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Automatic Monitoring System in Fodder System for Livestock

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Abstract: The fodder system can provide food for a wide range of livestock used for milk and meat production. Hydroponically grown green fodder is made from forage grains that are germinated and grown for a short period inside special growing rooms with the proper growing conditions. However, a food shortage is happening because farmers are dependent on feeding their livestock with maize pellets. Some of them are trying to use green fodder, which requires them to harvest it weekly. Therefore, this project will be designed to monitor humidity and temperature to create a suitable environment for green maize fodder. The project starts by collecting materials reading, specifically the temperature and humidity of the surrounding environment. A water level sensor indicates the low amount of water in the tank. The average daily temperature in Malaysia is 21 to 32ºC and the relative humidity is 80.5%. So, if the reading of the temperature and humidity sensors is not in the range needed, then the water pump and cooling fan will turn on and vice versa. The sensors are expected to send data to the Raspberry Pi, which reads it and switches on the actuators when they receive a signal from the sensor or actuator as needed for temperature and humidity monitoring.

Keywords: Green Fodder System, Raspberry Pi, Hydroponic

1. Introduction

There is renewed interest in dairy and livestock production fodder systems. The pellet price has remained high and there is a shortage of forage supply because of the conditions in Malaysia. Alternatively, a grain such as maize, barley, wheat, or oats is sprouted in plastic trays and allowed to grow for seven days in a fodder system before being fed to livestock. A fodder system can provide food for a wide range of livestock used for milk and meat production. Green bean fodder has a high fiber content as well as a high energy density. It is one of the most cost-effective forages to grow in yield and energy value. Hydroponically grown green fodder is made from forage grains germinated and grown for a short period inside special growing rooms with the proper growing conditions. Depending on hay and grain feed costs, fodder can produce a higher quality feed for

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less money than traditional methods. The idea of creating a fodder system based on a smart garden with a smart plant monitoring system arises in the case of this situation.

The "smart agriculture revolution" refers to the use, integration, and deployment of the latest technologies such as the Internet of Things (IoT) in agriculture, intending to improve and increase the quantity and quality of crop harvest [1]. DHT11 monitors the humidity content and temperature of the fodder and controls the cooling fan and UV/LED light on the plant at regular intervals. The temperature and humidity inside the greenhouse were controlled through micro-sprinkler irrigation to maintain a range of 22 - 27ºC temperature and 70 - 80% relative humidity [2]. The Arduino interfaces for real-time monitoring of all the sensors in this project, assisted by the microcontroller atmega328p. Simultaneously, large-scale agriculture farms could be easily implemented and precisely monitored [1]. This value allows the system to use appropriate water to avoid over or under irrigation.

2. Irrigation System for Green Fodder

This project is to monitor the irrigation data for green bean fodder plants, where the data is kept on a personal web-based server. The project should be executed according to planned steps and phases to ensure the work is done in the best way possible. The project starts by collecting materials reading, specifically the temperature and humidity of the surrounding environment. A water level sensor indicates the low amount of water in the tank. Thus, temperature and humidity sensors were also connected to water pumps used to supply water to plants. The average daily temperature in Malaysia is 21 to 32ºC, and the relative humidity is 80.5%. The required temperature for the green bean plant is between 27 to 30ºC, or the humidity sensor detects 70 to 80% relative humidity. So, if the reading of the temperature and humidity sensors is not in the range needed, then the water pump and cooling fan will turn on and vice versa. Besides, the data collected from the temperature and humidity sensors will be recorded on the web-based server while sending a notification when the water level sensor measures the low water level in the tank. Figure 1 shows block Diagram of Automatic Plant Monitoring in Fodder System for Livestock.

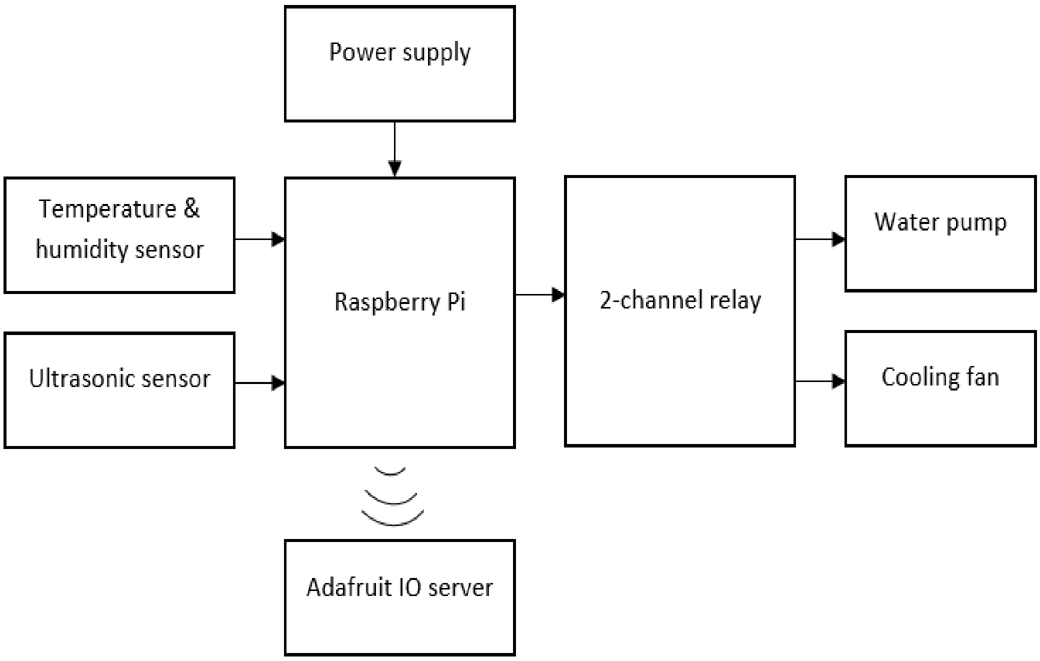

Figure 1: Block Diagram of Automatic Plant Monitoring in Fodder System for Livestock

3. Results and Discussion

The circuit simulation is being done using Fritzing software, where the number of processing units in its library can be used to determine the optimum need in terms of microcontroller, flash memory, and clock speed. The components are easier to get and manageable to set up the wiring according to the proposed connection. The analysis of the requirement to complete this proposed work will be done from the results obtained from the simulation. This result is the discussion of models or hypotheses to be tested before continuing to the next phase, which is to fabricate the prototype. Figure 2 shows a schematic diagram for automatic plant monitoring.

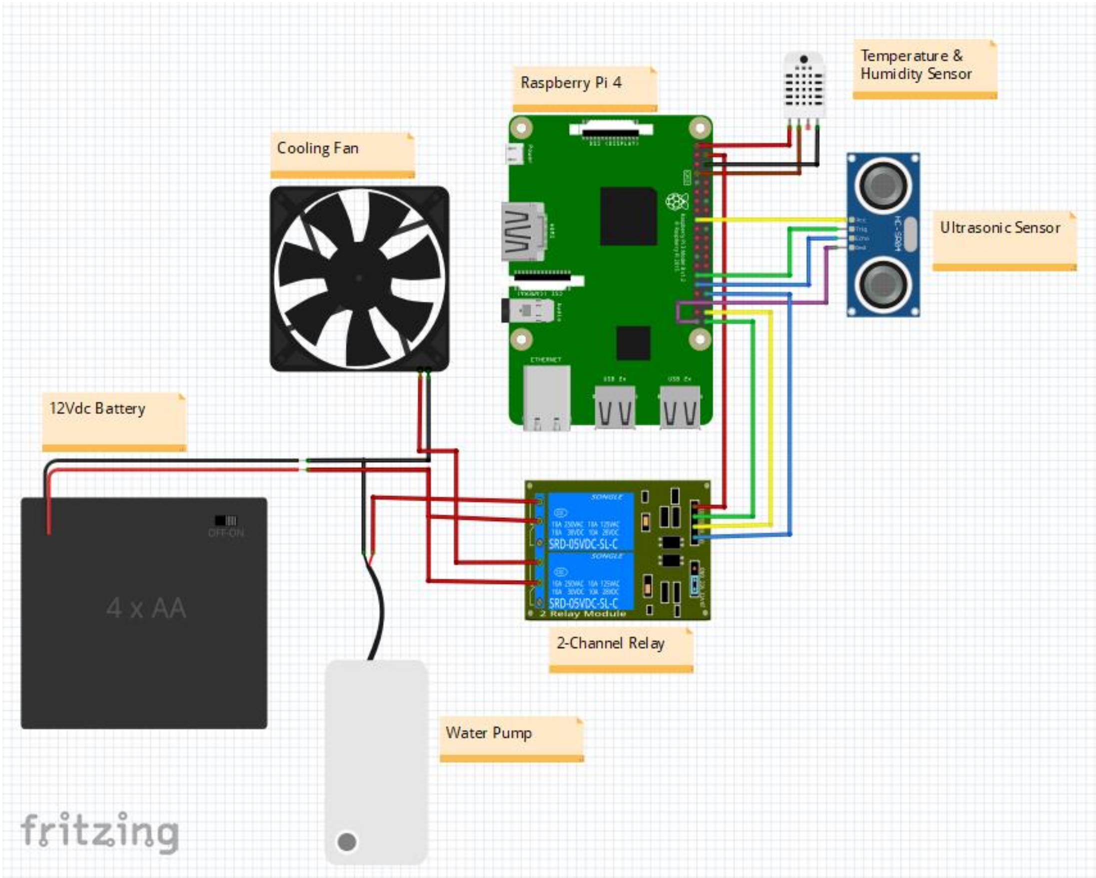

Figure 2: Schematic Diagram for Automatic Plant Monitoring

All of the data sent by the Raspberry Pi will show up as shown in Figure 3. The data from the temperature and humidity sensors will be shown in a graph to make it easier for the user to notice if there is an error. Adafruit IO can be accessed by using a personal computer (PC) or smartphone as long as there is an internet connection. A water level sensor is in the gauge display where the maximum value is 100, and the warning level will be at 20 for it to give a notification to the user. The automatic monitoring system will monitor the temperature, humidity, and water level periodically for a week until it is mature enough to be fed to livestock.

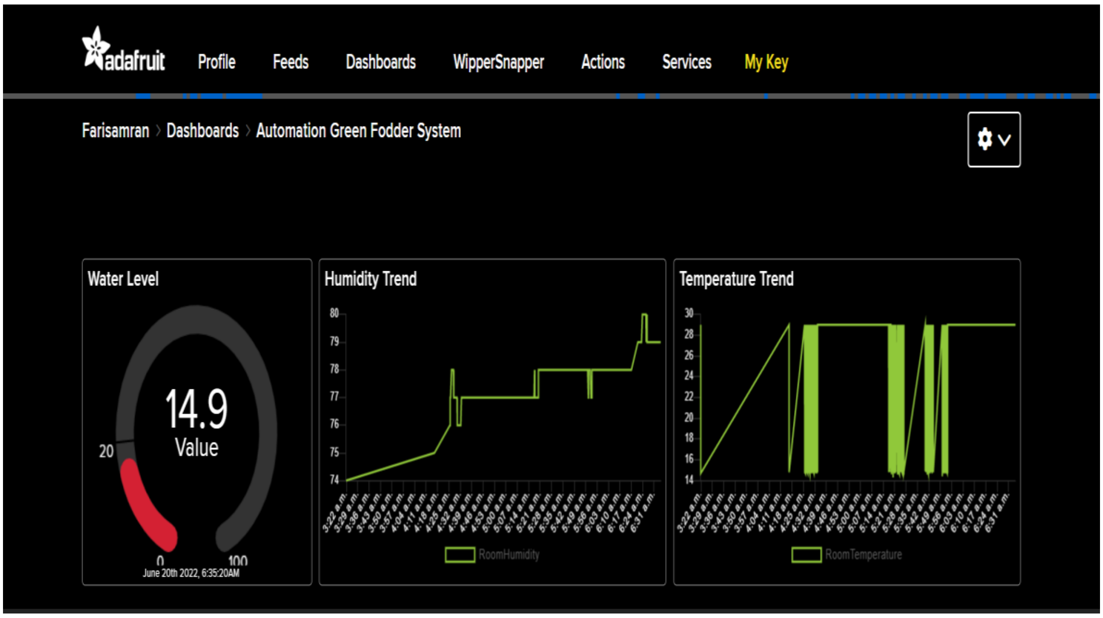

Figure 3: User Interface in Adafruit IO for Automatic Plant Monitoring

System evaluation for this automatic fodder system can be measured using the equation for total water use and water usage efficiency. However, the data obtained by the sensor is not accurate, and the output for this system is not suitable for implementing this equation. When the weather is sunny, the temperature will rise, and even the cooling fan does not lower it. But when the weather is rainy, the temperature will drop, the condition will not be met and causes the water sprinkler to turn off, which led to green fodder becoming dry. Table 1 lists the collected data for this project.

Table 1 Data Collected from Sensor

Day	Average Temperature (ºC)	Average Humidity (%)	Present Output
1	30	70	Fan = 1, Spray = 1
2	29	71	Fan = 1, Spray = 0
3	29	70	Fan = 1, Spray = 1
4	28	72	Fan = 0, Spray = 0
5	29	71	Fan = 1, Spray = 0
6	30	69	Fan = 1, Spray = 1
7	28	72	Fan = 0, Spray = 0

When the system cannot meet the requirements as set up, the system will cause a water loss due to continuous water spray. On a sunny day, the maximum temperature can reach up to 31ºC. At night, the humidity can reach 74%, which may cause the water sprinkler to turn off and lead to a miscalculation in water usage efficiency. This problem can be solved if the system provides water spray in a set time.

4. Conclusion

To conclude this research, a prototype for an automatic monitoring system is developed. It is achieved by developing a wireless network for communication using the Adafruit IO web data collector. The information on the website can help farmers notice if there is a fault in the system to prevent green fodder growth from stunting.

Acknowledgement

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