

# Eka V1: Emergency Call Auto-Register, An Emergency Warning System Based On Internet Of Things For Intensive Care Patient At Hospital

Prisma Megantoro, Hendra Ari Winarno

**Abstract:** The emergency calling device for nurse is generally located in every ward of a hospital. It is an important facility for every inpatient. However, generally these devices are still in the form of conventional electrical components that uses long wiring. This is because this system must reach all inpatient rooms. In addition, the caller feature is also very limited, usually only in the form of an emergency button. The caller system is also not yet integrated with the hospital database, so it becomes an obstacle for nurses and doctors to understand the patient's condition in an emergency. This article discusses the design of a nurse calling device that is connected wirelessly via a wifi network on the ward. There are also several types of calling features so that the nurse or doctor immediately knows the type of assistance a patient needs. In addition, the client and server system is integrated with the hospital database, which shows a detailed patient history. This device uses the NodeMCU ESP 8266 board as a client and Raspberry Pi 3 as a server. The features placed on this device work well as a design and are successfully implemented for one ward per server.

**Index Terms:** public service, hospital, nurse caller, ESP8266, microcontroller, raspberry pi, internet of things.

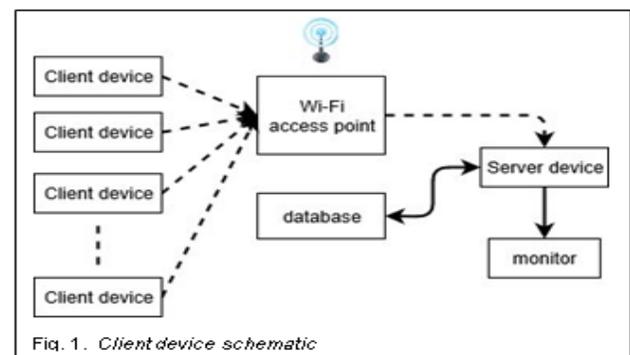
## 1 INTRODUCTION

Industrial Revolution 4.0 provoked the development of many new technologies that simplify human work and can be used remotely without a physical cable connection. One of the technologies created in this era is the Internet of Things (IoT)[1][2][3]. IoT itself has grown so rapidly along with the development of telecommunications technology. With a fast wireless connection, it makes all electronic devices can be connected wirelessly and remotely. Utilization of IoT is very broad, almost in all areas of life can take advantage of this technology, especially in the field of medical services. Medical services in hospitals must also follow technological developments, especially with the use of this IoT [4]. With this, will improve hospital medical services for patients [5][6]. If this happens, the level of public health will also increase as more sophisticated technology is used. The relationship between patients and doctors and nurses is one of the most important services [7]. Handling quickly and precisely becomes a major factor in this regard. Nurse call feature is one of them, where the patient is needed when an emergency requires effective and efficient treatment. Then a nurse call device is needed that is mobile, concise, and has many features. On the other hand, this device must also be able to provide sufficient detailed information about the patient's history. This is done so that doctors and nurses can handle emergency conditions quickly and precisely.

## 2 METHOD

This device design method includes designing the client side with arduino microcontroller [8]–[14] and server side. For the client side it is used specifically for 1 patient in 1 room on the ward. This client microcontroller [15] device is used as an emergency caller.

And the server side is used as an interface or indicator for emergency calls by patients.



If the patient is in need of emergency treatment, then just press one of the feature buttons available on the client device. After that, the server will receive data on the type of assistance and the patient's room number. The data will appear in the server device interface layer along with detailed data about the identity and history of the patient's stay. The data was obtained from the hospital database. It is expected that with this, the doctor or nurse can prepare the equipment or medication needed before entering the patient's room.

### 2.1 Client device

This device is placed in each patient's room. The device is used if the patient needs the help of a doctor or patient. Caller features included are 3; emergency, infusion, and usual help.. This device uses a NodeMCU 8266 microcontroller [16] board and the user interface is a push button. The power supply uses a Li-Po type battery, so the device can be carried by patients anywhere, including when going to the bathroom. As a battery power source, simply connect it to the adapter if the battery has run out.

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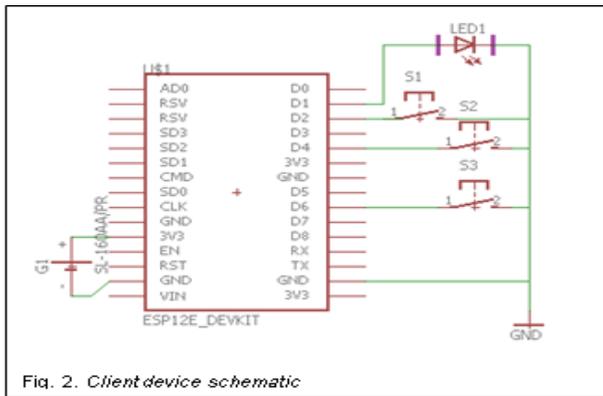


Fig. 2. Client device schematic

The NodeMCU board is a microcontroller [17] board specifically used for control that requires an internet connection wirelessly or with Wi-Fi media. This device can be connected to both local and public networks. In this article, both the NodeMCU microcontroller [18] board and the Raspberry Pi [19] must always be connected to

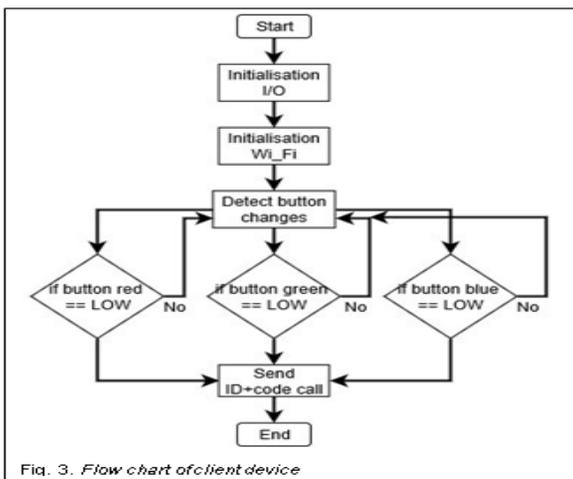


Fig. 3. Flow chart of client device

a hospital or ward Wi-Fi network. This program initialization is done by connecting to the access point device on the nearest Wi-Fi network. After that, initialize the push button and indicator features. In general, this device program is made to detect logic changes when push buttons for each of the caller features that have been mentioned. If one push button is pressed, the logic will change from HIGH to LOW. This change in push button logic will trigger a program to execute a sub program to send device ID data and help type codes to the server device. The data sent will be processed and displayed by the server in the nurse's or doctor's office. Thus, the client device packaging is made so that its use is easy, practical, and informative for patients.

**2.2 Server device**

This device is placed in the nurse's or doctor's room in a ward. This device is used to process and display patient data while simultaneously displaying call signals from patients in the room and certain types of assistance. This device uses a Raspberry Pi 3 B type mini computer with a user interface using the Python programming language. This device is not mobile, so it requires a wired power supply. For power supply use an AC / DC adapter 5 V and 3 A. Use of this type of adapter is adjusted to the specifications of the electrical

requirements of the Raspberry Pi and the monitor. This Raspberry Pi type mini computer board is very easy to find on the market with various types. For this study using type 3 B. Raspberry Pi board in this type is equipped with a Wi-Fi adapter on board and an HDMI connection for the monitor.

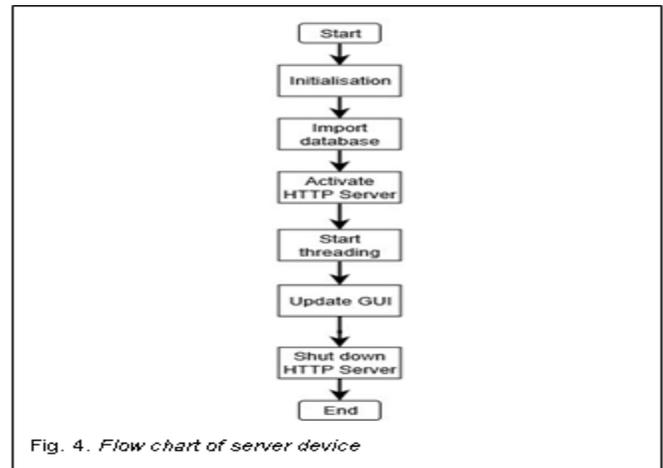


Fig. 4. Flow chart of server device

This program initialization is done by connecting the device to the access point locally. After that, making a graphical user interface (GUI) application at the monitor layer. This GUI application is used to monitor assistance calls from client devices held by patients in the treatment room. If there is data coming in from a client device, the monitor will show a rapid emergency accompanied by an alarm aimed at the doctor or nurse who is on standby in his room. In the GUI view, the application will show the room number and type of assistance needed by patients in a particular room. This message is accompanied by a "OK" button. The message will continue to appear and the alarm will continue to sound if the button has not been pressed. This is done as a warning to doctors or nurses on guard. After pressing the "OK" button, the application will search for patient data in the hospital database, then show it on the monitor.

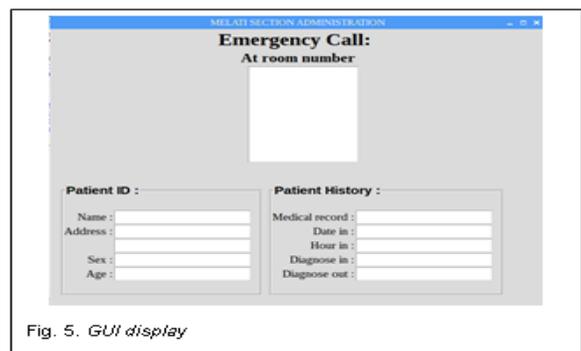


Fig. 5. GUI display

Figure 6 shows the patient identification data and patient history in detail. With this, it is expected that emergency treatment can be more swift and on target, without requiring doctors or nurses to go back and forth in the patient's room due to unclear information or medical equipment left behind.

**2.3 System device test**

The first test is done separately between the client device and server device. This test is conducted to determine the success of the design of both sides of the device's function. Testing on

the client side is done to determine whether the data sent is correct and in accordance with changes in the logic of each push button. Electrical testing is also carried out to determine the reliability of the device and the usage period from full to empty battery conditions. For testing the server device is also not much different. This is done to find out whether the operation of the program is in accordance with the features created, namely to process client data, access the database, and display in the application. The second test is done by integrating both sides of the device via Wi-Fi network. This is done to find out whether the whole system is running well according to design. It also considers ergonomics and ease of use and information transfer, both by the patient and the doctor or nurse. All tables and figures will be processed as images. You need to embed the images in the paper itself. Please don't send the images as separate files.

### 3 IMPLEMENTATION

#### 3.1 Client device test

##### a. Sending data test

The data sent to the server is a string containing 2 types of variables, namely the device ID variable, which represents the caller's patient room number, and also the calling code. Call code 1 for emergencies. Call code 2 for conditions for additional infusion requests. Call code 3 for ordinary help. Both variable values are parsed into one variable and sent to the server device via the Local Wi-Fi network. This test uses a number of 3 client devices.

**Table 1.** Output data from client device

Device ID	Call code	Pressed button	Output data
1	1	Red	1,1
	2	Green	1,2
	3	Blue	1,3
2	1	Red	2,1
	2	Green	2,2
	3	Blue	2,3
3	1	Red	3,1
	2	Green	3,2
	3	Blue	3,3

Table 1 shows the output data according to the design format. This format can only be sent from a programmed microcontroller [20], cannot be sent from other devices, such as a browser on Windows. Only data that matches the format can be processed by the server program.

##### b. Power supply test

This client device uses a 18650 Li-Po battery which is arranged in 2 parallel as its power supply. Test results show that this device can be used for a maximum of 15 hours..

#### 3.2 Server device test

##### a. Data receiving and processing

As the previous explanation, that the data sent by the client device is a string consisting of 2 variable values. This server program was first created for splitting data. With this the room number and call code data will be known.

**Table 2.** Data result from client

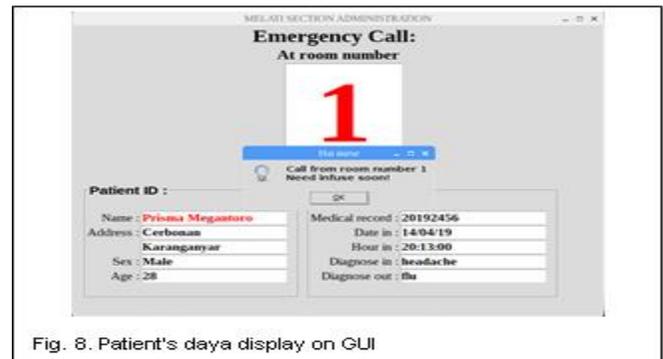
Input	Room number	Call code
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data		
1,1	1	1
1,2	1	2
1,3	1	3
2,1	2	1
2,2	2	2
2,3	2	3
3,1	3	1
3,2	3	2
3,3	3	3

In this test, splitting data was successfully carried out with the indicator value of the two variables shown in Python Shell.



This test is carried out with access to the database to find the data of patients who make calls and display it in the GUI application.



#### 3.3 System test

This test is carried out in real time with a Wi-Fi network topology via the router access point. This is done whether the overall features of the nurse call system are made to function as a design. If a button from a client device is pressed, warnings and data that appear on the server application are correct.

**Table 3.** Overall system test result

Device ID	Pressed button	Patient's ID correct?	Patient's history correct?	Patient's request correct?
1	Red	Yes	Yes	Yes
	Green	Yes	Yes	Yes
	Blue	Yes	Yes	Yes
2	Red	Yes	Yes	Yes
	Green	Yes	Yes	Yes
	Blue	Yes	Yes	Yes
3	Red	Yes	Yes	Yes
	Green	Yes	Yes	Yes
	Blue	Yes	Yes	Yes

From table 3 it can be seen that the data processing and appearance of the data are in accordance with the design. Thus this will greatly help the doctor or nurse to improve the performance of medical services to patients for 24 hours.

#### 4 CONCLUSION

From this study it can be concluded that the device made meets all the testing criteria, both from the client and server side, both from the program and hardware. This set of system can be implemented well in a hospital ward with adequate Wi-Fi network. The number of uses of client devices is unlimited, it only needs to be adjusted on the server side.

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