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IOT Based Automatic Counters For Classroom Capacity In The New Normal Era Of Covid-19

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Abstract

This study aims to design and develop a prototype of a program for automatic classroom capacity counters in the new normal era of COVID-19. The prototype consists of an ultrasonic sensor to detect students who are entering and out from the classroom, a microcontroller as a data processor from sensor readings, and output is the number of students who are in the room, displayed on an LCD and can be monitored remotely with an IOT (Internet of Things) system. This study employs Research and Development approach, consisting of several stages covering information collection, continued by designing and developing the prototypes, testing and repairing the tools. From the test, the developed prototype function properly, the counter results in the LCD display has 100% of conformity, and the display on the Blynk Web Application results in 75% of confirmity.
Keywords: IOT, Ultrasonic, Arduino, Microcontroller.

Abstrak

Penelitian ini bertujuan untuk merancang dan membuat protoype alat otomatis penghitung kapasitas ruang kelas era new normal covid-19. Protoype terdiri dari sensor ultrasonik untuk menditeksi siswa keluar masuk ruang kelas, microcontroller sebagai pengolah data dari pembacaan sensor, output adalah jumlah siswa yang berada dalam ruangan yang ditampilkan pada LCD display dan bisa dimonitor dari jarak jauh dengan sistem IOT (Internet of Things). Metode yang digunakan adalah Research and Development, terdiri dari beberapa tahapan, yaitu pengumpulan informasi, kemudian merancang dan membuat prototype, melakukan pengujian dan perbaikan alat. Dari dasil pengujian keseluruhan, protoype yang dibuat dapat berfungsi dengan baik, hasil counter pada tampilan LCD 100% sesuai dan tampilan pada Web Aplikasi Blynk mendapat kesesuaian hasil sebesar 75%.
Kata Kunci: IOT, Ultrasonik, Arduino, Mikrokontroler.

1. INTRODUCTION

Since the first case of Coronavirus was announced by the President of the Republic of Indonesia Joko Widodo in March 2020, Indonesia then entered a pandemic situation [1]. Positive cases of the infection of covid-19 virus continue increase and to the date March 8, 2022, there have been 5,800,253 cases reported where 5,226,530 of them are recovered with deaths reaching 150,831 people [2].

The risk of the mobilization of people where they tend to gather in public places and facilities, has a considerable potential for contagion of COVID-19. In order to preserve economic activity, it is necessary to mitigate the impact of the COVID-19 outbreak, particularly in public sites and facilities. Being discipline in applying health protocols is the key in suppressing the transmission of COVID-19 to the community, thus it is expected that the outbreak will come to an end. The community must change their lifestyle with a new order and adaptation to live productively and avoid the transmission of COVID-19 [3].

The Covid-19 pandemic has caused multiple sectors to experience paralysis, including the education sector [3]. The Covid-19 outbreak has led instructional process be carried out online to avoid the widespread of the COVID-19 virus [4]. However, being fully online is less effective in learning, yet face-to-face learning is still significant for students' improvement. In this respect, the government has issued a Joint Decree of four ministers, namely the Minister of Education and Culture, the Minister of Religious Affairs, the Minister of Health, the Minister of Home Affairs Number O3lKBl2O2l, Number 384 OF 2021, Number HK. O1.08/MENKDSl4242/2021, Number 440-717 OF 202 1 concerning Guidelines for Instructional Process During the COVID-19 Outbreak[5]. This decree concerns on the face-to-face learning process is permitted to be carried out under a strict health protocol implementation and being monitored by local governments, provincial offices of Ministry of Religious Affairs, and / or offices of the Ministry of Religious Affairs of districts / cities according to their authority by cultivating a hygiene lifestyle in the context of preventing and controlling COVID-19.

One of the procedures for restricted Face-to-Face instructions in the Education Unit is the class conditions where students from elementary to upper secondary level and its equality programs keep a minimum distance of 1.5 (one point five) meters and a maximum number of 18 (eighteen) students in a class [3]. Referring to this procedure, the aim of this study is to make a prototype of an automatic tool that calculates the entry and exit of students in the classroom using ultrasonic sensors[6], [7], [8]. the results of sensor readings are processed by a microcontroller and can be monitored with an Internet of Things (IOT) system remotely[9],[10],[11]. Thus, the classroom capacity can be monitored at any time by stakeholders and remain within the established procedure.

2. RESEARCH METHOD

This study employs an R&D (Research and Development) design. Research and Development is a research method used to produce certain products & test the effectiveness of these products [12].

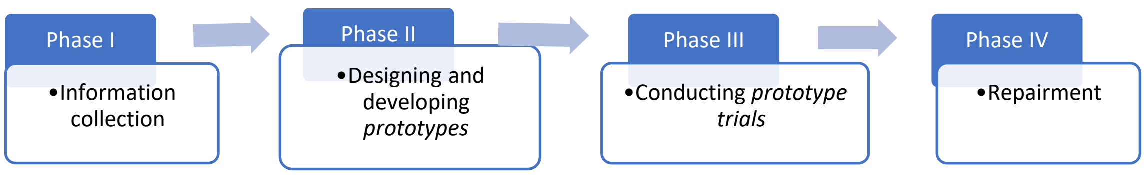

Figure 1. Research and Development Procedure

2.1 RESEARCH APPROACH

The Research and Development approach has led the researcher to utilize the four phases of R & D to develop the IOT based Automatic Counters for Classroom Capacity during New Normal Era of Covid-19 as elaborated in Figure 1.

The details of the stages according to Figure 2.2 are presented as the following:

PHASE I: Information collection. At this phase, information related to sensors and microcontrollers that will be used in this study is collected. This phase also directs the researcher to review previous related studies.

PHASE II: Designing and developing prototypes. Based on the needs analysis in the previous stage, designing and developing the prototype is carried out.

PHASE III: Conducting a field test for the prototype. At this stage, a prototype of the Classroom Capacity Counter is tested to find out whether or not the tool functions as desired or not.

PHASE IV: Repairing the prototype. At this stage, improvements will be made to the prototype of the Classroom Capacity Counter by solving the errors found during the test.

3. FINDINGS AND DISCUSSION

3.1 POWER SUPPLY TESTING

In electrical equipment power supply is vital, it must be tested first. In the power supply test, an input voltage of 5V DC is used, and several test schemes are performed as can be seen in Figure 2.

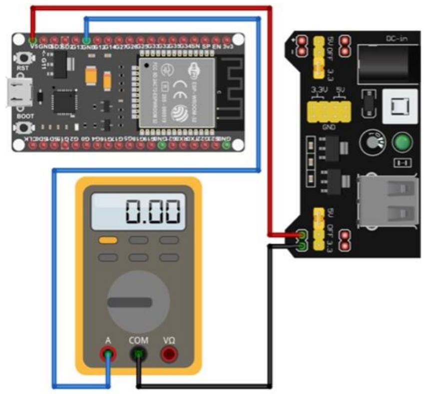

Figure 2. Power Supply Testing Circuit

From the tests that have been repeatedly conducted for eight times, it is concluded that the power supply can function properly. The test results can be seen in Table 3.1.

Table 1: Power Supplay Testing.

No.	The Test	Output Voltage (V)	Description
1	1st test	4,9	Arduino On
2	2nd test	4,8	Arduino On
3	3rd test	4,9	Arduino On
4	4th test	4,7	Arduino On
5	5th test	4,8	Arduino On
6	6th test	4,8	Arduino On
7	7th test	4,7	Arduino On
8	8th test	4,9	Arduino On

3.2 LCD DISPLAY TESTING.

This study utilizes a 16x2 LCD where it is then being tested as provided in the Figure 2. LCD testing is conducted by displaying the character and calculating the voltage entering the LCD, the test results can be seen in Table 2 below.

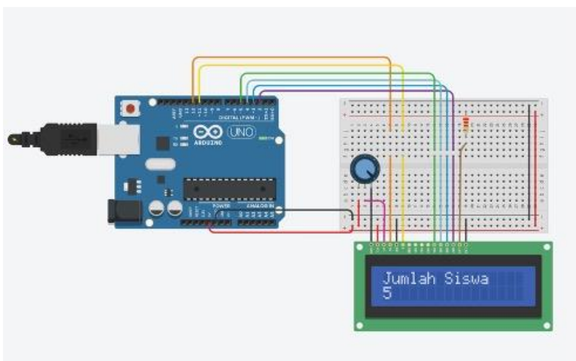

Figure 3. LCD Testing.

Table 2: LCD Testing.

No.	Source Voltage (V)	Input Voltage (V)	Voltage On LCD (V)	Description
1	4,8	4,8	4,2	LCD ON
2	4,9	4,9	4,2	LCD ON
3	4,7	4,7	4,3	LCD ON
4	4,8	4,8	4,2	LCD ON
5	4,8	4,8	4,2	LCD ON
6	4,8	4,8	4,2	LCD ON

From the results of the tests that have beencarried out, the character set was successfully displayed on the LCD, indicating that the LCD is functioning properly and is suitable for use in this research.

3.3 MICROCONTROLLER PORT TESTING.

This study using the manufacturer's microcontroller from Arduino[13],[14], this was chosen because it is easy to use. To find out the feasibility of the microcontroller port used, testing is carried out on each port / PIN as shown in Figure 3.

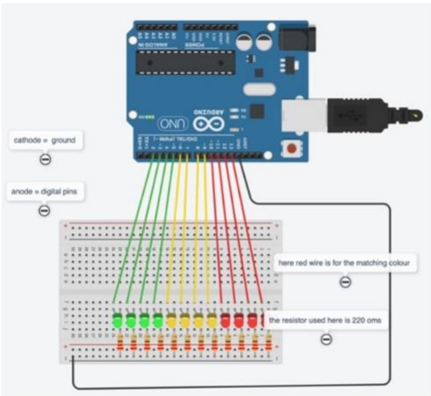

Figure 3. Microcontroller Port Testing

Arduino uno have several port. The test is conducted on PIN two (2) to PIN thirteen (13), the results of the Mirokontroler PIN test can be seen in table 3. 3. From the test results of the Microcontroller PIN, it can be said that the tool can function properly.

Table 3: Microcontroller Port Testing.

No.	Testing	Source Voltage (V)	Voltage On LED (V)	Description
1	PIN 2 Testing	4,8	2,4	LED ON
2	PIN 3 Testing	4,9	2,4	LED ON
3	PIN 4 Testing	4,7	2,3	LED ON
4	PIN 5 Testing	4,8	2,4	LED ON
5	PIN 6 Testing	4,8	2,5	LED ON
6	PIN 7 Testing	4,7	2,3	LED ON
7	PIN 8 Testing	4,9	2,4	LED ON
8	PIN 9 Testing	4,8	2,4	LED ON
9	PIN 10 testing	4,7	2,3	LED ON
10	PIN 11 Testing	4,8	2,4	LED ON
11	PIN 12 testing	4,8	2,5	LED ON
12	PIN 13 testing	4,7	2,3	LED ON

3.4 ULTRASONIC SENSOR TESTING.

This study also employs ultrasonic sensor with HC-SR04 model[15] where it is tested by positioning objects within the sensor range, then the sensor readings is operated and its results are displayed on the LCD. The test is illustrated in the Figure 4.

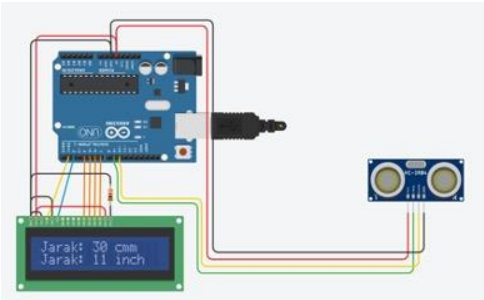

Figure 4. Ultrasonic Sensor Testing

The test results is shown in Table 4 below. From the results of the tests that have been carried out, it is found that the ultrasonic sensor used can function properly where the margin of error obtained is 1%.

Table 4. Ultrasonic Sensor Testing.

Testing to	Real Distance (cm)	Sensor Reading (cm)	Margin of errors
1	100	98	2%
2	90	88	2%
3	80	78	3%
4	70	68	3%
5	60	58	3%
6	50	50	0%
7	40	40	0%
8	30	30	0%
9	20	20	0%
10	10	10	0%
Average error			1%

3.5 MICROCONTROLLER CONNECTIONS TO INTERNET NETWORKS TESTING.

Furthermore, to ensure that the Microcontroller can be connected to the internet network, testing is carried out by connecting the Microcontroller with a Wifi network with the name of *access point*, or "surya_mac". From the results of the tests, the microcontroller used in this study is successfully connected to the internet network using the Blynk server [9], Figure 5. below illustrate the test process.

Figure 5. Microcontroller Connections To Internet Networks Testin

3.6 ENTIRE SYSTEM TESTING.

In the system testing, the prototype is equipped with two ultrasonic sensors which are placed at the entrance, functioning to detect students who passed through the entrance and one ultrasonic sensor at the exit, functioning to detect students passing through the exit. Each of the sensors will detect students coming in and out through the door (in this case ultrasonic sensor 1 and ultrasonic sensor 2). The microcontroller processes the sensor readings and performs calculations, the processing results are displayed on the LCD display and monitored through the Blynk application.

Table 5. Entire System Testing.

No.	Testing	*Real* testing passes through the entry point or Sensor 1 (student)	*Real* testing passes through the Exit or Sensor 2 (student)	Readings Calculation on LCD	Status Calculation of the display system on the LCD	Total View of Blynk Web Students	Status On the Blynk Web
1	Test 1	1	0	1	Conformed	1	Conformed
2	Test 2	2	0	2	Conformed	2	Conformed
3	Test 3	3	0	2	Conformed	2	Conformed
4	Test 4	4	0	4	Conformed	4	Conformed
5	Test 5	5	0	5	Conformed	5	Conformed
6	Test 6	5	1	4	Conformed	5	Conformed
7	Test 7	5	2	3	Conformed	5	Unmatched
8	Test 8	8	2	6	Conformed	6	Conformed
9	Test 9	9	3	6	Conformed	6	Conformed
10	Test 10	10	4	6	Conformed	6	Conformed
11	Test 11	11	5	6	Conformed	6	Conformed
12	Test 12	12	5	7	Conformed	6	Unmatched
13	Test 13	13	6	7	Conformed	6	Unmatched
14	Test 14	14	6	8	Conformed	7	Unmatched
15	Test 15	15	7	8	Conformed	8	Conformed
16	Test 16	15	7	8	Conformed	8	Conformed
17	Test 17	15	8	7	Conformed	8	Unmatched
18	Test 18	16	8	8	Conformed	8	Conformed
19	Test 19	17	9	8	Conformed	8	Conformed
20	Test 20	18	9	9	Conformed	9	Conformed
Total Conformity					100%		75%

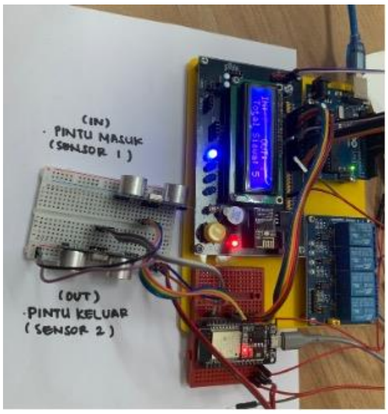

Figure 6. Entire System Testing.

Figure 7. WebViews of Blynk App.

Table 5 shows the test values of the entire prototype system, where the experiment is carried out twenty (20) times, the ultrasonic sensor 1 detects the entrance and the ultrasonic sensor 2 detects the door at the exit. The counter calculation is processed by the microcontroller and being displayed on LCD display and on Blynk Web application for remote monitor. The experimental results shown on the LCD got 100% of conformity value according to the actual conditions, and the display results on the Blynk Web Application got a conformity value of 75%.

4. CONCLUSION AND SUGGESTIONS

Based on the findings from the tests and discussions that have been conducted, all components can function properly, ranging from power supplies, LCD displays, microcontrollers and ultrasonic sensors, it can be concluded that the prototype " Automatic Counters For Classroom Capacity In The New Normal Era of COVID-19" works well. It can be seen from the total conformity test results in the entire system testing that get 100% conformity value displayed on the LCD, while the displays monitored remotely via the Blynk Web application get a conformity value of 75%. There is a slight difference from the results of the tests that have been carried out, ideally the display on the LCD display is the same as that by the Blynk Web Application

The suggestion for prospective researchers is how to adjust the display on the Blynk Web Application to be the same as the results displayed on the LCD since the Blynk Web Application is an application from a third party, there are several parameters that affect the transmission of data from the microcontroller to the Blynk Web Application, and since the process is through the internet network, one of the problem is the latency of the network itself.

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