A SIMPLE OF IOT BASED SOCIAL CONTACT TRACKING FOR INFECTIOUS PATIENT USING ULTRASONIC SENSOR: A PRELIMINARY STUDY

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ABSTRAK

Salah satu upaya untuk menghambat penularan penyakit menular yang disebabkan oleh virus dan bakteri adalah melalui penerapan jaga jarak (physical distancing). Penelitian ini bertujuan untuk membuat sebuah alat monitoring kontak pasien yang telah terinfeksi penyakit menular berbasis sensor ultrasonic dan internet of things (IoT). Sistem instrumentasi ini terdiri empat buah sensor ultrasonic yang dipasang pada sisi kiri, kanan, depan dan belakang. Sensor tersebut akan mendeteksi jarak objek yang medekat secara langsung. Kemudian, data hasil pengukuran masing-masinng sensor akan dikrimkan ke cloud dan diakses melalui aplikasi Blynk. Hasil penelitian menunjukkan performansi setiap sensor ultrasonik sangat baik dan dapat diaplikasikan sebagai divais pengukur jarak antara pasien dengan orang lain. Hasil kalibrasi menunjukkan bahwa sensor ultrasonik dapat mengukur jarak 10-200 cm dengan nilai R kuadrat 0,999-1. Selain itu, ESP8266 juga menunjukkan performasi yang sangat baik. ESP8266 mampu mengirimkan data ke cloud sehingga dapat diakses dan ditampilkan dalam bentuk grafik batang dalam telpon genggam. Dengan demikian, secara keselurahan sistem dapat dinyatakan bahwa sistem instrumentasi telah berfungsi dan bekerja dengan baik.

Kata Kunci: *ESSP8266; IoT; Jaga Jarak; Penyakit Menular; Sensor Ultrasonic*

ABSTRACT

[A Simple Of IOT Based Social Contact Tracking For Infectious Patient: A Preliminary Study] *One of the efforts to inhibit the transmission of infectious diseases caused by viruses and bacteria is through applying physical distancing. This study aims to create a contact monitoring tool for patients who have been infected with contagious diseases based on ultrasonic sensors and the internet of things (IoT). This instrumentation system consists of four ultrasonic sensors mounted on the left, right, front and rear sides. The sensor will detect the distance of the object that is approaching directly. Then, the measurement data of each sensor will be sent to the cloud and accessed through the Blynk application. The results show that the performance of each ultrasonic sensor is excellent and can be applied as a distance measuring device between patients and other people. The calibration results show that the ultrasonic sensor can measure a distance of 10-200 cm with an R squared value of 0.999-1. In addition, the ESP8266 also shows excellent performance. ESP8266 can send data to the cloud to be accessed and displayed in the form of a bar graph on a mobile phone. Thus, the overall system can be stated that the instrumentation system has functioned and is working well.*

Keywords: *ESP8266; Infectious Diseases; IoT; Physical Distancing; Ultrasonic Sensor*

INTRODUCTION

There are many types of diseases in the world. Many of these diseases are classified as infectious diseases. Infectious diseases are diseases caused by biological agents such as viruses, bacteria, or parasites, not caused by physical factors such as burns or chemicals like poisoning (Sumampouw, 2017). Infectious diseases caused by viruses and bacteria, one of which has recently been experienced by all countries, is Covid-19. Viruses and bacteria can spread quickly through airborne media, making the spread challenging to control.

The spread of viruses through the air can be reduced by implementing the physical distancing (Ilpaj and Nurwati, 2020), (Lestari and Wibowo, 2020), (Etikasari, et.all., 2020), (Saraswati, 2020), (Aquarini, 2020) between sufferers and other people. Usually, the virus has a short lifetime. Therefore, the virus would be killed before it infects other people's bodies when implemented that way. However, applying a social distance is sometimes very difficult to do, or even on a small scale, it is still challenging to use (Martias and Aldo, 2020), (Riyadi and Larasaty, 2020). As a result, a lot raises a distance violation in the social environment.

To overcome the difficulty of implementing social distancing, researchers have tried to innovate in order to be able to track people who make social contact with fellow humans, for example, an early warning system for physical distancing based on passive infrared receiver sensors (Andesfa and Wildian, 2021), the prototype of a distance measuring device using an ultrasonic sensor HC-SR-04 (Muzawi, et.all., 2020), physical distancing early warning tool using RCWL-0516 sensor and ultrasonic sensor HC-SR04 (Fauzansyah, et.all., 2022).

Generally, those developed instruments could be used to track infectious patients. However, the device only serves as a warning for people who use it and cannot be monitored by medical personnel, especially for patients who are still in the monitoring process. Therefore, it still has an opportunity to develop a simple, accurate, and inexpensive instrument. In this study, we create a device that uses low-cost sensors to track social contact for infectious patients integrated into the internet of things (IoT). This device was incorporated into the internet to be easy to know how many people interact with patients. Moreover, this instrument could be an alternative media for monitoring the infectious patient.

METHOD

The main object of this study is to develop an IoT-based instrument monitoring for infectious patients. So, the person as a user of this device could be monitored in real-time. The development was divided into instrumentation system design and system integration to the internet. A complete design is shown in Figure 1.

The instrumentation system design consisted of three LEDs used as an indicator to represent the object's distance from a user, a vibration motor as an alarm for a user, and two rechargeable batteries used as a voltage source. An ESP8266 is used to control all monitoring processes and as a central component of IoT to send the data to the cloud. A computer or smartphone is used as a media to display data and monitor the user. The complete design of instrumentation system design is shown in Figure 1.

According to Figure 1, four ultrasonic sensors were used to measure the object beside the user in this instrument. This sensor was chosen because the detection range is appropriate to this study's physical distance. In addition, it is also cheap. According to the datasheet of ultrasonics sensor HC-SR04, this device could measure the space with a 2 cm minimum range, while the maximum range is 4 m. Therefore, they could be suitable sensors for this instrument because the average distance to reduce the risk of infectious diseases is 1-2 m (WHO, 2020).

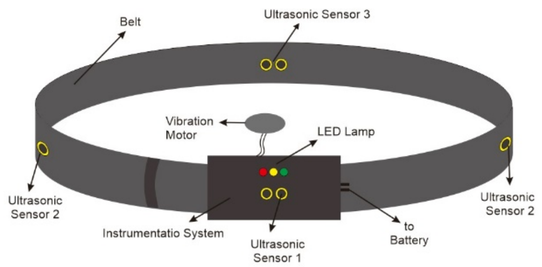

Figure 1. Design of IoT-Based Social Contact Monitoring

Furthermore, these sensors lay forward, backward, left, and right. The purpose is they could measure every distance change of the objects on the side of somebody in real-time. An ESP8266 would process the obtained data and send it to the cloud. Since the minimum distance was 1 m, this was decided as a set point. Therefore, the data would be compared to the setpoint value to determine if the condition is safe. If there were an abject interaction with the user in which the distance was less than 1 m, then a bar sign on the smartphone's LCD would be complete. In addition, an LED would turn off. This condition would be interpreted as somebody had contacted the infectious patient and counted in the system. The maximum number for getting to other is five people.

The next stage is the calibration process. The purpose is to ensure all of the ultrasonic sensor's performance is good. The process was started by measuring the object's distance from the ultrasonic sensor for every 10 cm. After that, the object could be shifted. It was finished when the space achieved 200 cm. The calibration process is illustrated in Figure 2.

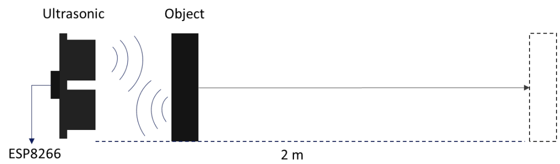

Figure 2. The calibration process of ultrasonic sensor

After the ultrasonic sensors indicated good performance, system integration to the internet could be executed. The IoT was implemented in this research. An ESP8266 could be connected to the internet by using a WIFI network. To access the data, a smartphone must be installed a Blynk application. It could be found and downloaded on GooglePlay.

RESULT AND DISCUSSION

This research successfully developed simple instrumentation for tracking an infectious patient based on an IoT platform. In developing this instrument, four ultrasonic sensors are used to measure the object that could stand beside the user. Before these sensors were installed in the system, their performances needed to be ensured to validate the obtained data. Therefore, the calibration process should be executed. The calibration process was done by comparing the measurement data read by each ultrasonic sensor to the actual distance data. The calibration result is displayed in Figure 3.

After all the measurements were collected, the data was plotted on the graph, as shown in Figure 3. The calibration data were analyzed by using linear regression. The purpose is to check how many ultrasonic sensors generate error data. We obtained the maximum error of data for each ultrasonic was 3.63%, 3.83%, 3,38%, and 3.33%, respectively. According to these data, it could be concluded that the performance of each ultrasonic sensor was excellent, with the value of R square being 0.999-1. Thus, these ultrasonic sensors could be installed in the system and used to measure the distance for monitoring the infectious patient.

After the sensor indicated excellent performance, they could be integrated into the system. A complete instrumentation design is shown in Figure 4. In this stage, the system would be tested by putting the object on each side of the system. After that, the system should give a response by sending the data to the cloud. Then, the bar would be filled and displayed on the smartphone if there is an object.

Meanwhile, LEDs in the instrumentation system would be turned on based on the object's distance to the user. The three LEDs are red, yellow, and green. The red LED means that the object was very close to the system, the yellow LED is used to warn a user because the object is coming closer, and the green LED indicates a safe distance.

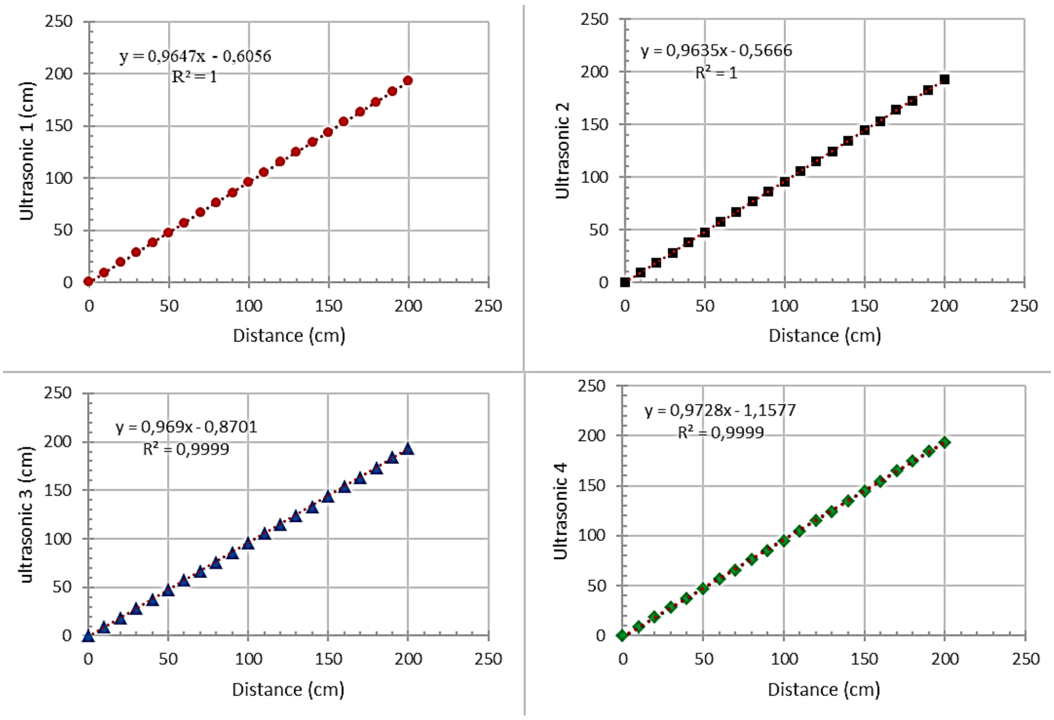

Figure 3. The calibration data of each ultrasonic sensor

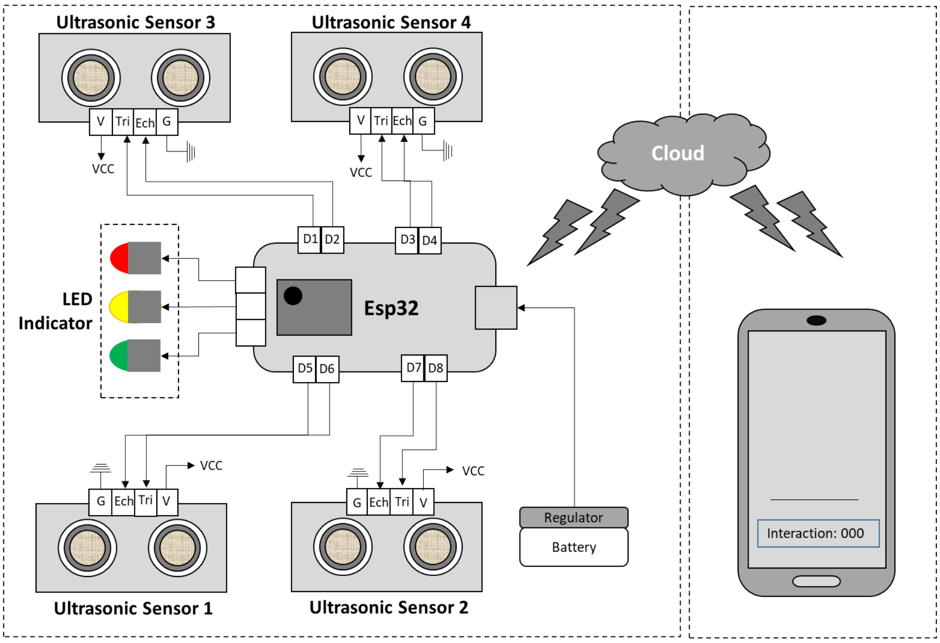

Figure 4. An integrated sensor to the IoT System

The experiment could be executed after integrating sensors and instrumentation system into the IoT system. The experiment was done by putting an object in front of every sensor. The purpose is to indicate that person came closer to the user. The result of this experiment is displayed in Table 1.

Table 1. The experiment results

No	D (cm)	Ultrasonics Sensor (cm)				E (%)	P
		1	2	3	4		
1.	95	91	129	188	136	3.19	F
2.	95	146	91	188	137	3.19	B
3.	95	145	161	102	136	6.38	L
4.	75	145	159	190	72	4	R

D: Distance, E: Error
P: Position (Forward, Backward, Left, and Right)

From Table 1, it could be indicated that the system has shown an excellent response to the object. Four ultrasonic sensors successfully determined the object's distance forward, backward, left, and right. However, still, there was a small error. The highest error was obtained in ultrasonic sensor 3. The error is 6.38%, while others are under 5% of error.

Meanwhile, the integrated sensors and instrumentation systems into the IoT system were also successfully built up. The measurement data could be sent to the cloud through ESP8266 and accessed by Blynk Application via smartphone, as displayed in Figure 5.

Figure 5. The graphic user interface (GUI) on the smartphone's LCD

According to Figure 5, it could be seen that every bar was filled and LEDs turned off. It indicated that each ultrasonic sensor could detect every object in front of the sensor. Thus, it can be concluded that the instrument performs well for tracking an infectious patient based on an IoT platform.

Furthermore, the experiment continued to understand more about the performance of the ultrasonics sensor in terms of the determinate object between them. The result showed that if an object came closer between two sensors, then each sensor would detect the object. So, the system would define two entities that came closer to the user. In addition, the ultrasonic sensor could not distinguish between an object and a living thing in this research. Therefore, it still needs elaboration, improvement, and additional algorithms while using ultrasonic sensors in monitoring. However, according to these results and discussion, the ultrasonics sensor could be implemented in monitoring based on IoT for a simple case.

CONCLUSION

This research successfully developed a simple instrument for tracking an infectious patient based on an IoT platform. The system uses an ESP8266 to control all monitoring processes and as a central component of IoT to send the data to the cloud, as well as a smartphone used as a media to display data and monitor the user. The performance of each ultrasonic sensor is excellent. The calibration results show that the ultrasonic sensor can measure a distance of 10-200 cm with an R squared value of 0.999-1. In addition, the ESP8266 also shows excellent performance. ESP8266 can send data to the cloud so that it can be accessed and displayed in the form of a bar graph on a mobile phone. Thus, the overall system can be stated that the instrumentation system has functioned and is working well.

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