

IEEE International Conference on
Communications, Networks and Satellite

COMNETSAT

2021



PROCEEDINGS

PURWOKERTO, INDONESIA
Online Conference, on July 17-18, 2021

**Welcome Message from General Chair
The 10th Comnetsat 2021**

(Saturday – Sunday), 17th – 18th July 2021



On behalf of the IEEE Indonesia Section, we would like to extend our warmest welcome to all keynote speakers, presenters, and participants to the 10th 2021 IEEE International Conference on Communications, Network, and Satellite (IEEE Comnetsat 2021). IEEE Comnetsat is an annual conference of the IEEE Communications Society (ComSoc) Indonesia Chapter, the IEEE Indonesia Section, and the IEEE AESS/GRSS Indonesia Joint Chapter. This year, IEEE Comnetsat 2021 is organized by Institut Teknologi Telkom Purwokerto (ITTP) with IEEE conference. Due to the COVID-19 pandemic, it will be held as a virtual event.

IEEE Indonesia Section has conducted many activities over 30 years in Indonesia. In terms of collaboration, IEEE Indonesia section has a good and mutual relationship with ICT organizations, Industries, Government, Universities as well as the Community in Indonesia. As the ten years of Comnetsat, this conference shows its sustainability due to the hard work of the conference organizers, well-organized conference, and high-quality papers. We do hope in the near future some high-quality conferences will be continued and strengthened, so the result will give more benefit and positive impact to the human being, especially to Indonesian people.

The core purpose of IEEE is to foster technological innovation and excellence for the benefit of humanity. We believe that this conference will bring researchers, academicians, scientists, students, engineers and practitioners together to participate and present their latest research finding, developments and applications related to the various aspects of current state of technology and the outcome of ongoing research in the area of Communications, Networks, and Satellite Systems.

Despite the challenges, the IEEE Comnetsat 2021 Organizing Committee and volunteers worked very hard to complete the conference program, uphold the quality of conferences, and meet authors' expectations. IEEE Comnetsat 2021 aims to address the current state of technology and the outcome of ongoing research in the area of Communications, Networks, and Satellite Systems, which covers theory, design, and application of computer and communication, networks, satellite systems as well as broadband photonic systems, data science, and artificial intelligence.

I significantly hope you all find this conference highly engaging, fruitful, and beneficial for your future venture. Your support will also make this a memorable and successful event. We wish you to stay safe, healthy, and productive. We are looking forward to your contributions and participation.

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Nomor: IT Tel8382/LPPM-000/Ka. LPPM/VII/2021

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“Real-time Signboards using Panels P5 RGB and NodeMCU esp8266 with Library PxMatrix”

Selanjutnya kepada personil yang ditugaskan agar dapat segera menyampaikan hasil pelaksanaan kegiatan.

Demikian surat tugas ini diberikan untuk dilaksanakan sebaik-baiknya dengan penuh rasa tanggung jawab.

Purwokerto, 17 Juli 2021

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Real-time Signboards using Panels P5 RGB and NodeMCU esp8266 with Library PxMatrix

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Abstract— The causes of traffic congestion are divided into two, one of which is natural factors and the other is human factors. One way to resolve this is by diverting the flow. Usually, the diversion is carried out by the police. The other way to divert the flow is by using a signboard that can change its direction. This board is made using the P5 RGB LED panel and the NodeMCU esp8266 microcontroller. This panel uses the Internet to communicate with the database. The database used is the Firebase that contains the name of the city and the direction to the city. It used the HTML Protocol to send the data from the database to the board. From the tests that have been done, the results obtained shows that NodeMCU esp8266 is not suitable to be used by the PxMatrix Library for large panel configurations. But on a small panel, the test was successfully carried out. The test was carried out by changing all directions of the city. The result of this test is that the direction of the entire city can be changed according to changes in the Firebase.

Keywords— signboard , database, NodeMCU, esp8266, traffic congestion

I. INTRODUCTION

Traffic congestion is a major problem in urban transportation. Many people complain of the frequent traffic congestion. There are two main causes of traffic congestion. One of them is natural factors and the other is human factors. Congestion because natural factors often occur due to natural disasters that hit the area. Indonesia is located on the Pacific Ring of Fire, which means that Indonesia's territory is a region with a lot of tectonics activities. Some of the natural disasters that can cause traffic congestion are floods, landslides, hurricanes, volcanic eruptions, earthquakes and tsunamis [1]. Traffic congestion because of human factors is divided into two, which is intentional and unintentional traffic congestion. Examples of intentional traffic congestion are congestion when there is road repair or because the road closed because of public interest or celebration. Unintentional traffic congestion is caused by accidents that make the roads inaccessible [2].

Traffic congestion can be unravelled or controlled. To unravel the congestion depends on the congestion itself [2]. Traffic congestion because of repeated events, for example, due to the number of vehicles parked recklessly, to solve it is to divert the vehicles to the parking space in a building or other empty

parking lot. Another way is to charge a high parking fee, specifically for busy locations. Traffic congestion caused by narrow roads can be resolved by widening the roads. In addition, it can also be resolved by limit the number of vehicles that enter the lane.

Traffic congestion because of non-recurring events usually resolved by the authorities with opening and closing lanes, diversion of traffic flows, and contraflow[3]. Diversion of traffic flow or limiting the number of vehicles to enter a road segment is usually carried out by the police. The police will go down the streets and put up a sign that there is a diversion of traffic flow.

The materials for the signboard include aluminium, acrylic, wood and galvanized steel pipe. However, today people install signboard using LED panels. The LED panel was chosen because it can contain text, picture and moving media. Then the government start to use LED panels to inform traffic conditions, controlled by the command centre [4]. On the LED display, information about road conditions is displayed on each road segment. However, the display cannot provide a direction replacement when one of the roads that are traversed is congested.

In our research, we make a signboard using LED panels. The LED panel is an informative media of information [5]. The LED panel are designed to be controlled in real-time. The contents of the LED panel are the name of the city and the direction to the city. The purpose of this study is to be able to change the direction shown in the LED panel, online and in real-time. . This microcontroller is tasked with connecting the LED panel to the Internet. If there is a change in the database, the LED panel will then follow the changed data in real-time.

This paper consists of several parts. Part II contain the literature review that discussed what is used to construct road signs. Part III discusses the research methodology that will be applied to compile the signboards from both hardware and software. Section IV describes the results and analysis. Part V describes the work that will be carried out after this research is published. Part VI describes the conclusions of the study.

II. LITERATURE REVIEW

A. Panel LED P5 RGB

The P5 RGB LED panel was chosen for this study because the panel has a density of 5mm spacing between lights (Pixel pitch). Panel P5 was chosen because this panel is very suitable for advertising media. Small density makes writing easy to read. In addition, a lot of information can be displayed in comparison with the P22 LED[6].

As an added feature, the waiting time when the light turns red can be used effectively to spread information. Because, when the driver stops at a red light, the driver focuses on waiting for the green light. Information that can be spread usually in the form of advertisements, public information, weather forecasts and so on. Advertising can serve as a source of income that creates a profitable return on investment. Colored or monochrome LED displays also add a colourful aesthetic to the surroundings to beautify every corner of the city

B. Library PxMatrix

The PxMatrix library is a library used to control the RGB LED Matrix Panel. The RGB LED Matrix Panel is a panel with a large-scale LED display with the resolution and size shown in Table I [7].

TABLE I. RESOLUTION DISPLAY

Pitch (mm)	Size	Resolution	Rows-scan pattern
P6	192mmx96mm	32x16	1/2, 1/4 or 1/8
P10	320mmx160mm	32x16	1/2, 1/4 or 1/8
P4	128mmx128mm	32x32	1/8 or 1/16
P5	160mmx160mm	32x32	1/8 or 1/16
P6	192mmx192mm	32x32	1/8 or 1/16
P7.62	244mmx244mm	32x32	1/8 or 1/16
P2.5	160mmx80mm	64x32	1/16
P4	256mmx128mm	64x32	1/16
P5	320mmx160mm	64x32	1/16
P2.5	160mmx160mm	64x64	1/32
P3	192mmx192mm	64x64	1/32

From the several types, sizes and resolutions in Table I, the PxMatrix library can control multiple RGB LED Matrix panels at once with a maximum resolution of 64x32. The PxMatrix library is compatible with several microcontroller boards such as ATMEL-based Arduino, ESP8266, and ESP32.

In programming, to control the colour of the RGB LED Matrix panel, it used a colour combination of R, G, B by entering the value of each colour, which is 0 to 255. Meanwhile, to display a character manually, it is done by input the matrix coordinates from the panel with a hexadecimal number format.

C. Library Smart Matrix

The Smart Matrix library is a more complex library than the PX Matrix. This library can control multiple panels or channels (more than 64x32) using only one microcontroller board.

To use the Smart Matrix library, additional libraries are needed, including:

- 1) *Adafruit GFX*
- 2) *FastLED*
- 3) *LED Matrix*

The use of the library in the program has the same concept as the PX Matrix library, which is to adjust the colour by inputting each R, G, B value, and to display characters by accessing each panel matrix coordinate in hexadecimal format [8].

D. Firebase

Firebase Realtime Database is a NoSQL cloud-based database that syncs data across all clients in real-time and provides offline functionality. The data is stored real-time in the database as JSON, and all connected clients sharing one instance, will automatically get the same updates as other clients.

The use of the Firebase is different from the use of MySQL generally. This is because Firebase uses NoSQL which is easier to use. Users can structure data in a fundamentally different way using JSON instead of traditional tables using SQL[9].

E. NodeMCU esp8266

The MCU node is a microcontroller board based on the ESP8266 WiFi module, making it suitable to be applied in the Internet of Things (IoT), smart home control or other wireless control applications. Node MCU is an IoT Opensource platform and has firmware to run the Wi-Fi system ESP8266 chip module. The firmware is using LUA Scripting Language. Using Arduino IDE, Node MCU can be programmed. By installing the ESP8266 board driver from the board manager option or web source, the MCU Nodes can be programmed from the Arduino IDE. The MCU node has 128 Kbytes of Memory and uses the eXtensible Testing Operating System (XTOS). Node MCU is a very cheap IoT development board compared to Intel Galileo, Raspberry Pi, UDOO and other IoT development boards[10].

F. Testing Accuracy of Program

Accuracy testing is essential for the designed program. Testing is done by dividing the number of successful tests divided by the total tests. To make the data as a percentage, dividing the data is multiplied by 100%. The higher the percentage level, the higher the number of correct test data. The formula for this accuracy is shown in equation (1)[11]

$$\text{Accuracy} = \frac{\text{Number of successful tests}}{\text{Total tests}} \times 100\% \quad (1)$$

III. RESEARCH METHODOLOGY

The research design is divided into two main points. These points are hardware design and software design. Fig.1 describes the research flow. The research began with the preparation of the panel. If the panel has been successfully connected to a laptop that has Arduino IDE installed, the next step is to create a code so that the panel can turn on and light up according to the code command.

Next, prepare the code so NodeMCU can connect to the Internet. This is need to be done for NodeMCU so it can connect to the database. The research was declared successful when the image or writing on the LED panel could change according to the database contents. The following is the design of the hardware and software used in this study.

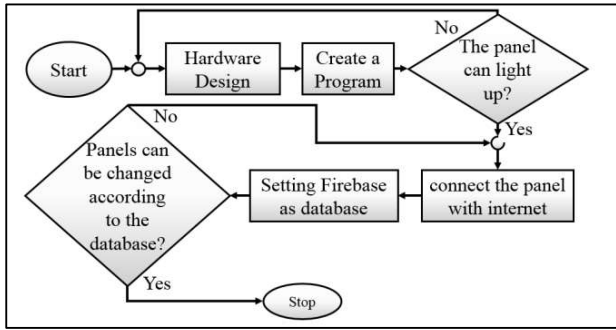


Fig. 1. Research Flowchart

A. Hardware Configuration

The hardware used is a P5 RGB LED panel and a NodeMCU esp8266 microcontroller. The support tools for this design are the power supply and jumper cables. The collected equipment is then arranged as shown in Fig.2. Three LED panels arranged into 1 row and the panels are connected using a jumper cable and each panel is connected to the power supply as shown in Fig.3. The first panel is connected to NodeMCU and then connected to the computer to enter the code from the Arduino IDE.

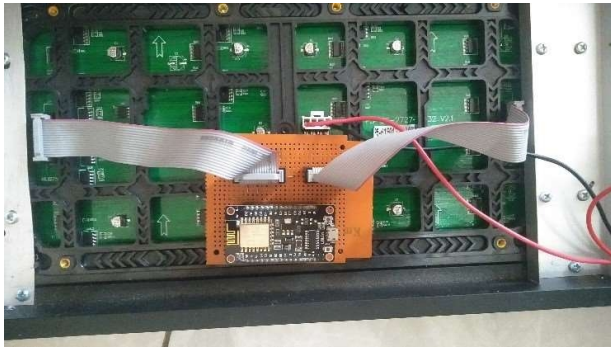


Fig. 2. NodeMCU with Panel

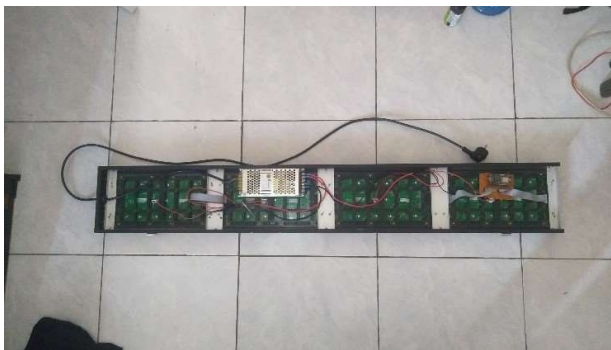


Fig. 3. One row of panels

The pins used on NodeMCU to connect to the panel are shown in Table II.

TABLE II. CONNECT PANEL WITH NODEMCU

Panel Input	ESP8266 GPIO (NodeMCU)
A	05 – (D1)
B	04 – (D2)
C	15 – (D8)
D	12 – (D6)
E	00 – (D3)
STB/LAT	16 – (D0)
P_OE	02 – (D4)
CLK	14 – (D5)
R1	13 – (D7)

B. Software Designing

The programming software used is Arduino IDE. In the database section, we use Firebase. On the Arduino IDE, to communicate with the NodeMCU, we use the esp8266 board setting. Library using PxMatrix.

To make the directional sign LED display, the LED is set to a green background. Colouring on RGB LEDs uses a mix of red, green, and blue colour scheme. The light intensity of each colour is between 0 and 255. To make the LED panel look like a road sign, the background colour is set to 0.255,0 as shown in Fig.4. To make the text and arrow direction, the LED panel colour is changed to 255,255,255 as shown in Fig.5. The number 255 255 255 shows the maximum light intensity on each LED. Therefore, this setting makes the LED white.



Fig. 4. LED Panel with Green Background



Fig. 5. LED Panel with City Name and Direction

After the manual setting is complete, the next step is to set the WiFi connection. When Arduino connects to WiFi, this can be monitored on the serial monitor. On the serial monitor, the phrase "WiFi connected" will appear, followed by the IP Address. A stable internet connection is essential for easy communication with the database.

The next step is to set the database. The first thing to do with the Firebase database is to create an account. After the account is created, Firebase will show Firebase host and Firebase auth. These two things are used as keys to enter the database. Next, create the contents that will be displayed in the database. In this study, we used a design as shown in Fig. 6.



Fig. 6. Table in Firebase

Tables from the database are created for four cities. Each city has its direction. The goal is made like Fig.6 so that when there is a traffic jam, the direction of the city can be changed easily. The GET database script created on Arduino has a 5 seconds refresh time for each city. The reading starts from the first city, the next five seconds changes the display to the second city, the next five seconds changes the display to the third city, this lasts until the fourth city. After the fourth city, the looping will back to the first city.

IV. RESULT AND DISCUSSION

A. Result and Discussion

Hardware and software have been successfully assembled. The results of the first experiment are that 1 row of LED panels can light up, but errors show in panel 2 and panel 3. This error is shown in Fig.7. The error is predicted because of the lack of jumper from NodeMCU to the panel. For panels 2 and 3, there is supposed to have an additional jumper cable from the NodeMCU. In this case, we are using the PXmatrix library.



Fig. 7. Error in Panel

Next, we try to stick with that row of LED panels. We replace the library using Smart Matrix. However, the Smart Matrix library only suitable for esp32 microcontrollers. Therefore, in

this study, we only utilize 1 LED panel from the available LED row.

The first idea we thought, because the length of the LEDs was limited, we made an abbreviation for the city name. Next, we create arrow directions for each city name. For this study, we created 4 sample cities. The example is shown in Table III.

TABLE III. LIST OF CITIES AND DIRECTION

City	Direction
BDG	Right
SBY	Left
BALI	Up
PWT	Bottom

The test carried out when the database changed the direction of each city. The results of this test are shown in Table IV. From the test data in table IV, the accuracy value can be calculated at:

$$Accuracy = \frac{Number\ of\ successfull\ tests}{Total\ tests} \times 100\% \quad (1)$$

$$= \frac{36}{36} \times 100\%$$

$$= 100\%$$

The evidence of successfully changing direction is shown in Fig. 8. In Fig.5 the BDG city has a direction to the right, but in Fig.8 the BDG city direction changes to a downward direction.



Fig. 8. BDG City With Other Arrow

TABLE IV. TEST RESULTS

No	City	Direction		Result
		Before	After	
1	BDG	Right	Left	Success
2			Up	Success
3			Bottom	Success
4		Left	Right	Success
5			Up	Success
6			Bottom	Success
7		Bottom	Right	Success
8			Left	Success
9			Up	Success
10	SBY	Success
19	BALI	Success
28	PWT	Success

B. Future Work

The use of NodeMCU as the main microcontroller is not satisfactory. Because when the 3 panels arranged into one, only 1 panel can light up. The next work after this is to replace NodeMCU with esp32 and use the same panel. Hopefully that all panels will turn on without errors.

After the replacement of esp32 is successful, the next is to add rows of LED panels. The current size is $3 * 64 \times 32 = 192 * 32$ LED points. After add one line below it, the size becomes $3 * 64 \times 2 * 32 = 192 \times 64$. This is done so that the name of the city will be bigger and can contain more than 1 city.

The main objective of this research is that the direction of the signboards could be changed in real-time. The NodeMCU esp8266 system uses wireless media in the form of WiFi to connect to the database. This makes it difficult when the tool is installed on the highway. At a highway junction, not much WiFi available. Therefore, we will try to change the delivery medium from WiFi to LoRa

V. CONCLUSION

In this study, the main objective is to be able to change the direction of the arrows on the street signs online. The research was successful. The arrow direction can be changed online using the HTML protocol. In this study, the LED panel and the system were tested. The tests carried out from testing the data transfer from the database to the LED panel to testing the direction change of the arrow for each city. In testing the direction change of the arrow, the result is an accuracy rate of 100%, which means it produces a perfect value. A perfect value means that all tests were successful and that there were no failed tests. So it can be said that one LED panel with a NodeMCU esp8266 controller combined with the PXMMatrix library can be used as a signboard tool that can be controlled online and in real-time.

Another conclusion from this study is that the NodeMCU esp8266 is not suitable to use with many LED panels when using the PXMMatrix library. If you want to arrange a large number of LEDs, you have to replace NodeMCU esp8266 with esp32 and use the Smart Matrix library.

ACKNOWLEDGEMENT

This research is fully funded by the Ministry of Research and Technology / National Research and Innovation Agency using a novice lecturer research scheme. The research took place from mid-2020 to the end of the year. The research was conducted at Institut Teknologi Telkom Purwokerto Campus. We would like to express our deep gratitude to all those who helped with this research.

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