Development Of A Patient Control And Monitor System Using Esp32-Cam And Android

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***Abstract*—** The health sector is a field that cannot be separated from human life. Therefore, developments need to be carried out so that the health sector can support human life in the current era. This development can take the form of developing medical aids that really support the performance of medical personnel.To change the settings and modes on the patient monitor device in the isolation room, this would be quite risky for doctors and nurses if they had to go into the isolation room every time just to see the patient's condition on the patient monitor device.The author intends to design a tool to make it easier for doctors and nurses to control patient conditions based on *ESP32 CAM WIRELLES* , in this discussion the author uses *ARDUINO UNO, HC-05 BLUETOOTH MODULE* , and *the Patient Monitor Monitoring application. Menu selection on the patient monitor device is controlled via a gearbox motor, where the gearbox motor selects the menu by turning the knob on the patient monitor servo device to select the menu set on the patient monitor device.*After testing, this tool displays images with *2 MEGAPIXEL quality* and the range of the *BLUETOOTH HC-05 Module* so that the tool is suitable for use and in accordance with testing. And the range (connection/application distance on the device) is 1 – 8 meters.

Keywords: *camera, patient monitor , esp32 cam wirelles ,h hc-05, arduino sketch .*

I. Introduction

Current technological progress can no longer be doubted, both digital technology and electrical technology. Not only has it developed in the fields of economics, education and government, the progress and development of electrical technology has also greatly influenced the health sector [1]. The health sector is a field that cannot be separated from human life. Therefore, developments need to be carried out so that the health sector can support human life in the current era [2]. This development can take the form of developing tools to help paramedics which really support the performance of medical personnel. For isolation rooms in hospitals, especially for certain diseases that have a high risk of transmission [3], [4]. Medical personnel have an important role in human life, so electromedical equipment is needed that can help their performance to help the wider community. The tools referred to here are electromedical tools that can make it easier for nurses and doctors to monitor patient conditions remotely [5], where this tool can control patient monitoring devices at a certain distance, so this tool is very effective in supporting the development of health device technology [6], [7].

A patient monitor is a tool that is used to monitor a patient's physiological condition [8]. Where the monitoring process is carried out in real-time, so that the patient's physiological condition can be known at that time [9].

Figure 1. patient monitoring device

Patient Monitor is also a tool used to monitor a patient's vital signs in the form of heart rate , pulse, blood pressure, temperature and heart pulse shape continuously [10], [11].

In terms of patient monitoring, we know several parameters that are checked, these parameters include:

1. ECG is an examination of the electrical activity of the heart. This ECG examination also includes checking the

"Heart Rate" or the patient's heart rate in one minute.
2. Respiration is a check of the patient's breathing rhythm in one minute
3. Blood saturation / SpO2, is the oxygen level in the blood.
4. Tension / NIBP (Non Invasive Blood Pressure) / Blood pressure check. Temperature, body temperature examined patients.

ESP32 - CAM is a WiFi/Bluetooth development board with ESP32 microcontroller and camera. There are also a number of GPIOs available as well as connections for external antennas.

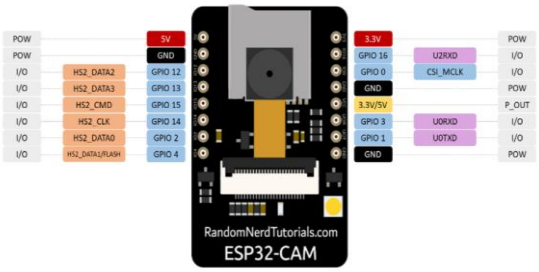

Figure 2. Esp32 Cam

ESP32 -CAM module is equipped with a camera to provide images or video [11], [12]. Meanwhile, the software configuration is via the Arduino IDE as the program editor and the web framework as the interface for displaying images from the ESP32 built-in camera [13]. The advantage of the ESP32 module with a built-in camera compared to the ESP8266, the ESP32 uses a NodeMCU used by the Xtensa DualCore 32-bit LX6 with 600 DMIPS. And the distance is approximately 5 meters with obstacles and approximately 10 meters with no obstacles.

Arduino Uno is one of the most popular microcontroller boards and is widely used in various electronic applications and Internet of Things (IoT) projects. The Arduino Uno uses an ATmega328P microprocessor and has a number of digital and analog input/output pins that can be programmed according to application needs.

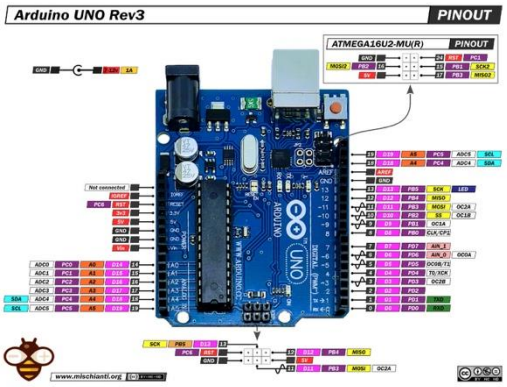

Figure 3 . Arduino Uno

In the remote monitoring and control system for patient monitors, Arduino Uno acts as the main controller that receives commands from Android devices via Bluetooth communication [14]. This command is then executed by the Arduino Uno to control components such as servo motors and gearbox motors connected to it.

Arduino Uno is used to control sensors installed on the patient and send the data to a web application via WiFi or Ethernet communication [15].

II. RESEARCH METHODOLOGY

The research method for the Esp32 cam wireless based patient monitoring device includes hardware design and software design. Systematically the steps in this research:

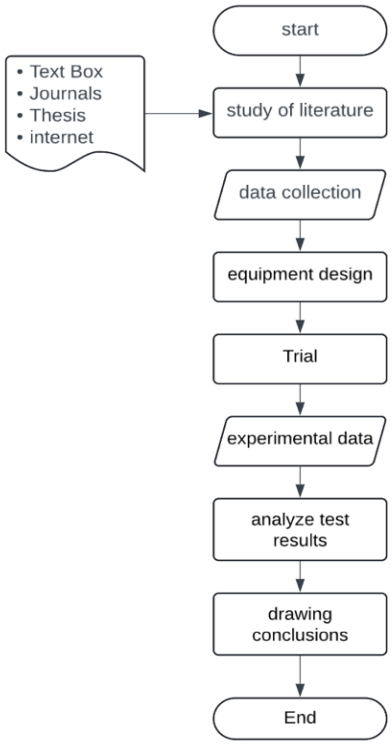

Figure 4. Research flow diagram

a. Hardware Design (Hardware)

The conceptual framework and research design from:

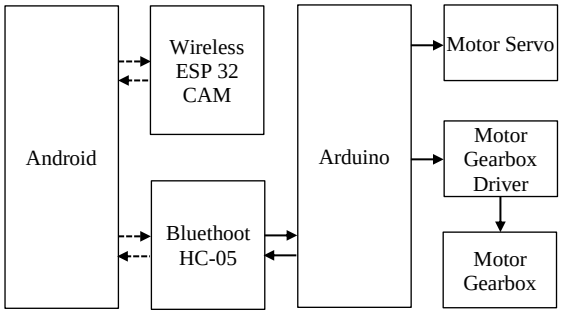

Figure 5. Diagram Block

The ESP32 CAM wireless functions as a device that takes images on the patient monitor screen, the captured images are forwarded to the Android device via wireless, apart from the image data the Android device is also connected to the Arduino Uno device via a Bluetooth connection using the HC-05 module.

The message received from the Android device will then be forwarded by Arduino to drive the gearbox and servo motor, each of which has a different function and work. The gearbox motor is used to move the rotary switch which is used to select the menu on patient monitoring device, while the servo motor functions as a device that will press the "OK"/"Enter" button on the rotary switch when the menu has been selected. All commands/controls are carried out via an Android device with the aim of making it easier for health workers and doctors to control and manage the patient monitoring equipment without being in the treatment room, thereby reducing the risk of exposure to nosocomial infections.

b. Software Design (Software)

Software design includes programs that are used as support in the system in this research, including:

1. *Flow Chart and Circuit Explanation as follows:*

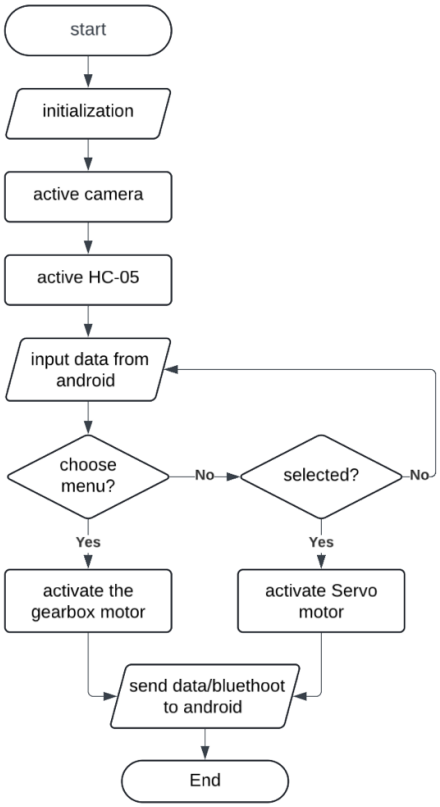

Figure 6. circuit Flow chart

After initializing and activating the ESP32 Cam device and the HC-05 Bluetooth module, the program will then read commands from Android via Bluetooth communication. Command data in the form of menu selection or selected

menus will be translated by the microcontroller to activate the gearbox or servo motor device according to the command received by the Arduino microcontroller. All command activities are sent back to Android as verification that the command has been carried out.

The images captured by the ESP32-Cam device will also be sent to the Android device in real time.

2. *Flowcard and application explanation as follows:*

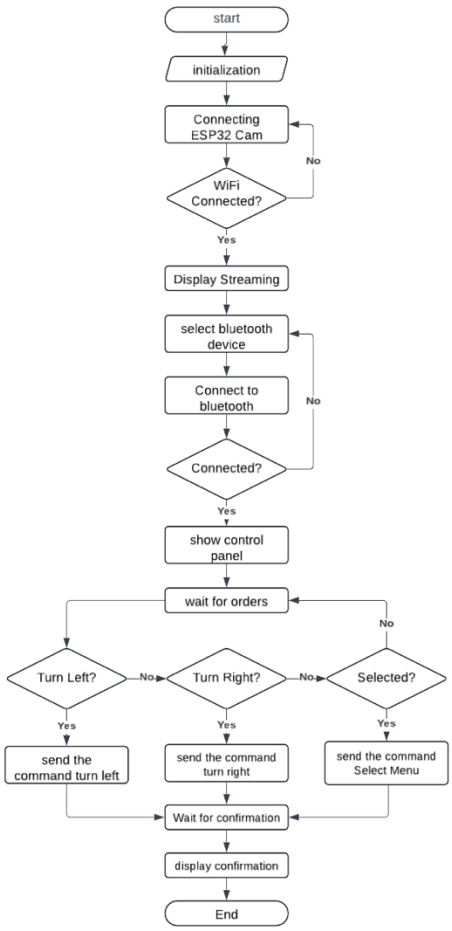

Figure 7. Application flow cart

When the application starts running, WiFi and Bluetooth initialization is carried out, then the program will try to connect to the ESP32-Cam device via a WiFi connection. If the connection is successful, the camera streaming process will be displayed on the Android screen. Next, the program will display the Bluetooth option on the screen and will connect to the selected HC-05 Bluetooth device.

The control panel, namely "turn left" and "turn right" along with the "OK"/option button will be displayed on the Android screen after the Bluetooth connection has been successful. Next, the program will wait for commands from the user and will send commands to the HC-05 device via Bluetooth. All commands that have been carried out will be sent back by the HC-05 as confirmation and will be displayed on the Android screen.

III. RESULTS AND DISCUSSION

a. Schematic of the entire device circuit

Figure 7 shows the entire system circuit for the patient monitor device. Where all circuits and outputs will be integrated with a microcontroller as the controller:

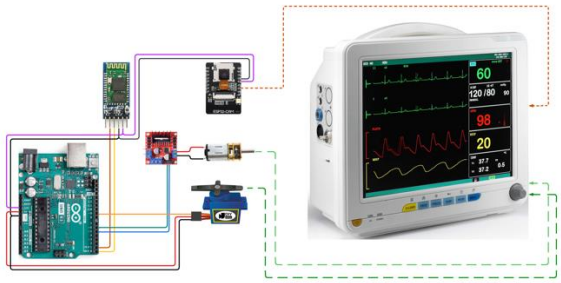

Figure 8. Overall series of tools

The wiring connections can be seen in the circuit in Figure 7 above. When supplied, the ESP32-Cam will pair with an Android device via a WiFi network by adjusting the ID and password. Once connected, the ESP32-Cam will send images from the patient monitor screen to Android. Next, the Bluetooth connection process will also work, where if it is successfully connected, commands from the Android device can be carried out. Commands from the Android device received by the Bluetooth BC-05 will be translated and then forwarded to the Arduino device as a data processor, where the command data received will be forwarded to the motor gearbox device, namely left rotation or right rotation via the motor driver to turn the rotary switch on patient monitor, as well as moving the servo motor to press the "OK" button on the

patient monitor as a sign that the menu on the patient monitor has been selected.

The entire process on the monitor screen will be captured by the ESP32-Cam and then the screenshot will be forwarded to the Android device via WiFi signal

b. ESP32 CAM Schematic In Flashing Mode

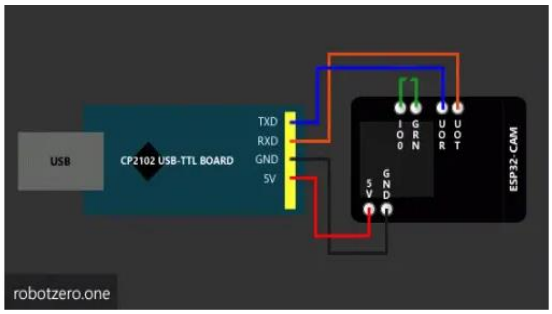

Figure 9. ESP32-Cam circuit

To perform *flashing mode* , connect the RX & TX serial pins on the USB TTL module to the TX & RX serial pins of the ESP32 Cam, connect the GPI0 pin to *Ground* , and connect it to the POWER pin at 5V. And before *uploading* the program, it is necessary to press the reset button on the ESP32 CAM board.

c. Tool Parts:

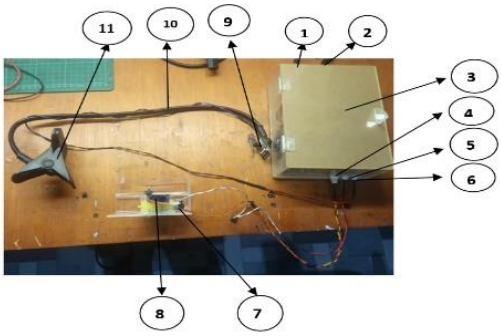

Figure 12. Tool parts

Information:

1. AC 220V power cable port
2. Switch
3. Box for components
4. Servo Motor PWM, VCC and GND cable sockets
5. Gearbox motor cable socket
6. Esp32 Cam VCC and GND cable sockets
7. Gearbox motors
8. Servo motors
9. Esp32 Cam Camera Module
10. Camera flexible handle
11. Camera stand clip

d. Parts of the application

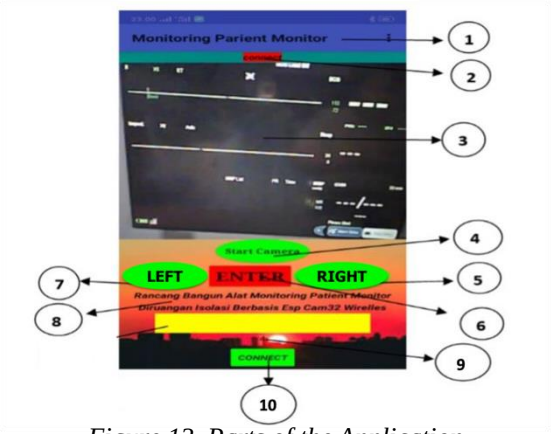

Figure 13. Parts of the Application

Information:

1. Application toolbars
2. Bluetooth indicator when connected
3. The results of the Esp32 cam display what he recorded
4. Camera Start Button
5. Right direction menu selection button
6. Enter button if the menu selection/setting is appropriate
7. Left menu selection button.
8. Tool title
9. Button indicators
10. Bluetooth connection search-HC05

Application image results if a distance of 3 meters exists and there are no obstacles.

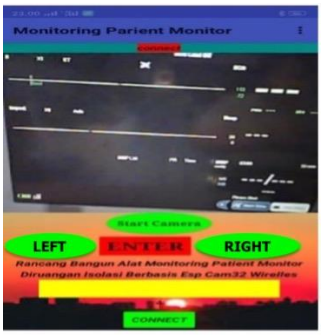

Figure 13. application at a distance of 3 meters

Application image results if the distance is 8 meters and there are no obstacles.

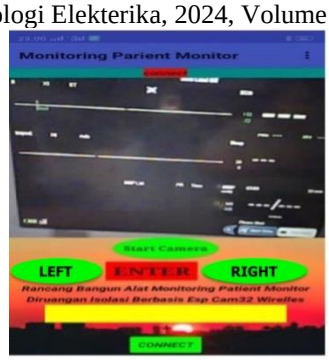

Figure 14. Application at a distance of 8 meters

If the Esp32-Cam module is not connected to the internet or the hostspot that has been set with the ESP32-cam.

Figure 15. Results of the application image on application no connection

The image in the application, if the Hc-05 Bluetooth is not connected either from the smartphone device or the application, then the writing in the application directly above the monitoring image is *Not Connected* and displays the message " *error 515: not connected to a Bluetooth device".*

Figure 16. Application image results if the HC-05 Bluetooth module is not connected

IV. CONLUSIONS & SUGGESTIONS

Conclusion

remote monitoring and control tools for ESP32-CAM based patient monitoring devices is able to provide an effective solution to reduce the risk of exposure to nosocomial infections for medical personnel working in isolation rooms. By using ESP32-CAM for real-time image monitoring via WiFi and Arduino UNO with a Bluetooth HC-05 module for physical control connected to an Android device, this tool allows doctors and nurses to monitor and control patient vital parameters remotely.

Test results show that the ESP32-CAM is capable of providing images with 2 megapixel quality and a stable WiFi connection distance, while the HC-05 Bluetooth module has a range of 1 to 8 meters in open spaces, sufficient for operational needs in a hospital environment. The use of gearbox motors and servo motors to control menus on patient monitoring devices has also been proven to be effective and accurate.

Overall, this tool offers convenience and safety for medical personnel in operating patient monitoring devices in isolation rooms, while increasing work efficiency and quality of health services. It is hoped that this innovation can be widely applied in health facilities to provide significant benefits in treating patients, especially during a pandemic or in conditions of other infectious diseases.

Suggestions

The authors realize that this research is far from perfect, so for the further development of patient monitors and remote control devices based on ESP32-CAM, the following are some suggestions that can be considered:

- Better image quality and connectivity:

  Consider using a camera module with a higher resolution to improve the quality of the resulting images.

Evaluation and improvement of the WiFi module to ensure more stable connectivity and wider coverage in various hospital environmental conditions.

- Battery usage and power consumption:

  Use longer-lasting batteries or wireless charging technology to ensure devices can work without interruption.

  Optimize the power consumption of each component to make it more efficient, especially when used for long periods of time.

- Additional sensor integration:

  Add additional sensors such as temperature, humidity, or heart rate sensors that can provide more complete data about the patient's condition.

  Integration with other sensors can increase the device's functionality in monitoring various patient vital parameters simultaneously.

THANK-YOU NOTE

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