Journal of Industrial Automation and Electrical Engineering
Vol. 01, No. 01, June 2024, pp. 39~45

Design and Implementation of Robot Abu Robocon Using Joystik Wireless Based on Extrasenory Percepsion

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Article Info

Article history:

Received March 10, 2024
Revised April 08, 2024
Accepted May 15, 2024

Keywords:

ABU Robocon
Extrasenory Percepsion
Arduino
Wireless
Joystick

ABSTRACT

The development of technology, particularly in the field of robotics, is increasingly influencing various aspects of life, including the organization of robot contests which are attracting more participants. The Indonesian Robot Contest (KRI) and the ABU Robocon Indonesia Robot Contest (KRAI) are competitions involving broad participation from across the Asia Pacific. Robots in these competitions are controlled using instructions from operators, where the use of wireless joysticks has become very common to enhance control efficiency. However, in practice, issues such as signal connection loss often occur, especially when using PlayStation 2 joysticks with limited signal range. This study aims to develop a more stable remote control system using an ATmega 2560 microcontroller and an ESP32 to provide Bluetooth signals. The research method used is experimental, including the stages of analysis, design, implementation, and evaluation. The results show that the control system with an ESP-based PS4 joystick can increase the control range up to 15 meters with more stable connectivity compared to the previous system. Testing also indicates that precise IP address assignment can prevent signal interference from other devices, making this system effective for use in robotics competitions.

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1. INTRODUCTION

Aspects of life are influenced by technological developments, especially in the field of robotics [1]. This is proven by the many robot contests that are held and the number of participants who take part in the competition increases from year to year. The Indonesian Robot Contest (KRI) is a competition held by the Ministry of Education, Culture, Research, and Technology (Kemendikbudristek) as a university-level robot competition [2]. KRAI (ABU Robocon Indonesia Robot Contest) is an annual competition held by the national achievement center with participation from all over the Asia Pacific region [3]-[4]. The 2024 ABU Robocon Contest uses two robots, namely a robot that is manually controlled by an operator and a robot that works automatically using sensors. Both robots contribute to winning the match in planting rice and moving balls.

Robots are designed with controls so that they can work according to instructions [5]. Robots are controlled by instructions from the operator as a form of human language with robots, to be more efficient it is necessary to use more practical tools, for example wireless joysticks [6]. The use of Joysticks in this era is very common, one of which is used as the main controller that can make it easier for users to control robots [7]. In 2020, research made a rifle control using a joystick based on the ATmega32 microcontroller with the NRF24l01 module as a data sender to the ATmega32. The ATmega32 will process input data from the

joystick to move the servo motor as desired [8]. During the Indonesian Abu Robot Contest (KRAI) competition, many still used the PlayStation 2 Joystick control to control wirelessly with limited receiver signal distances of only 10 M [9]. In 2022, the KRAI team encountered problems with the joystick connection used. The obstacle that occurred during the competition was the disconnection of the Joystick signal connection with the robot, so that the robot could not be controlled. The ABU Robocon contest uses two robots that contribute to each other to win the match and of course both use the same controls, because they use the same joystick, the connection between the joysticks is often exchanged because the receivers used have the same signal [10].

Therefore, the author wants to develop a further communication distance between the robot and the controller to control the actuator components on the robot wirelessly extrasensory perception so that robot control is more stable with many devices and a longer distance. The development is focused on the manual ABU Robocon robot which will be competed in KRAI 2024. Control is carried out using a microcontroller with the ATmega 2560 chipset [11] as the controller center. To provide a Bluetooth signal to the microcontroller, ESP32 is used [12].

2. METHOD

The research method used to collect data from the tool experiment uses the experimental method [13]. The research stages must be explained so that the research process can take place systematically and measurably [14]. This study began with analysis, design, implementation and evaluation. It all starts with collecting materials according to sturdy factory standards, then selecting actuator components that match the robot's functional motion so that they can be controlled. Reading the theory related to the components used and starting to assemble the robot. Figure 1 shows a block diagram of the ABU Robocon 2024 robot system. A block diagram is a diagrammatic explanation of the working system to simplify the understanding of the structure and function of a system or process [15]-[16].

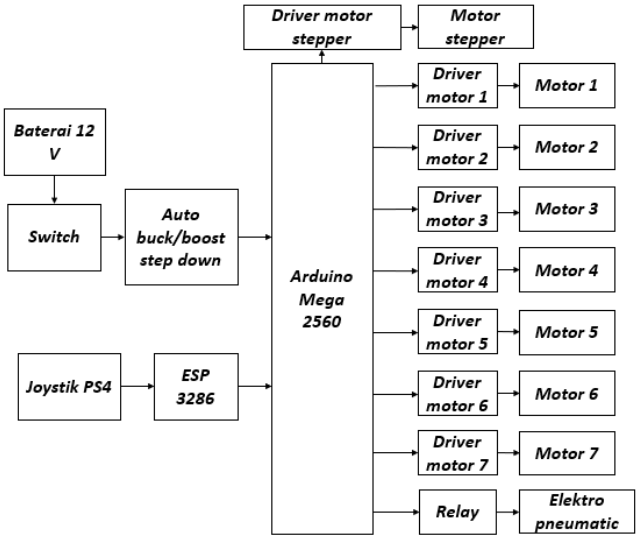

Figure 1. Diagram block of ABU Robocon

Figure 1 shows that the ABU Robocon Robot consists of several components, namely: 1) The PS4 joystick is used as a control for moving components on the wireless-based ABU Robocon robot using a wifi communication signal via esp 3286, 2) Esp 3286 is used to provide a bluetooth signal to the PS4 joystick so that it can be connected to the Arduino mega 2560 microcontroller, 3) The Arduino Mega 2560 microcontroller is used to determine which actuator components on the ABU Robocon robot can be controlled, 4) The battery is a power supply that can provide electrical energy to electrical devices. The battery is used to supply electricity to the Arduino mega and components that require a power source such as motors, electro pneumatics, and steppers, 5) Switches are used to disconnect and connect the power source from the battery to the electrical circuit on the robot, 6) Auto Buck / Boost Step Down functions to reduce the voltage of 12 Volts to a voltage range of 5 Volts to be transmitted to the Arduino and ESP, 7) Motor drivers are used to change the direction of motor rotation to forward and reverse so that the robot can move forward or backward, 8) Motors are the main components of robot drives so that the robot can move places, 9)

Steppers are DC motors that can rotate according to the rotation control at each stage, 10) Relays are used to switch between pneumatics and power sources. If the relay is given voltage, it will provide a power source to the pneumatic so that the pneumatic is in working condition, and 11) Pneumatics are used to clamp objects that will be taken by the robot with air pressure actuation. All components are assembled according to the shape and size of the ABU Robocon robot that has been determined by the national achievement center in KRAI 2024. Figure 2 shows the design of the ABU Robocon robot made in this study.

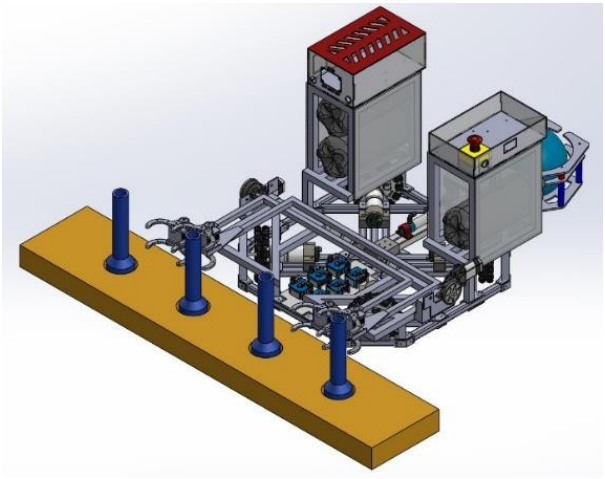

Figure 2. Mechanical design of ABU Robocon

After the robot frame is finished, the next step is assembling the circuit using a PCB circuit board. The circuit plays an important role in a moving object such as a robot. In the process of assembling the electrical circuit on the robot, a schematic diagram of the circuit is needed, which is shown in Figure 3.

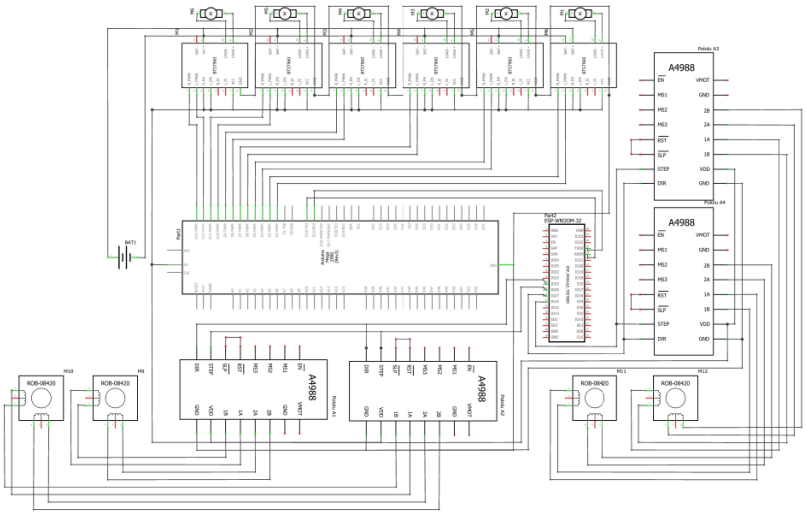

Figure 3. Robot electronics circuit

Next, the ABU Robocon robot that has been assembled and equipped with a circuit is programmed using Arduino IDE software because the microcontroller used is the Arduino AT mega 2560 type. The programming language used in Arduino IDE is C language. The program input is given from the activation of the joystick button to run the actuator on the robot wirelessly. The control of the ABU Robocon robot is designed wirelessly which can be controlled remotely. When the activation signal is activated via the wireless joystick to the ESP 3286, then this data will be sent to the ATmega 2560 microcontroller, then the robot will move according to the command that has been made using the C language on the ATmega 2560 microcontroller. Then the microcontroller will provide data to the actuator to be active so that the actuator components on the robot can be controlled via the joystick. Reading serial data due to activation of the joystick button affects the movement of the robot which is different for each button. The moving component will receive digital data from the joystick via the ESP intermediary. this digital data will be forwarded to the ATmega 2560 microcontroller and processed by the actuator. Each button has its own function. Figure 4 shows the flowchart of the ABU robocon 2024 robot system created in this study.

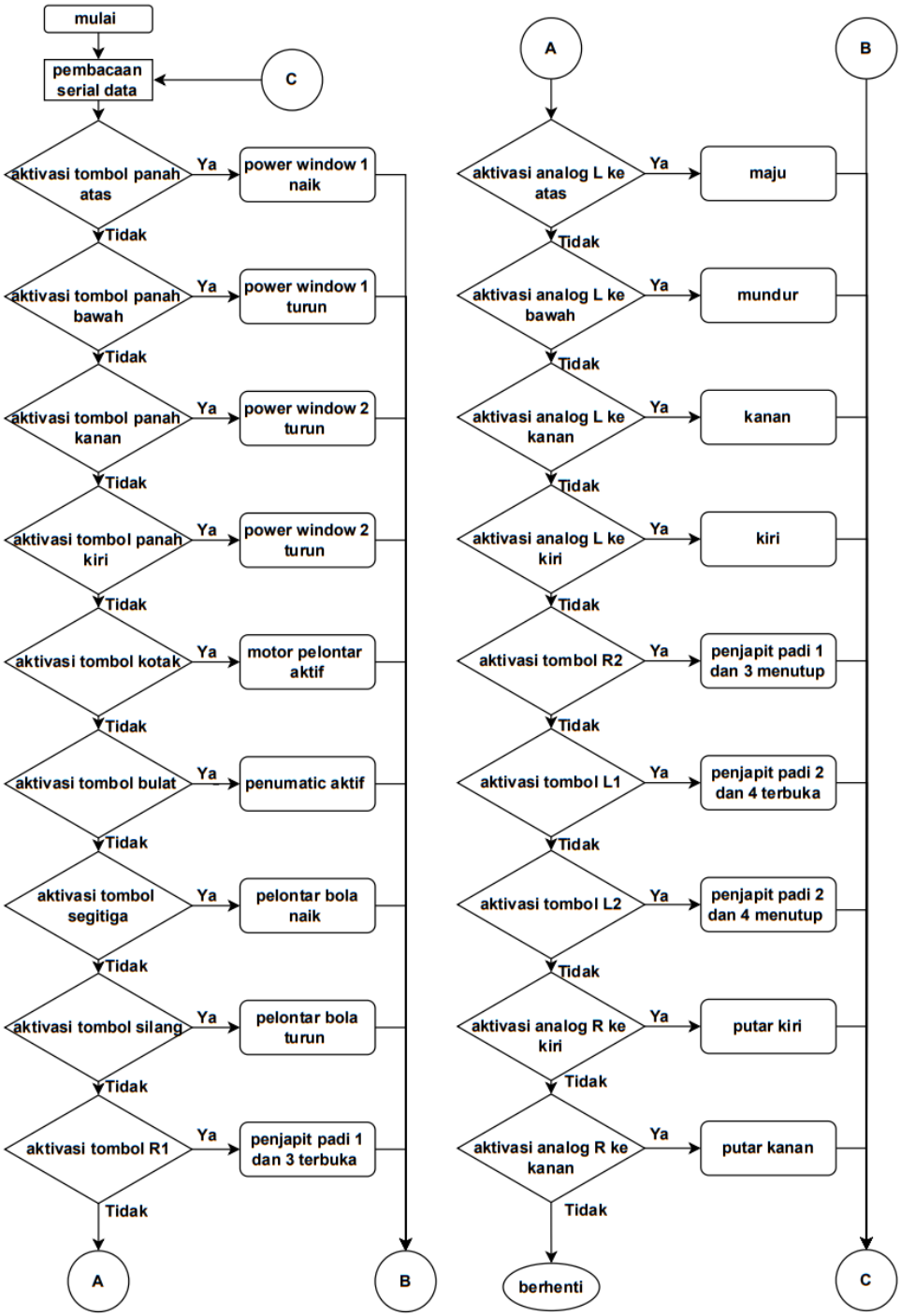

Figure 4. Flowchart

3. RESULTS AND DISCUSSION

The result of this tool is a robot used for the Indonesian Robot Contest in the Indonesian Abu Robot Contest Division. This robot is likened to planting rice and harvesting rice with materials made in such a way as to resemble rice. For rice seeds, they are replaced using balls. The ABU Robocon robot moves to plant rice using 4 hands and one hand to take rice seeds (balls). Figure 5 shows the shape of the ABU Robocon 2024 robot. Figure 5 shows the front and side views of the robot.

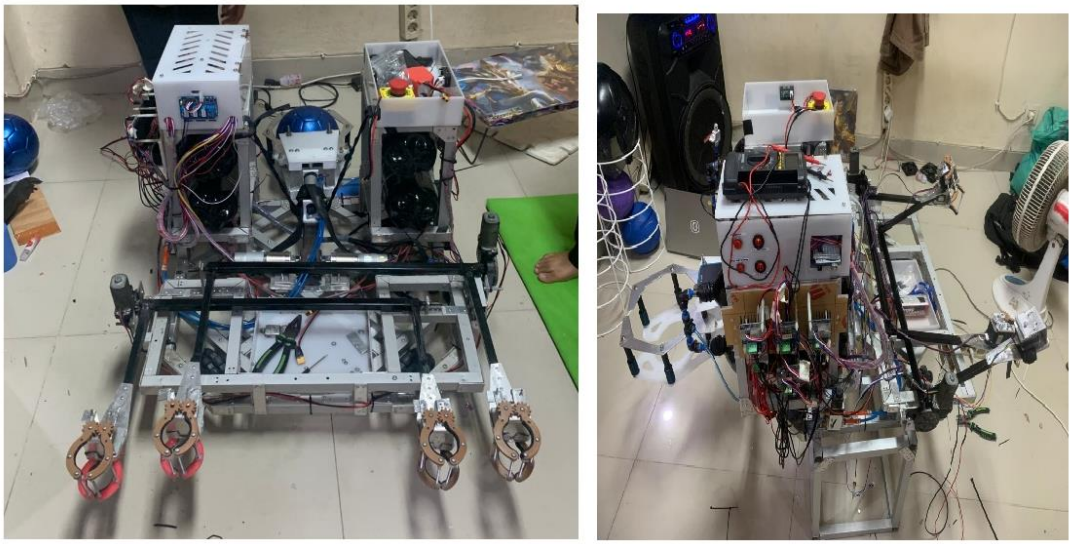

Figure 5. The results of making the robot, front view and side view

After the mechanics are finished, electrical testing is carried out with the aim of ensuring that the electrical components receive a supply according to the specified specifications. System program testing is carried out with the aim that the components used can work according to their functions. Testing is carried out to ensure that the drive components have been activated with the program that has been entered into the microcontroller. The test method can be carried out by activating all joystick buttons alternately. Figure 6 shows the appearance of the joystick along with its description. Testing the joystick button function on the ABU Robocn robot is described in Table 1 below.

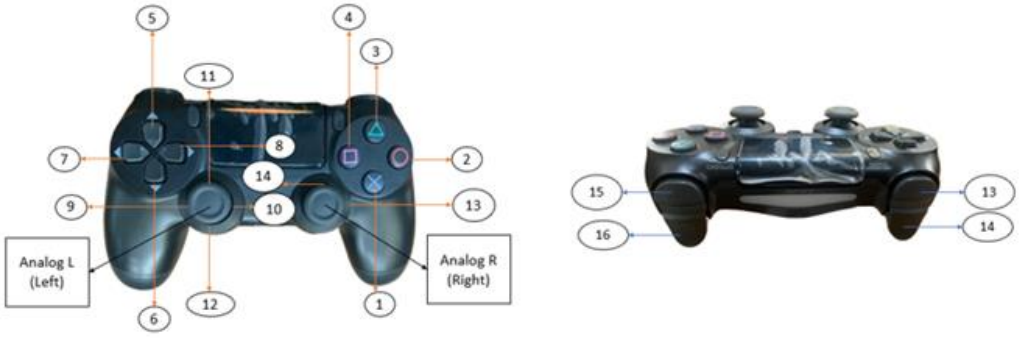

Figure 5. Joystick

Table 1. Testing the function of each joystick button

No	Joystick button	Robot activity	Testing Results
1	X	Thrower's hand goes down	Succeed
2	O	Shooter relay on throwing hand on	Succeed
3	Δ	Shooter's relay on thrower's hand goes up	Succeed
4	□	Thrower's hand throws	Succeed
5	Up arrow	Power window 1 goes up	Succeed
6	Down arrow	Power window 1 goes down	Succeed
7	Left arrow	Power window 2 goes up	Succeed
8	Right arrow	Power window 2 goes down	Succeed
9	Analog L to the left	Robot moves left	Succeed
10	Analog L to the right	Robot moves right	Succeed
11	Analog L to the top	Robot moves forward	Succeed
12	Analog L to the bottom	Robot moves backward	Succeed
13	Analog R to the right	Robot rotates right	Succeed
14	Analog R to the left	Robot rotates left	Succeed
15	R1	Upper hand opens	Succeed
16	R2	Lower hand opens	Succeed
17	L1	Upper hand closes	Succeed
18	L2	Lower hand closes	Succeed

After all the buttons have functioned properly, then a connectivity test is carried out on the wireless-based joystick signal by providing a distance between the joystick and the robot. The test results can be written in Table 2.

Table 2. Joystick testing based on distance

Distance (m)	Experimental status	Delay (ms)	Testing Results
1	Activate all buttons	0,05	Succeed
2	Activate all buttons	0,05	Succeed
3	Activate all buttons	0,05	Succeed
4	Activate all buttons	0,05	Succeed
5	Activate all buttons	0,05	Succeed
6	Activate all buttons	0,05	Succeed
7	Activate all buttons	0,05	Succeed
8	Activate all buttons	0,05	Succeed
9	Activate all buttons	0,05	Succeed
10	Activate all buttons	0,05	Succeed
11	Activate all buttons	0,05	Succeed
12	Activate all buttons	0,05	Succeed
13	Activate all buttons	0,05	Succeed
14	Activate all buttons	0,05	Succeed
15	Activate all buttons	0,05	Succeed

Based on the test results, it can be analyzed that the wireless joystick has a stable connectivity with a delay of 0.05 seconds due to the data transfer connection from the ESP to the AT Mega 2560. The responsiveness of the joystick is more sensitive compared to the previous wireless joystick whose connectivity is easily disturbed. In addition to a stable signal, addressing on the ESP-based joystick is very influential and effective in getting interference from other devices' Bluetooth signals. This is proven in testing 2 devices that are given the same address and different addresses. Table 3 shows the results of the ESP-based wireless joystick addressing test.

Table 3. ESP based wireless joystick addressing

Devices	IP address	connection status	Testing Results
1 and 2	b8:d6:1a:a7:2e:af	connected	Succeed
1	b8:d6:1a:a7:2e:af	connected	Succeed
2	b8:d6:2a:a8:2e:af	not connected	Succeed

Based on the data in table 4, it can be analyzed that ESP-based wireless joystick addressing is effective for use in situations with many signals, especially in the Indonesian robot contest. All participants will use the same control, by using IP Address addressing, the joystick signal will not be disturbed by other joystick signals. To provide IP addresses using the sixaxis pair tool software. The test results show that the ABU Robocon Robot created in this study has worked well according to the expected goals. The robot can be controlled using a wireless joystick based on Extrasenory Perception.

4. CONCLUSION

From the results of the research conducted, it can be concluded that ESP-based wireless joysticks are more effective for remote robot control, this is evident from the distance of the joystick connection to the robot which exceeds the distance from previous research, where the distance of the wemos-based wireless joystick used is only a maximum of 10 M while the Extrasenory Perception-based wireless joystick can be connected up to a distance of 15 M. In addition to distance, the advantage is the addressing of the joystick with the microcontroller so that the connection signal is not misdirected and does not interfere with other signals. This is evidenced by the provision of the same IP Address and different IP Addresses. The test results prove that the same IP Address will be connected to the microcontroller, if the IP Address is different it will not be connected to the microcontroller. This tool can be used in the Indonesian robot contest or the ABU Robocon competition event.

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