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Dripper Irrigation Monitoring System for Chili Fertigation using EC-GSM

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Abstract: Fertigation is the process of supplying plant nutrients along with water to produce a quality crop with higher yields. The use of an automated fertigation system can help farmers significantly improve their water and nutrient use. In the fertigation system, the efficiency of irrigation will decrease because of the clogged dripper. Therefore, in order to achieve high irrigation efficiency, the clogged dripper should be repaired as soon as possible to prevent the growth of chilies stunted by malnutrition. In this paper, the efficiency of the fertigation system was analyzed. The objective of the study is to automatically monitor the dripper that has been clogged by impurities due to fertilizer, dry soil, and so on and to develop a communication system to help the farmers. The communication system uses a GSM module to send data information to the user. Arduino is selected as the microcontroller to program the system. The soil moisture sensor is used for this project in order to detect the clogged dripper. With the proposed system, this project is looking forward to the best method for improving the efficiency of fertilization. Apart from that, the concept of a water flow feedback mechanism is executed in order to improve the accuracy of the proposed system. The system has been built accordingly and the performance of the system is tested. As a consequence, the result shows that the system is able to run and the overall concept of the system can be implemented for the real application of the fertigation system. Last but not least, this project looks forward to providing high-quality fertilization practices to farmers, and at the same time expanding monitoring systems in fertilization technology to the international market.

Keywords: Arduino Uno R3, GSM SIM900A, Soil Moisture Sensor, Water Flow Sensor

1. Introduction

In Malaysia, besides Oil & Gas, agriculture is one of the most important industries. Plants are highly dependent on fertilizer and irrigation systems to deliver good yields [1]. One of the most popular methods in the irrigation system is a drip irrigation system. The liquid fertilizer drip irrigation system is a kind of agricultural technology that has recently grown due to efficiency and convenience [2]. In

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addition to providing water, the application is to supply plant nutrients (fertigation) or other chemicals. The water and nutrients are then distributed to the plant at a fixed rate through an irrigation system. Almost any plant that is appropriate for this method is highly recommended for vegetable agriculture [3]. A dripper is a liquid fertilizer distribution transmitter at the end of the irrigation system. Dripper must be placed near the root of the plant to optimize the use of nutrients for planting. The Bend Arrow dripper is a type of dripper commonly used by farmers of chili plants. This dripper has an arrow shape that, since it works to keep the dripper, can be easier to stick in through the medium. The advantages of fertilization are to increase fertilizer recovery quality, minimize fertilizer loss due to leaching, monitor concentration of nutrients in soil solution and optimization of nutrient balance as it provides directly to the plant root. [4]. In terms of energy consumption, the fertigation device saves labour and minimizes human monitoring. Since the irrigation system is highly dependent and effective, it is very important to keep the system alive [7]. There's always a chance for the system to fail, though. The failure system causes the plant to have a problem. One of the main problems with the use of a drip irrigation system is that the impurities due to fertilizer will clog the dripper [5].

One problem with the irrigation system is the dripper clogged. Dripper can be clogged by impurities due to fertilizer, dry soil and so on [5]. The result is that liquid fertilizer can't absorb into the plant and will cause the plant to wilt and die. Unfortunately, due to the large scale of the plantation, a farmer cannot do so much, they can't check manually through one by one which is a waste of time. One way to overcome this is that most farmers do chemical treatment to irrigation system, but this maintenance is done only at the end of the season [6]. It will cause losses for the farmers and generate low yields.

This project work will stress on the study of the experiment of the clogged dripper irrigation and monitoring system. There are several objectives are targeted from the work, such as: to establish a monitoring system for clogged drippers in the chili fertigation irrigation system, to develop EC-GSM applications for chili fertigation technology and to develop a prototype for a chili fertigation monitoring device.

2. Methodology

To ensure this project will succeed, a variety of methods were used in this project to obtain precise information that could be used to maximize the idea of this project. Research has been carried out on fertilization methods in chili planting. Next, a lot of site visits were conducted to interview some experienced farmers in order to get information and data from them so that this project had good data and during the presentation display it as evidence. The problem that often occurs which is the dripper sometimes clogged due to the concentration of fertilizer during water flow throughout the poly pipe in the fertilization system and use it through the use of creative problem solving to overcome the problem. In addition, after the fertigation problem has been identified and experimentally conducted, a system is developed to overcome the problem by using a microcontroller-controlled water-flow sensor. The system was practically tested by doing numerous experiments so that this project moves towards perfection.

2.1 Flow Chart Dripper Irrigation Monitoring System for Chili Fertigation using EC-GSM

The flow chart in Figure 1 shows the flow of dripper irrigation monitoring system for chili fertigation using EC-GSM.

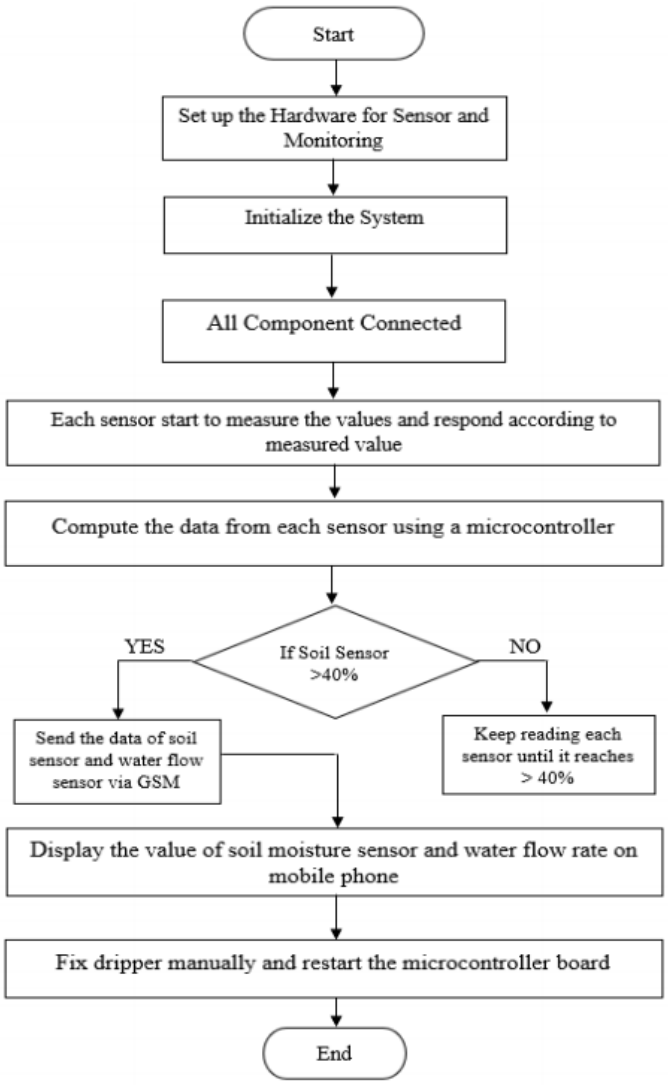

Figure 1: Dripper Irrigation Monitoring System for Chili Fertigation using EC-GSM

2.2 Research Instrument

The evaluation checklist is an instrument developed by the researcher to evaluate the functionality of a dripper irrigation monitoring system for chili fertigation using EC-GSM. The analysis conducted by the researcher is based on the views and comments from experts in the relevant field in the expert confirmation of the functionality and also the prototype design developed.

3. Results and Discussion

In this section, the researcher will explain the results of the study about a dripper irrigation monitoring system for chili fertigation using EC-GSM. The result and discussion section present data and analysis of the system.

3.2 Functionality of Water Flow Sensor and Soil Moisture Sensor

In the development of this project dripper irrigation monitoring system using EC-GSM is to compare the value of water flowrate for each pipe when the dripper clogged. To get the functionality of the water flow sensor and soil moisture sensor functioning well and determine its effectiveness, researchers have set the test method by determining the different cases. Data were taken from the serial monitor Arduino for each value of the soil moisture sensor and water flow rate sensor. Each data was recorded as Table 1 until Table 4.

A. Case 1

The first test was conducted as case 1 to determine the value of soil moisture sensor and water flowrate in good condition for all drippers. The value for each sensor indicates the status each dripper. Table 1 and Figure 2 shows that each sensor has reached around 80 percent and above and flowrate 1 and flowrate 2 has reached around 5.0 L/Min and above in good condition. All these values prove that no dripper is clogged by impurities.

Table 1: Case 1

Case	Dripper Condition	Sensor Percentage (%)	Flowrate (L/Min)
1	All Dripper in Good Condition	Sensor 1 : 86%	Flowrate 1 : 5.68
		Sensor 2 : 85%	Flowrate 1 : 5.68
		Sensor 3 : 84%	Flowrate 1 : 5.68
		Sensor 4 : 87%	Flowrate 2 : 5.29
		Sensor 5 : 89%	Flowrate 2 : 5.29
		Sensor 6 : 89%	Flowrate 2 : 5.29

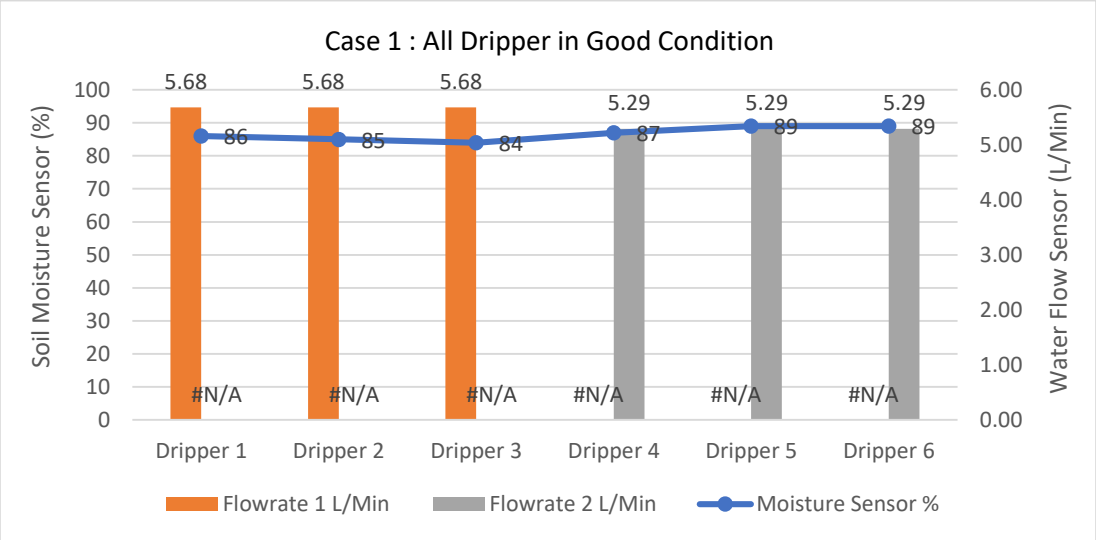

Figure 2: Graph for Case 1

B. Case 2

The second test was carried out as case 2 showed that dripper 1 was clogged in the first water flow. Tables 2 and Figure 3 show that 1 dripper was clogged affected water flow from 5.68 L/min in good condition to 2.19 L/min in condition 1 clogged dripper. This indicates that the water flow rate decreases by 3.49 L / Min. Figure 4 proved that SMS was send via GSM after soil moisture sensor read below than 40 percent. Please take note that all data from figure was taken manually by removing the sensor from the soil by hand.

Table 2: Case 2

Case	Dripper Condition	Sensor Percentage (%)	Flowrate (L/Min)
2	Dripper 1 Clogged	Sensor 1 : 20%	Flowrate 1 : 2.19
		Sensor 2 : 85%	Flowrate 1 : 2.19
		Sensor 3 : 84%	Flowrate 1 : 2.19
		Sensor 4 : 87%	Flowrate 2 : 3.74
		Sensor 5 : 89%	Flowrate 2 : 3.74
		Sensor 6 : 89%	Flowrate 2 : 3.74

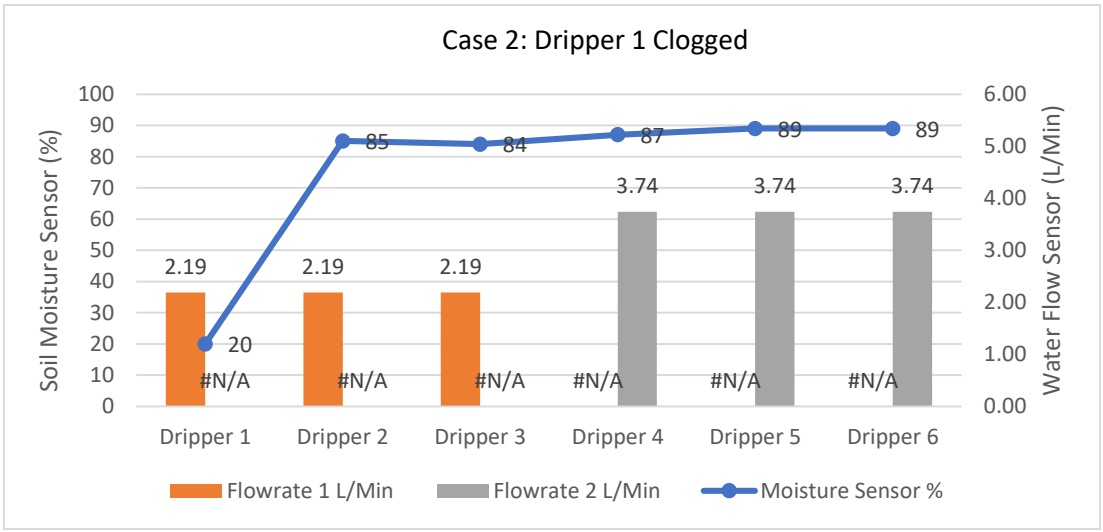

Figure 3: Graph for Case 2

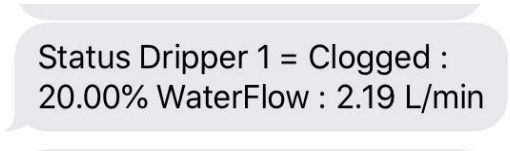

Figure 4: SMS received via GSM

C. Case 3

Case 3 was performed to indicates that 1 dripper was clogged but it different from table and graph above because in this case clogged condition was on the second water flow which is dripper 5. The result from Table 3 and Figure 5 shows that the value of flow rate may be slightly different but it still at the same range which is 1.99 – 2.99 L/Min for 1 clogged dripper on each distribution pipe. Figure 6 shows that data from dripper 5 was received via SMS.

Table 3: Case 3

Case	Dripper Condition	Sensor Percentage (%)	Flowrate (L/Min)
3	Dripper 5 Clogged	Sensor 1 : 86%	Flowrate 1 : 3.61
		Sensor 2 : 85%	Flowrate 1 : 3.61
		Sensor 3 : 84%	Flowrate 1 : 3.61
		Sensor 4 : 87%	Flowrate 2 : 2.71
		Sensor 5 : 6%	Flowrate 2 : 2.71
		Sensor 6 : 89%	Flowrate 2 : 2.71

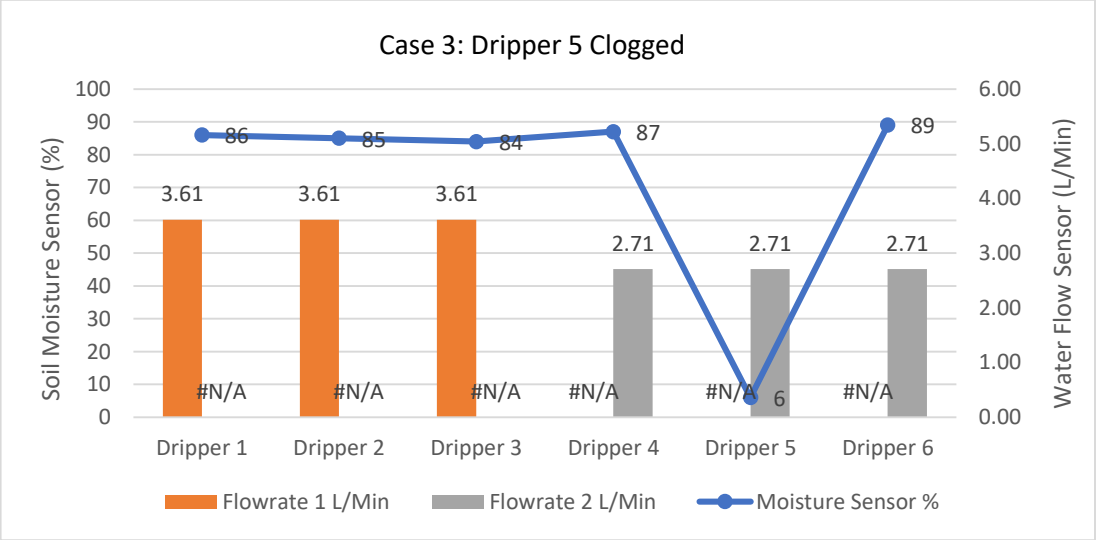

Figure 5: Graph for Case 4

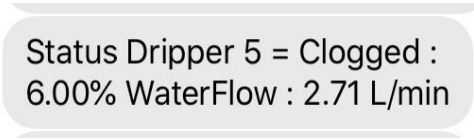

Figure 6: Data dripper 5

D. Case 4 and Case 5

Case 5 is run the same as case 4 but this time 2 dripper which is dripper 1 and 2 are clogged in water flow 1 and dripper 4 and 5 are clogged in water flow 2. Table 4 and Figure 7 shows that the value of flowrate 1 and flowrate 2 decrease drastically from 2.84 to 1.03 L/Min for water flow 1 and 2.97 to 1.29 L/Min for water flow 2. It also shows that the value of water flows 1 decreases simultaneously with the water flow 2 although that value slightly different.

Table 4: Case 4

Case	Dripper Condition	Sensor Percentage (%)	Flowrate (L/Min)
5	Dripper 1,2,4 & 5 Clogged	Sensor 1 : -3%	Flowrate 1 : 1.03
		Sensor 2 : 0%	Flowrate 1 : 1.03
		Sensor 3 : 84%	Flowrate 1 : 1.03
		Sensor 4 : -1%	Flowrate 2 : 1.29
		Sensor 5 : -6%	Flowrate 2 : 1.29
		Sensor 6 : 89%	Flowrate 2 : 1.29

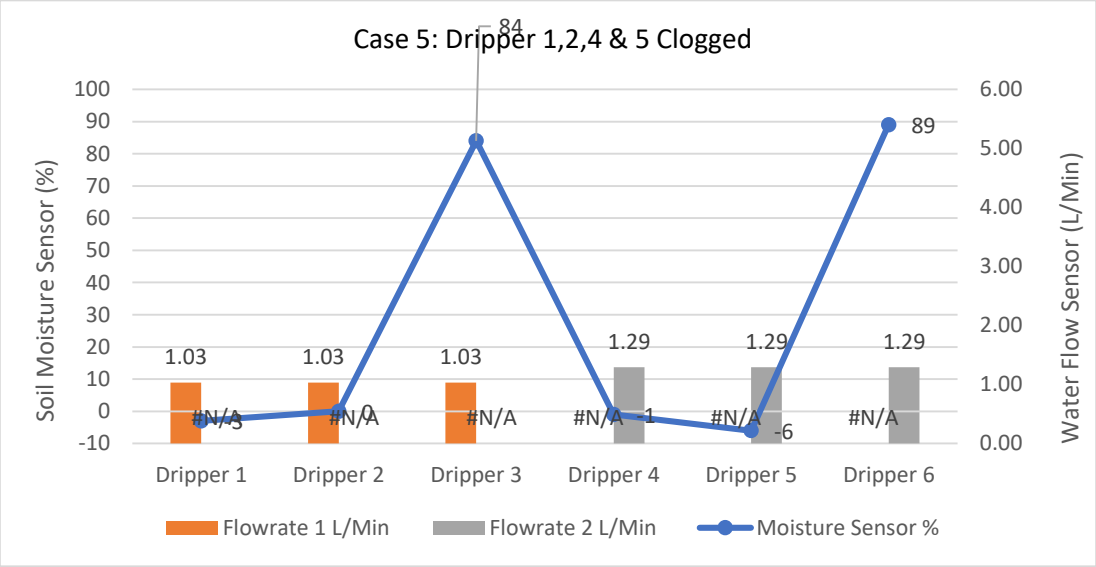

Figure 7: Graph for Case 5

4. Conclusion

In conclusion, the dripper irrigation monitoring system for chili fertigation using EC-GSM has succeeded in achieving the set research objectives. It is hoped that the stakeholders can benefit from the results of this study developed, and the researchers can further improve the design of this system and can further expand the functionality and capabilities of this system to increase the effectiveness and solve problems faced by the farmer in the agriculture sector in the future.

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