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Integrated Visitor Management System with Smart Hand Sanitizer based on IoT Approach

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ABSTRACT Establishing visitor management system is necessary to manage the total number of visitors especially in pandemic when the protocol of social distancing is applied. The purpose of this research is to design a visitor management system integrated with an automatic Internet of Things (IoT)-based hand sanitizer using Arduino. This research contributes to answering the two challenges which are managing the total number of visitors and providing protection against bacteria or viruses. The improvement of this system compared to the existing similar approach is the automatic hand sanitizers could be installed at two entrances and exits which can simultaneously limit the number of visitors who will be monitored through the IoT platform. This system is designed with Arduino Uno R3 components as a microcontroller, ultrasonic sensors which will be installed at two entrances and exits, and automatic hand sanitizer using a water pump. For remote monitoring use the IoT platform with the ESP8266 ESP-01 Wi-Fi module as a link. From the results of testing this system, the results of testing the correct hand distance when using a hand sanitizer are from 3 cm to 9 cm and the right amount of hand sanitizer liquid volume is approximately 1 ml for a duration of 250 milliseconds. The system design has been successful for visitor management and the hand sanitizer works well. The Thingspeak webserver can receive visitor data and send it to the MIT app as a display for remote monitoring. Hopefully, this system could support the situation which needs to manage the restriction of total number visitors and hygiene practice in a more efficient way.

INDEX TERMS Hand Sanitizer, Visitor Management System, IoT

I. INTRODUCTION

In COVID-19 crisis, it has been reported that social distancing is the one of the most effective experience to mitigate the pathogen exposure[1][2]. Concerning that the core of the infectious disease could transmitted directly or indirectly from a person to one or more people[3], it could be witnessed that in certain conditions the visitor management system was insisted on facing social distancing protocol. The area which has limited space needs to be monitored related to how many visitors that allows to enter the building. Moreover, to enter the building another protocol should be enforced which is the visitor have to use disinfectant or hand sanitizer to keep the condition is hygiene.

Visitor management system (VMS) is the system which considers regarding the level of overcrowding of the area to avoid the negative effects of uncontrolled mass and gives necessary information to understand that capacity is limited[4]. In general visitor management system has a function to provide required output and data and confirmation the incoming and outcoming visitors[5]. It has been reported that a visitor management system could be implemented by an IoT system for managing the visitors in an office environment in more cost effective. Thie wireless transmitter and wireless display could make the visitors wait in the visitor's waiting area[6]. Another approach also has been reported that a VMS has built by applying a camera to distinguish faces and measure temperature using an infrared thermometer sensor that is activated using an ultrasonic proximity sensor[7].

Regarding hand sanitizer, it could be observed that the use of hand sanitizers develops during pandemic. It could be found that it is no longer applied manually. The transformations of

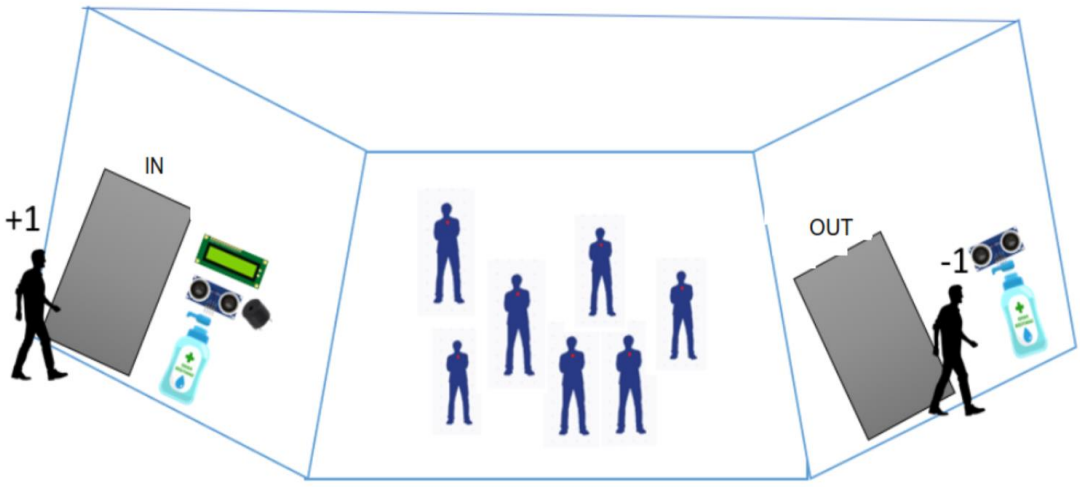

FIGURE 1. Illustration of research design regarding visitor monitoring using hand sanitizer

hand sanitizer are adjusted to be automatic and touchless to avoid direct contact with hands. The attempted technology such as Internet of Things (IoT) implemented to response the challenge[8]. Based on literature, the development of hand sanitizer are included: various container[9], temperature sensing [10][11], mask detection[12], sanitizer level monitor [9][13][14], electric door[14][15], IoT-based data logging[16][17], and low cost[13].

It has not been reported yet the system which integrates the smart hand sanitizer and visitor management system as solution to answer the challenge regarding social distancing and hygiene protection. This research has the objective to integrate the visitor management system with hand sanitizer for managing the fulfilled protocol steps are more efficient. Ultrasonic sensor has been applied to reduce the risk by touching the hand directly. In this system the visitors who come in entrance gate and leave the exit gate are recorded parallel with proposed of the hand sanitizer when its used. FIGURE 1 is an illustration of this system where automatic hand sanitizer will be applied at two doors, namely the entrance and exit of a room, with sensors on each hand sanitizer to detect the presence of objects and carry out visitor management with input +1 at the entrance and -1 at the exit. Visitor information will be displayed on the LCD at the entrance and the buzzer will issue an alarm when visitors reach the limit.

In this study the tests to be carried out have 3 focuses, namely sensor testing, hand sanitizer testing, and overall testing to be able to find out the results including: (a) The sensor can work well in detecting objects at a certain distance, to find out the sufficient distance to use a hand sanitizer. (b) The water pump works well to dispense hand sanitizer liquid and how much liquid is dispensed in a certain time duration to find out how much liquid is enough to do hand sanitizer. (c) The visitor management system works accurately in counting incoming and outgoing visitors and can limit visitors according to settings and display on the LCD. (d) The Thingspeak web server can be connected to the system via the internet to display visitor data graphs. And (e) The MIT app can function as an application for monitoring incoming and outgoing visitors on Android and displays notifications when visitors are full. This approach could improve the visitor management system that provides needs more accurate and integrated real time information [18][5][19]. The system design could give information that could increase the confidence and objectivity of visitors[20][21].

Hopefully, by designing the integrated visitor management system combined with smart hand sanitizer based on IoT approach could be used as reference about advanced visitor management system that also works as safety hygiene tools. This idea could contribute to certain buildings that requires crowd management system related to total number visitors and prevention regarding pathogen exposure.

II. METHOD

In this research, several designs were carried out including hardware design and software design. The hardware design includes assembling the system according to the schematic circuit, and the software design includes programming on the Arduino IDE to create source code that is used as commands to run the system on Arduino, connecting devices with the Thingspeak web server as data transmission, and creating simple Android applications using the MIT application. Application inventor as a monitoring application of the system created. The system design can be shown through the block diagram in FIGURE 2.

FIGURE 2 has three parts, namely input, process, and output. The input section consists of an ultrasonic sensor at the entrance to detect objects entering and ultrasonic sensors at the exit to detect objects coming out. In the process section, there is an Arduino Uno R3 component as the main microcontroller

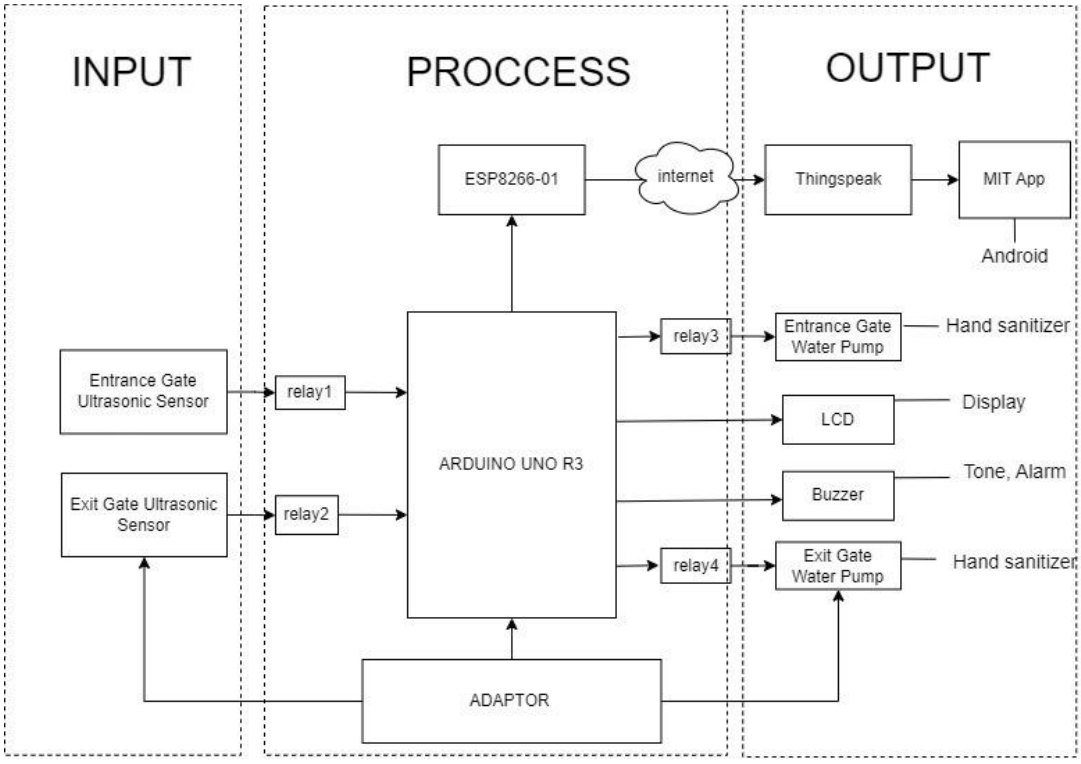

FIGURE 2. Schematic design regarding visitor monitoring using hand sanitizer

to run system processes, as well as an ESP8266 Wi-Fi module as an intermediary for internet connection to the Thingspeak webserver. Whereas in the output section, there is a 16x2 I2C LCD component as a data viewer for incoming and outgoing visitors and total visitors, a buzzer as a tone or sound when objects/visitors are detected, and as an alarm when visitors have crossed the line, a water pump as a hand sanitizer trigger pump out, a relay 4 channels as a disconnect and opening switch as well as a delay provider for ultrasonic sensors and water pumps, Thingspeak as a webserver sending data from Arduino and the MIT app as an application on Android for monitoring incoming and outgoing visitors with data received via Thingspeak.

The working process of the tool starts with visitors passing through the entrance to be detected by an ultrasonic sensor. If an object is detected, the Arduino Uno R3 system will process the sensor data then the buzzer will issue a tone and the incoming visitor data will increase by 1 on the LCD screen, and the water pump will work to pump water to release hand sanitizer liquid. Then the data is sent to the Thingspeak webserver via the ESP8266 Wi-Fi module and from the Thingspeak webserver will send data to the MIT app on Android to be monitored remotely via a smartphone. When visitors in the room have passed the predetermined number of 10, the buzzer will issue an alarm tone as an indicator of full visitors and will also display notifications on the MIT app and LCD. Likewise on the exit side after visitors pass through the exit and are detected by the sensor, the system will process the data and the buzzer will issue a tone, reducing visitor 1 data and triggering the water pump at the exit to open and dispense hand sanitizer liquid, the data will be uploaded to Thingspeak webserver and the MIT app For a system workflow diagram can be seen in FIGURE 3.

In testing the ultrasonic sensor aims to retrieve distance data as a sample to find out how much distance is used which is appropriate for the needs of this research. The test was carried out by taking distance data through an ultrasonic sensor with 2cm, 3cm, 5cm, 7cm, 9cm. 12cm.

The hand sanitizer test aims to retrieve liquid volume data as a sample to find out how much liquid volume is suitable for the needs of hand sanitizers in this study. The hand sanitizer sampling test is carried out based on the duration of the pump pumping the hand sanitizer liquid and using a hand sanitizer reference in a pump bottle which is usually for one pump. Dispenses approximately 1 ml of hand sanitizer liquid. So that in this test sampling will be carried out with a pump time of 200ms, 250ms, and 300ms each 5 times to see which sample will approach approximately 1ml stably.

In this overall test, it aims to test the entire system whether it can run well, and by the objectives start from ultrasonic sensors to detect objects, water pumps as hand sanitizer

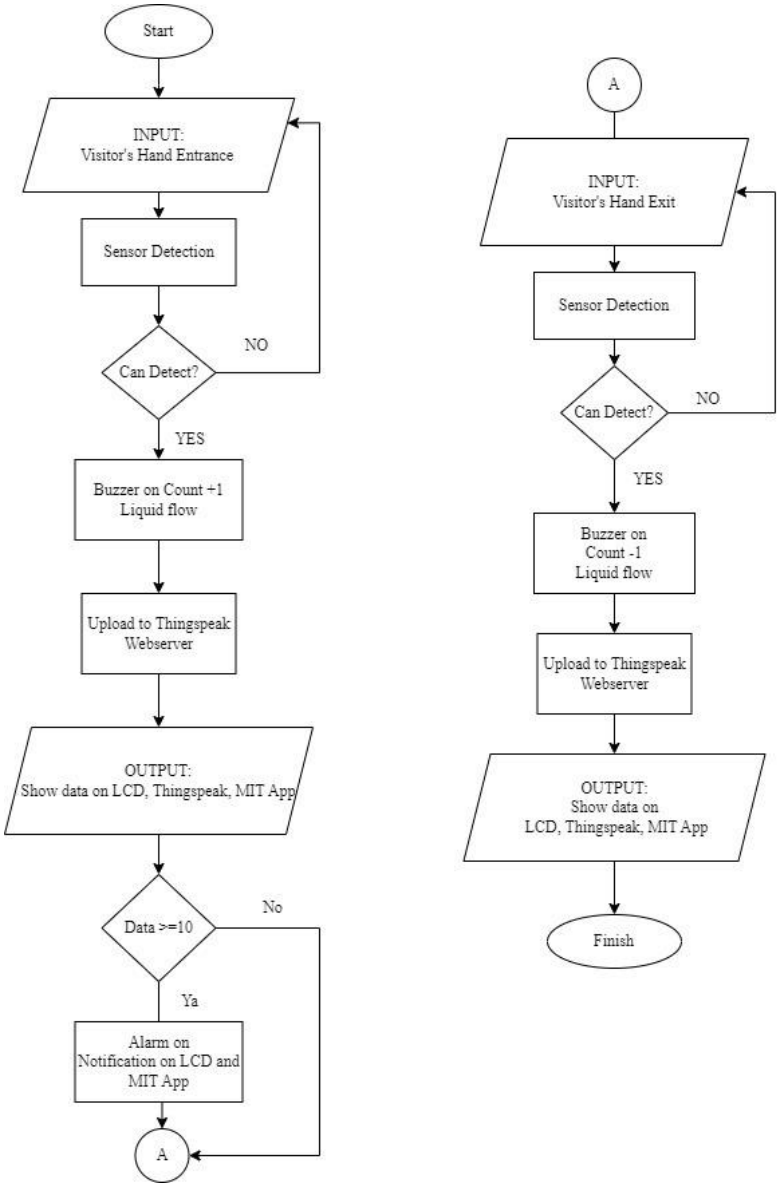

FIGURE 3. System Workflow of Visitor Management integrated with Smart Handsanitizer

pumps, visitor management in accurately counting visitors and visitor restrictions, and sending data to the Thingspeak webserver and the MIT app for remote monitoring.

This overall test was carried out with 2 scenarios including (1) The overall test at the entrance was carried out by as many as 10 objects/persons who entered and recorded the results, namely time, sensor distance (cm), amount of liquid (ml), and the results of sending data to the webserver Thingspeak and the MIT app. This test is carried out to see the overall performance of the system and find out whether the visitor restrictions work properly if the visitor has passed 10.

III. RESULT

System testing is carried out in stages starting from sensor testing to communication testing using the wifi communication medium from the ESP8266 module ESP-01 (FIGURE 4). The results of system testing will display graphical data on the platform Thingspeak and digital data on the MIT app Inventor application. The results of sensor testing are carried out to obtain the right sensor distance samples for application to the system which are carried out at 2cm, 3cm, 5cm, 7cm, 9cm, 12cm as shown in TABLE 1. From the results

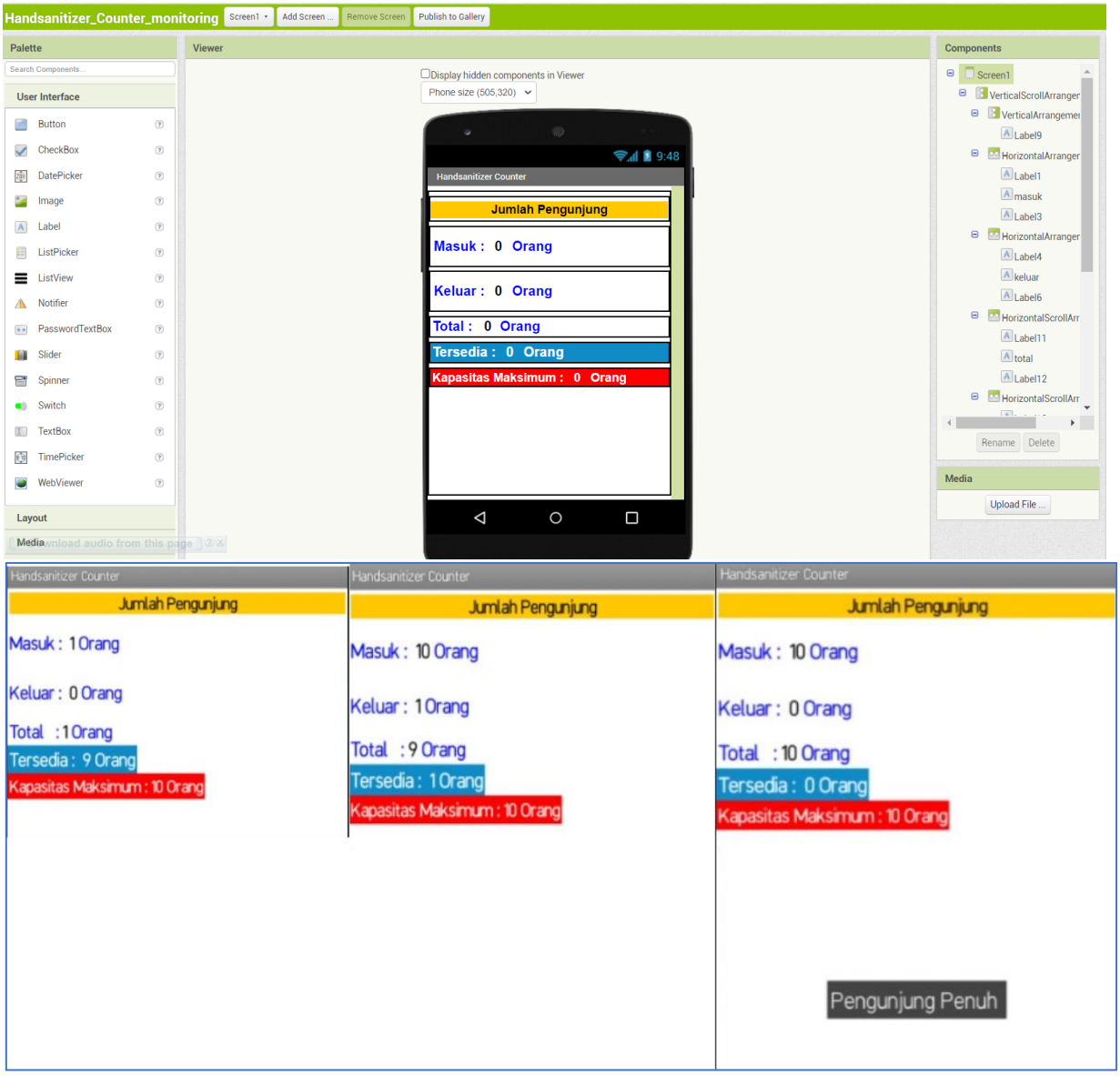

FIGURE 4. The display of the MIT app application

of sensor testing based on TABLE 1, the sample results show that for close distances, namely distances of 2cm and 3cm, the sensor is detected accurately. At distances of 5 cm, 7 cm, 9 cm, 12 cm, the sensor detection also works well. So, from the results of this distance sample, it can be concluded that the distance that is suitable for the application of hand use for hand sanitizers can be used from 2cm to 12 cm because to use a hand sanitizer you must bring your hand closer to the hand sanitizer so that it is at least 12 cm away.

TABLE 1
Ultrasonic Sensor Assessment Result

Distances (cm)	**2**	**3**	**4**	**5**	**7**	**9**	**12**
Detected (√) Error (X)	√	√	√	√	√	√	√

The results of the hand sanitizer test were carried out to obtain a liquid sample which functions to determine the appropriate volume of hand sanitizer liquid in this study. Tests were carried out by taking hand sanitizer liquid with a time of 200 msec, 250 msec, and 300 msec as shown in Table 2.

From the results of the hand sanitizer test based on TABLE 2, it was found that the volume of liquid that approached the reference was approximately 1 ml, namely at 200 msec and 250 msec. In the experiment with a time of 200msec the amount of liquid that was released tended to be less than 1 ml while for a time of 250msec the liquid that was released exceeded 1 ml, which means that the 250msec time is better to use because for a time of 200msec the liquid that is released is very little and to minimize the occurrence of liquid that does not come out because the pipe is long enough. So that the delay time for the water pump to release liquid in this study is 250 msec on Arduino

TABLE 2
Hand Sanitizer Liquid Result

Hand Sanitizer Assessment			
Measuremnet	Time (msec)		
	200	250	300
1	0,9 ml	1 ml	5,4 ml
2	1 ml	1,9 ml	4,8 ml
3	0,5 ml	1,7 ml	4,6 ml
4	0 ml	1,6 ml	4,4 ml
5	0,8 ml	2,4 ml	3,8 ml

Overall test results are carried out to determine the performance of sensors and hand sanitizers that can work properly, and visitor management can accurately count and reduce visitors and can limit visitors. The test was carried out by recording the results including detection time, sensor distance (cm), amount of liquid coming out (ml), and display on the MIT App, namely information on incoming, outgoing visitors, and total visitors.

Based on TABLE 3, the results of the overall test carried out at the entrance showed that the time difference between visitors was 20 seconds to 40 seconds. The time difference of 20 seconds to 40 seconds occurs due to the time gap between visitor 1 and the next visitor and in testing to be able to use the hand sanitizer then you must wait for the data upload process to reach the thingspeak web server until the "successful" display appears on the LCD and the handsanitizer can be continued when The LCD displays "standby".

For hand distance when using a hand sanitizer, as shown in Table 3, out of 10 visitors, the distance between using a hand sanitizer is from 3 cm to 8 cm and the maximum distance is at 5 cm which indicates that the distance for using a hand sanitizer is correct in this system. is 5cm and the distance that can be used for hand sanitizers is 3 – 8 cm according to the sample distance that has been measured previously.

The amount of liquid volume released by the water pump ranging from 1.4 ml to 2.2 ml for a duration of 250 milliseconds which shows that this volume is sufficient for the use of hand sanitizers, especially for liquid type hand sanitizers. The difference in the amount of liquid from 1.4 ml to 2.2 ml occurs due to the use of a long water pump pipe, the condition of the pipe being folded so that the hand sanitizer liquid cannot come out completely, and the liquid still attached to the pipe which causes the liquid to come out to increase.

One of the important components in designing a visitor management system is user interface. Generally, a user-friendly system which does not take complicated method (easy to learn and use) to display information is required to support the protocol[22]. The display of the MIT app application can be seen in Figure 3. It could be seen that the visitor management system is working well where the data of every incoming visitor has been successfully uploaded in the incoming data and when the 10th person passes the sensor there will be a full visitor display on the LCD and the MIT app and when the 10th person passes the sensor there will be a full visitor display on the LCD and the MIT app and when 11 pass through the sensor then the buzzer will issue an alarm. In the display of the MIT app application, it also can be seen that the visitor management system is working well where the data for every visitor who leaves has been successfully uploaded to the outgoing data and reduces the total number of visitors who are in the room accurately.

TABLE 3
Visitor Management System Result

Subjects	Time Stamp	Distance (cm)	Liquid (ml)
Visitor 1	13:44:08	7	1,6
Visitor 2	13:44:32	6	2,2
Visitor 3	13:44:47	5	1,4
Visitor 4	13:45:22	4	2
Visitor 5	13:45:46	8	1,6
Visitor 6	13:46:09	5	1,4
Visitor 7	13:46:39	4	1,8
Visitor 8	13:47:20	4	2
Visitor 9	13:47:53	6	1,6
Visitor 10	13:48:16	5	1,4

IV. DISCUSSION

It could be interpreted form the result that sensor testing, hand sanitizer testing, and overall testing found in promising result. The sensor could work well in detecting objects at a certain distance, the distance that is suitable for the treatment could be applied from 2cm to 12 cm. It could be concluded that with those range of distance, the hand sanitizer could still work properly. The water pump also worked appropriately to dispense hand sanitizer liquid and based on data it could be

seen that liquid was dispensed in a certain time duration and the liquid is sufficient as hand sanitizer to do its function. It also could be noticed that the visitor management system performed accurately in counting incoming and outgoing visitors and could restrict the visitors based on settings and display on the LCD. Regarding monitoring system, the Thingspeak web server could be connected to the system via the internet to display visitor data graphs and the MIT app could function to inform incoming and outgoing visitors on Android and displays warnings when the room was full.

In comparison, the conventional method of visitor management system is usually using paper logs or guest book to make the documentation regarding the visitors. This method takes time and the security issues should be concern in the certain situation [23]. By using paper logs or guest book the visitor needs to touch the paper that could increase the possibility to expose by pathogen. This approach also has disadvantages regarding traceability and is efficiently related to archiving the document[24]. Moreover, if the security staff in entrance gate needs verifying the identity of visitors, the more time the process will be taken[25]. As the system the conventional method is also lacking regarding the real time monitoring to know how many people right now in particular room. The infiltration of technology is needed to be involved to the system.

Solving the challenges of the safety protocol required strategic solution to make it efficient. Combining two or more strategy assists with technology is an approach to answer that challenge. This research develops a strategy to integrate the visitor management system and hand sanitizer. This idea comes from the two protocols which are restriction number to certain area [28] [29] and prevent the virus using hand sanitizer [30]. Based on results it could be seen that the system could be implemented in entrance and exit gate. This system also provides information regarding the number of visitors and the rest of the quota.

For future research, the identification of the visitors could be added considered that some places need to identify due to their restricted access. The Radio Frequency Identification (RFID) that is integrated with the visitor ID could be the next development to record the data of visitors that could be important to certain functional restriction rooms. However, this development has a significant impact on the area or room that needs to be sterilized and monitored in real time fashion.

This approach could also be a part of smart city or smart hospital that provide appropriate management that could provide real time monitoring and detail information comprehensively. Internet of Things (IoT) it is an approach that could implemented for identifying[26], finding,[27] tracking[28], monitoring objects[29], and triggering related events automatically and in real-time[30]. The growth and relevance the information and communication technologies (ICTs) have had an intense impact on society in various aspects including the visitor management system.

V. CONCLUSION

Based on the test data, analysis, and discussion regarding this approach the following conclusions are obtained: (1) The system design has been successful for visitor management and the hand sanitizer works well. The Thingspeak webserver can receive visitor data and send it to the MIT app as a display for remote monitoring. (2) From the results of testing the ultrasonic sensor the right distance for using hand sanitizer in this system is 3cm to 8cm and in hand sanitizer testing, the correct volume of liquid in this system is approximately 1ml with a reference equal to 1 pump on a regular hand sanitizer with liquid hand sanitizer and the duration of the water pump to remove the liquid is 250 milliseconds. For future research using 2 microcontrollers that already have Wi-Fi modules such as NodeMCU for 2 doors could be more powerful. Using a hand sanitizer method other than using a water pump such as a servo or solenoid valve could help issue regarding the pushing issue. Lastly, the real implementation in actual cases such as classrooms or public spaces which need restricted access regarding total visitors could be implemented.

REFERENCES

[1] K. Prem *et al.*, "The effect of control strategies to reduce social mixing on outcomes of the COVID-19 epidemic in Wuhan, China: a modelling study," *Lancet Public Heal.*, vol. 5, no. 5, pp. e261–e270, 2020.

[2] M. Qian and J. Jiang, "COVID-19 and social distancing," *J. Public Heal.*, vol. 30, no. 1, pp. 259–261, 2022.

[3] T. Li, "Diagnosis and clinical management of severe acute respiratory syndrome Coronavirus 2 (SARS-CoV-2) infection: an operational recommendation of Peking Union Medical College Hospital (V2.0): Working Group of 2019 Novel Coronavirus, Peking Union Medical College Hospital," *Emerg. Microbes Infect.*, vol. 9, no. 1, pp. 582–585, 2020.

[4] Y. Pérez Guilarte and R. C. Lois González, "Sustainability and visitor management in tourist historic cities: the case of Santiago de Compostela, Spain," *J. Herit. Tour.*, vol. 13, no. 6, pp. 489–505, 2018.

[5] M. Oktaviandri and F. Kah Keat, "Design and Development of Visitor Management System," *mekatronika-Journal Intell. Manuf. Mechatronics*, vol. 01, no. 01, pp. 73–79, 2019.

[6] S. Rao, A. Smitha, and K. Kulkarni, "Smart Phone based cost effective visitor management system for smart offices," *Int. J. Interact. Mob. Technol.*, vol. 12, no. 6, pp. 112–123, 2018.

[7] I. G. B. Wirawan, W. Wedashwara, A. Zubaidi, A. Z. Mardiansyah, and A. H. Jatmika, "IoT based anti covid visitor management system using Raspberry pi zero W," *AIP Conf. Proc.*, vol. 2482, no. 1, p. 100010, Feb. 2023.

[8] G. Ashok, J. John Paul, I. Thusnavis Mary Bella, S. V. Packiavathy, and S. Gautam, "Internet of Things (IoT) based automated sanitizer dispenser and COVID-19 statistics reporter in a post-pandemic world," *Health Technol. (Berl).*, vol. 13, no. 2, pp. 327–341, 2023.

[9] J. Lee, J. Y. Lee, S. M. Cho, K. C. Yoon, Y. J. Kim, and K. G. Kim, "Design of automatic hand sanitizer system compatible with various containers," *Healthc. Inform. Res.*, vol. 26, no. 3, pp. 243–247, 2020.

[10] J. Lesmana, A. Halim, and A. P. Irawan, "Design of automatic hand sanitizer with ultrasonic sensor," *IOP Conf. Ser. Mater. Sci. Eng.*, vol. 1007, no. 1, pp. 1269–1275, 2020.

[11] J. Singh, G. Singh, and G. Singh, "Semi-Automatic Sanitizer and Thermal Scanner," *J. Today's Ideas - Tomorrow's Technol.*, vol. 8, no. 1, pp. 41–45, 2020.

[12] A. Duth, A. A. Nambiar, C. B. Teja, and S. Yadav, "Smart Door System with COVID-19 Risk Factor Evaluation, Contactless Data Acquisition and Sanitization," *Proc. - Int. Conf. Artif. Intell. Smart*

Syst. ICAIS 2021, pp. 1504–1511, 2021.
[13] A. Yadav and S. Roy, "Low-Cost Automatic Hand Sanitizer and Water Station," *Artic. Int. J. Adv. Eng. Manag.*, vol. 5, no. January 2021, pp. 24–28, 2020.
[14] A. Das, A. Barua, M. A. Mohimin, J. Abedin, M. U. Khandaker, and K. S. Al-Mugren, "Development of a novel design and subsequent fabrication of an automated touchless hand sanitizer dispenser to reduce the spread of contagious diseases," *Healthc.*, vol. 9, no. 4, 2021.
[15] H. Vardhan and K. Pal, "Arduino Based Automatic Sanitizer Dispenser Controlled Door BT - Smart Energy and Advancement in Power Technologies," 2023, pp. 715–723.
[16] B. Chowdhury and T. De, "An Internet of Things assisted Smart Hand Sanitizer with Health Monitoring System help to reduce rapid spread of COVID-19," *Easychair Publ.*, pp. 1–6, 2020.
[17] R. V Kurhe, A. Sur, and S. Pandiya, "Live Temperature Monitoring: IoT-Based Automatic Sanitizer Dispenser and Temperature Detection Machine BT - Proceedings of Third International Conference on Computing, Communications, and Cyber-Security," 2023, pp. 49–58.
[18] D. Alkhodary, I. A. Abu-Alsondos, B. J. A. Ali, M. Shehadeh, and H. A. Salhab, "Visitor Management System Design and Implementation during the Covid-19 Pandemic," *Inf. Sci. Lett.*, vol. 11, no. 4, pp. 1059–1067, 2022.
[19] J. N. D. Rivera, "VMS Support: A mobile-based support to computerized visitor management system," *Softw. Impacts*, vol. 8, p. 100056, 2021.
[20] I. A. Abu AlSondos and A. A. M. Salameh, "The effect of system quality and service quality toward using m-commerce service, based on consumer perspective," *Manag. Sci. Lett.*, vol. 10, no. 11, pp. 2489–2496, 2020.
[21] J. Basel, Ali, R. Bakar, W. Ahmad, and W. A. Wan Omar, "The Critical Success Factors of Accounting Information System (Ais) and It'S Impact on Organisational Performance of Jordanian Commercial Banks," *Int. J. Econ. Commer. Manag.*, vol. IV, no. 4, pp. 658–677, 2016.
[22] M. R. M. Isa, Y. H. Yahaya, M. H. M. Halip, M. A. Khairuddin, and K. Maskat, "The design of fingerprint biometric authentication on smart card for pulapot main entrance system," *Proc. 2010 Int. Symp. Inf. Technol. - Syst. Dev. Appl. Knowl. Soc. ITSim'10*, vol. 3, 2010.
[23] H. Al Ghaithi and U. Eaganathan, "a Brief Study and Implementation of Visitor Management System for Asia Pacific University , Malaysia," *Int. J. Adv. Res. Sci. Eng.*, vol. No.5, no. No.4, pp. 317–326, 2016.
[24] N. K. M. Noor, J. Sulaiman, and H. C. Khor, "Development of Visitor Management System Using Smart Card:UMP Case Study," *Natl. Conf. Softw. Enginystems 2007 NaCSES'07*, 2007.
[25] N. S. Tadam, "A Study on Video Based Face Recognition for Real-Time Surveillance," vol. 6, no. 3, pp. 547–552, 2019.
[26] J. Kotak and Y. Elovici, "Iot device identification using deep learning," *Adv. Intell. Syst. Comput.*, vol. 1267 AISC, pp. 76–86, 2021.
[27] S. Misra, A. Mukherjee, and A. Roy, "Introduction to IoT," *Introd. to IoT*, no. January, 2021.
[28] Z. Li, G. Liu, L. Liu, X. Lai, and G. Xu, "IoT-based tracking and tracing platform for prepackaged food supply chain," *Ind. Manag. Data Syst.*, vol. 117, no. 9, pp. 1906–1916, 2017.
[29] Z. Mumtaz *et al.*, "An automation system for controlling streetlights and monitoring objects using arduino," *Sensors (Switzerland)*, vol. 18, no. 10, pp. 1–14, 2018.
[30] Y. N. Malek *et al.*, "On the use of IoT and Big Data Technologies for Real-time Monitoring and Data Processing," *Procedia Comput. Sci.*, vol. 113, pp. 429–434, 2017.

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