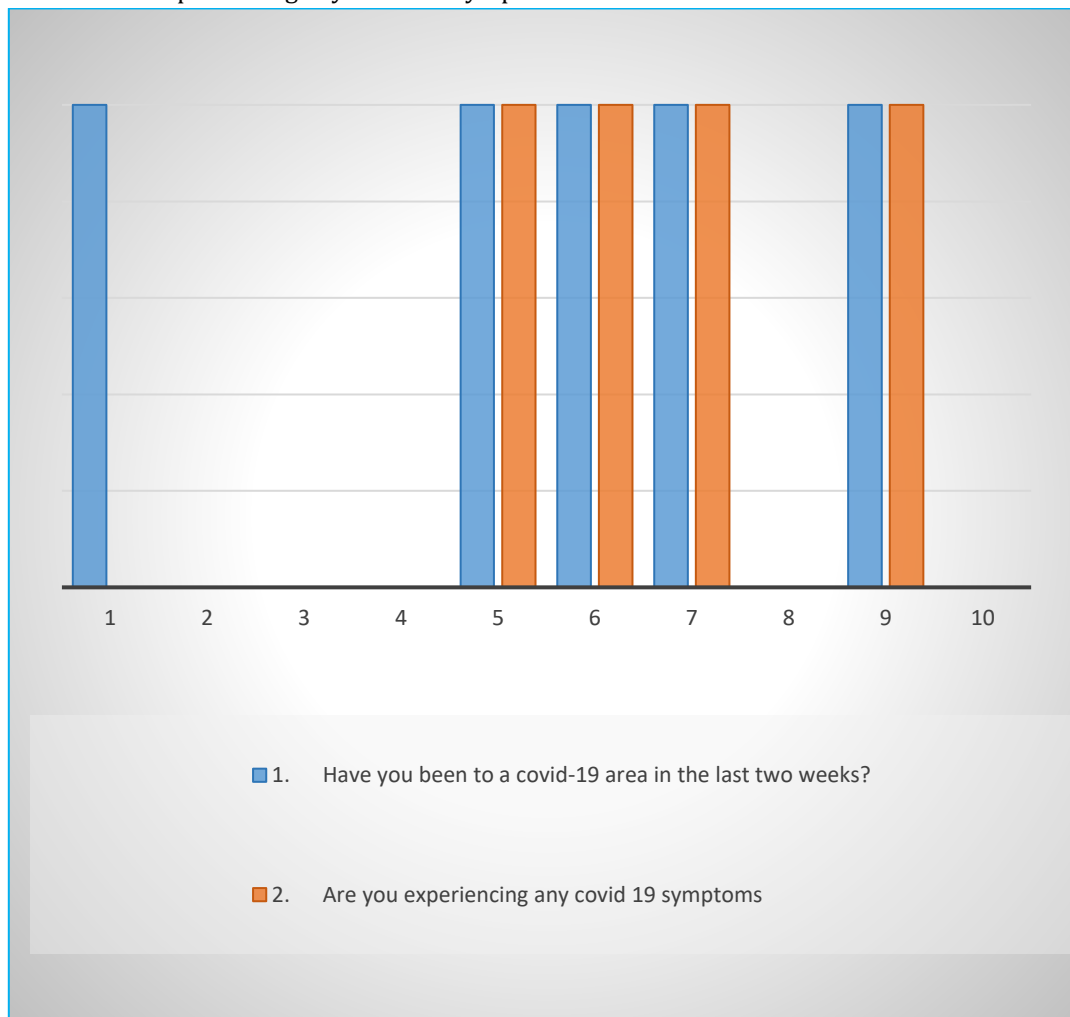


Figure 12: *Experimental test of prototype*

Based on the response of the ten individuals, the controller recommended the next line of action as thus;

1. Stay safe
2. Self-isolate for one week
3. Quarantine for two weeks.

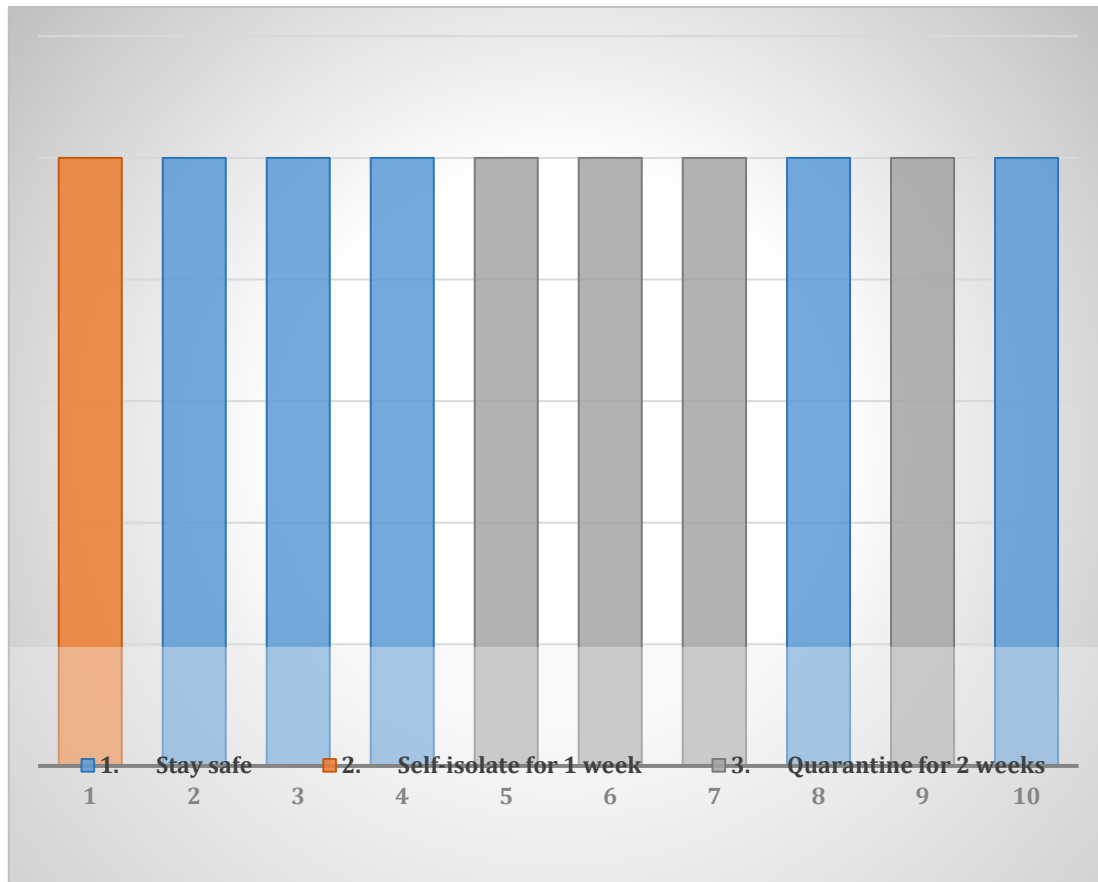


Figure 13: Recommendations generated during on Experimentation

Conclusion

This work presents the design and implementation of smart disinfection tunnel that provide counseling and disinfection of surfaces. The device could be very helpful in managing not only covid-19, but also other pandemics, especially in institutions of learning and remote areas. The system is equipped with sensors and actuators and most importantly powered by standalone power supply for effective utilization at all times.

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