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Automatic roof prototype on aviary with telegram-based monitoring

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ABSTRACT

Aviary is a large enclosure containing animals and plants for decoration or livestock and made in such a way as their natural habitat out there. Considering that Indonesia has a wet tropical climate, rain can fall at any time and this is very influential for the aviary because the more often it is exposed to rain, the aviary will become damp, which will hurt existing animals and plants. Based on these problems and literacy in previous journals, this research was finally carried out with the aim of making a roof for the aviary and updating it, namely an automatic roof with telegram-based monitoring.

1. Introduction

Some people may not know what an aviary is and even sound foreign to their ears, but for some people who have been involved in the world of flora and fauna for a long time, the aviary is nothing new. Aviary is a large enclosure and contains various kinds of plants and animals with environmental conditions made similar to the forest out there. It is intended that the flora and fauna in the aviary can live and develop perfectly as in their natural ecosystem[1].

Success in developing an aviary so that the flora and fauna in it can live and develop perfectly has several supporting factors both internally and externally, internal factors such as the quality of the feed and fertilizer provided while external factors such as the weather conditions faced by the aviary considering that Indonesia is a country that has Wet tropical climate where it rains more often so this also needs to be watched out for[2].

Based on observations in the field there are still many aviaries that do not have a roof as a protection from the heat and rain that hit the aviaries. When the rainfall is heavy enough, the inside of the aviary will become a pool of water which can disturb the animals and plants in the aviary. Based on this, it is used as a source of problems in this study.

The automatic roof is one of the innovations resulting from the development of previous research which began with a roof that can be opened or closed manually using a pulley, then developed using a microcontroller as a control so that the roof can be opened and closed automatically with commands through various sensors [3][4][5]. As technology develops, in the end, the automatic roof is developed better, that is, it can be controlled via IoT and can be done remotely wherever we are

2. The Proposed Method

In this study, research and development (R&D) research methods were used with the aim of updating and developing previous research by analyzing previous research to make improvements and updates so that new results were obtained that were effective and functioned in the wider community[6]. In this chapter, there are 3 processes, namely making block diagrams, compiling flowcharts and the last is designing the wiring diagrams that will be used. Each process has a different goal, but in the end, these three processes are continuous with the ultimate goal being to make a prototype that can run smoothly. effective and beneficial to the wider community.

2.1. Block Diagram System

A research block diagram was made to facilitate the design and manufacture of tools, the following is a block diagram of this study:

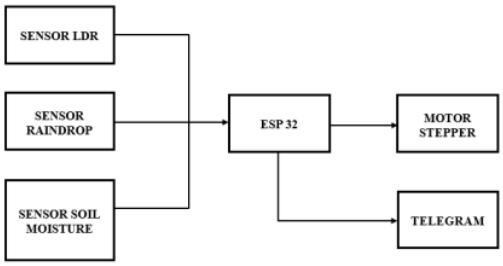

Fig.1. System Block Diagram

2.2. System Flowcharts

A flowchart is a flowchart of research from the beginning of the process to the end which is made to facilitate the research process. The following is the flowchart of the research:

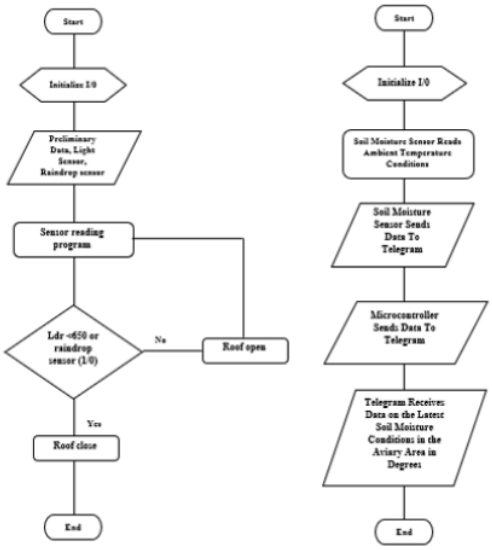

Fig.2. System Flowcharts

The flowchart on the left is the flowchart of the entire device starting from the start condition, then initializing (giving initial values) to the input and output. All input components are given a value limit, and the light intensity sensor / LDR is given a value between zero and hundred to detect whether or

not light is received. The rain sensor is also given a value limit between zero and one to detect whether or not rainwater occurs during the test. Furthermore, the sensor will read the surrounding conditions and forward them to the microcontroller, namely ESP 32 to be processed.

The data from the microcontroller processing will proceed to the output when the data detect cloudy conditions or rain[7]. Furthermore, the stepper motor will rotate which makes the roof close, and at that moment the microcontroller will provide a notification in the form of a message to the user via the connected telegram bot and the program is complete. When the data received by the microcontroller does not show cloudy conditions or rain, the microcontroller will return feedback to the sensor to read the sensor again, and so on.

The flowchart on the right is a flowchart of a series of soil moisture monitoring which begins with a start, then initialization, and continues with the sensor reading the condition of soil moisture in the aviary. The reading results by the sensor will be forwarded to the microcontroller. Furthermore, the microcontroller will provide a notification in the form of a message to the user via the telegram bot that has been connected and the program is complete.

2.3. Wiring Diagram

Wiring diagram of the automatic roof circuit on the aviary with telegram-based monitoring as follows:

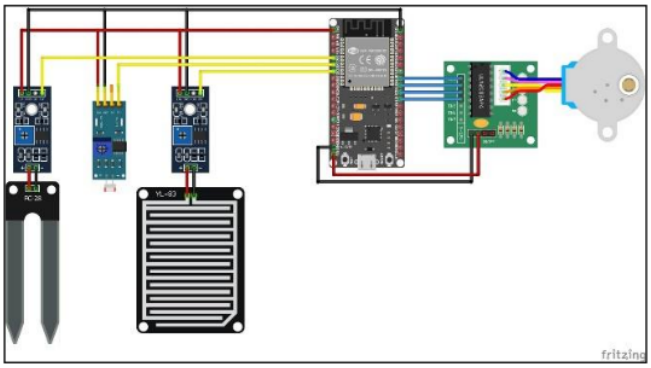

Fig.3. Wiring Diagram

In the circuit picture above there are several components that are used with their uses as follows:

- Soil moisture sensor as a component of measuring soil moisture levels in the aviary
- The LDR sensor is used as a light intensity detection, the less light that is captured, it will be implemented as cloudy conditions and vice versa
- The raindrop sensor is used for rain detection, when the sensor board is exposed to water droplets, the sensor will send data that the current conditions are raining
- The ESP32 microcontroller is used as the brain of the circuit, its job is to process the data received by the sensor and then forward it to the output components. This microcontroller will be connected to wifi so that it can be connected to Telegram[8].
- The ULN2003 motor driver is used as a module for the stepper motor, power for the stepper motor will be input through this module.
- The 28BYJ-48 stepper motor is used as the output which will rotate to drive the gearbox so that the roof can be opened and closed.

The pin addresses of each connected component can be seen in the following table:

Table1. Component Pin Addresses

No	Component	Component Pin Addresses	NodeMCU ESP32 Pin Addresses
1.	Stepper motors	Go directly to the ULN2003 module	-
2.	ULN2003 module	IN 1	D19
		IN 2	D18
		IN 3	D5
		IN 4	TX2
		VIN+	VIN
		VIN -	GND
3.	LDR sensors	A0	D35
		VCC	3V3
		GND	GND
4.	Soil moisture sensor	A0	D34
		VCC	3V3
		GND	GND
5.	Rain Sensor	A0	D32
		VCC	3V3
		GND	GND

3. Research methods

In this sub-chapter, the design and manufacture of tools begin, which consists of 3 processes, namely system design, tool design, and telegram bot design, all processes are carried out in stages so that it is easy to design tools from start to finish.

3.1. System planning

The system design contains the general architecture along with its explanation of the input stage, data processing stage, and finally the output stage.

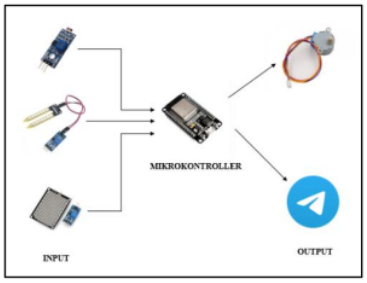

Fig.4. General Architecture

In the input section, there are 3 components in the form of a light intensity sensor which functions to detect sunlight around the aviary, then a soil moisture sensor which functions as a measuring instrument for soil moisture in the aviary and the last is a rain detection sensor which functions to detect whether or not it is raining around the aviary[9][10].

The data processing section is in the form of a microcontroller that is used, namely esp 32 which functions as a communication tool between all components and as a data processor that is received from the input section as well as command messages from the connected telegram bot. Processed data will be forwarded by the microcontroller to the output stage as the last action of this series.

The output part is a stepper motor with type 28BYJ-48 which functions as a gear drive to run the roof so that it can be closed according to the program that has been set[11]. Besides that, in the output section, there is also a telegram bot that is used for monitoring the entire series of tools[12].

3.2. Tool Design

The design of an automatic garage roofing device on an aviary with telegram-based monitoring is as follows:

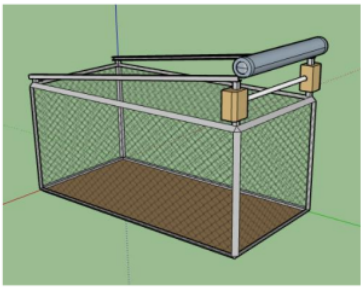

Fig.5. Tool Design

In the picture above you can see the design of the tool from the left side, the part covered by the net is an implementation of the aviary. Then at the top, there is a rail as a roof base which is used as a cover for the aviary, at the back of the aviary there is a box that is used as a place for the motor and the components used.

3.3. Telegram Bot Design

Telegram bots are a form of robot that can send messages or commands repeatedly on a device automatically, besides that bots are also used as a monitoring tool in a tool or research so that admins can monitor in real time[13]. The design of the telegram bot is carried out at the final stage when all processes have been carried out, according to the capabilities possessed, the telegram bot is used as a monitoring of the automatic roof prototype on the aviary.

The initial stage in the process of making a telegram bot is through the bot father which is available in the telegram application. BotFather will provide instructions to provide a name and username for the bot that will be created[14]. Then BotFather will provide an access token which will later be connected to the microcontroller in the Arduino IDE application

The making of the telegram bot has not been completed, the next step is to retrieve the bot id that was created in the ID Bot application which will also be used when connecting the telegram bot with the microcontroller in the Arduino IDE application so that the telegram bot can receive notifications and send commands to the device to be assembled[15][16]. When connected and programmed, the bot can be accessed by searching on the search and entering the appropriate bot name when creating it in the initial process.

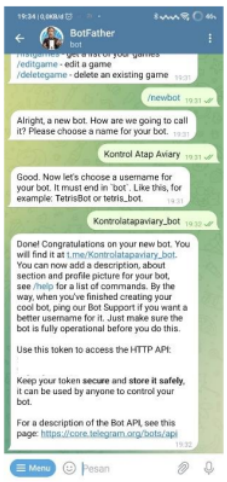

Fig.6. BotFather view

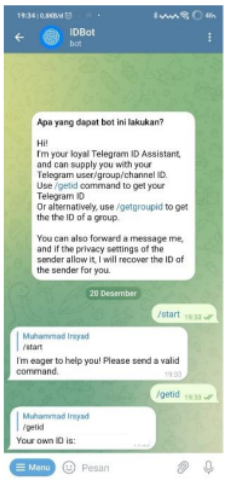

Fig.7.IDBot view

Fig.8. Made bots

4. Results and Discussion

In this study, several tests were carried out from the beginning to the end of the study with the aim that the resulting tools could work optimally. Following are some of the tests carried out:

4.1. Component Testing

Component testing was carried out at the beginning of the study when assembling components, tests were carried out on all components used to know that the components used were in good condition. The test results can be seen in the following table:

Table2. Component Testing Table

NO	COMPONENT	WORKING (YES/NO)
1	ESP32 microcontroller	Yes
2	Light detection sensor	Yes
3	Rain detection sensor	Yes
4	Soil moisture sensor	Yes
5	2003 ULN motor drivers	Yes
6	Stepper Motors 28BYJ – 28	Yes

4.2. Telegram Bot Testing

Telegram bot testing also needs to be done so that when used there are no problems. Testing is carried out after the telegram bot is made and programmed with the microcontroller used so that the bot can be known between the telegram bot and the microcontroller used whether it is connected or not. The test results can be seen in the following figure

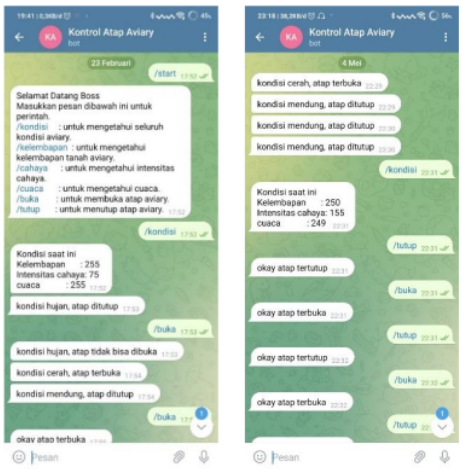

Fig.9. Telegram Bot Testing

The picture above is the initial appearance of the bot with various commands that have been set when making the bot. When given the / start command, a reply message will be given which gives several command menus. Then the picture shows the command/condition so the user will get a reply message in the form of the overall condition of the aviary, when it rains the roof will automatically close and the user will get a notification message namely "rain conditions, roof closed" and at that time when the command/open is entered then the user will get a notification that "rain conditions, the roof cannot be opened". When it's cloudy, the roof will automatically close, but users can still open it as long as no rain is detected.

4.3. Overall Testing Tool

Testing of the entire tool is carried out after the tool has been assembled, the test is carried out starting by providing the required inrush current. The logic of testing the entire tool can be seen in the following table:

Weather conditions tested: Sunny, Overcast, Rainy, Sunny Rainy

table3. Test Logic Table

No	Condition	Roof	Telegram orders
1	Bright	Open	Can be opened & closed
2	Overcast	Closed	Can be opened
3	Rain	Closed	Can not be opened
4	Sunny Rain	Closed	Can not be opened

Condition 1 (Sunny)

The first experiment presented sunny weather conditions, simulated by giving light to the LDR sensor then the reading data was forwarded to the microcontroller which then gave a signal to open the roof because the conditions were sunny.

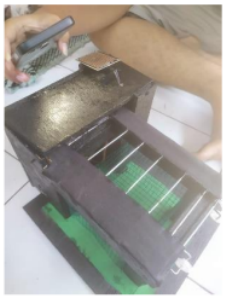

Fig. 10. Condition Sunny

Condition 2 (Cloudy)

The second experiment presents cloudy weather conditions, simulated by closing the LDR sensor so that the LDR sensor detects cloudy conditions. The experimental data will be forwarded to the microcontroller which will then give a signal to close the roof due to cloudy conditions. However, in this condition, the roof can still be opened as long as it doesn't rain by giving an open command to the telegram connected to the microcontroller so that the microcontroller will give orders to the stepper motor to open the roof.

Fig. 11. Condition Cloudy but roof can still be opened by telegram

Condition 3 (Rain)

The third experiment presented rainy weather conditions, simulated by giving water droplets to the rain sensor then the reading data was forwarded to the microcontroller which then gave a signal to close the roof because it was raining.

Fig. 12. Condition rain

Condition 4 (Sunny Rain)

The fourth experiment presented that the weather conditions were sunny but it was raining, simulated by giving light to the LDR sensor and water droplets on the rain sensor then the reading data was forwarded to the microcontroller which then gave a signal to close the roof because it was raining. In these weather conditions, the roof still cannot be opened even through a telegram command because in this condition the rain sensor is more important so as long as rain is detected the roof cannot be opened.

Fig. 13. Condition Sunny but is was raining

Soil moisture sensor experiment

The soil moisture sensor experiment is carried out by placing the sensor on the soil that has been provided, the sensor will detect moisture in the soil and the results will be sent to the user via telegram. The higher the water content in the soil, the value that appears on the telegram message will be high, while when the water content in the soil is low, the value that appears will be low.

Fig. 14. Notification moisture on telegram

5. Conclusion

Based on the research that has been carried out from the beginning to the end of the process, the following conclusions can be drawn:

1. The components used in this study are quite good, but for application in the field, tools and components that are of better quality than those currently used are needed.
2. In testing all weather conditions (cloudy, sunny, rainy, soil moisture) all sensors can work properly so that the microcontroller can process data according to the program.
3. The microcontroller can receive data and process it optimally.
4. More optimal research is needed for direct application in the field.

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