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# IMPLEMENTATION OF AUTOMATIC PLANT SPRINKLERS USING SOIL MOISTURE SENSORS

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***Abstract.*** *Automatic plant sprinklers aim to replace manual work into automatic, as for the benefits obtained from this tool is that it can facilitate human work in watering onion plants. This tool uses a soil moisture sensor that functions as a soil moisture detector and sends commands to Arduino uno to turn on the relay so that the pump can turn on and splash water according to soil needs automatically. The design of this tool utilizes the nature of water, which is to fill empty space, and is always flat, this automatic plant sprinkler uses a water reservoir before water is splashed on the ground. Output holes applied to water reservoirs of the same height and diameter allow watering of the soil evenly. The results of the automatic plant sprinkler design test obtained after three tests, have a difference in the amount of water released from water hole one and water hole two, which ranges from 0-7%, which means it is still within the tolerance limit for onion plants, onion plants need soil moisture between 70-80%, which means it has a moisture tolerance between 10%.*

***Keywords:*** *Automatic Watering, Moisture Detector, Relay, Load Schedule, Soil Moisture Sensor*

## Introduction

Agriculture and plantations have become the main source of livelihood in Indonesia which relied upon as a source of food for the community. Some farmers in Indonesia still depend on the weather to grow crops. As a result, agricultural production has never stabilized. The price of agricultural products can rise significantly because production decreases in the dry season. Then it comes down during the rainy season. When the supply of vegetables is large but not in accordance with consumer figures, the vegetables sold cannot last long and rotten. This caused farmers to suffer a lot of losses. In the dry season, farmers who want to keep farming have to spend additional energy and costs on manual watering to keep their crops fertile and harvesting.

Water is one of the main needs of plants. Water requirements for each plant vary depending on the type of plant constituent. Water watering in cultivating plants needs special attention. Because plants are very dependent on the adequacy of water in the soil [1]. The development of technology offers convenience for humans to do a certain job. Similarly, in the application for plant watering technology. Currently there are sensors that can find out the humidity value in an area. This sensor can be applied to the soil to assess soil moisture. So that an automatic device can be produced that can water plants according to the needs of these plants. Currently we are faced with rapid technological developments that can facilitate human work. Some studies have developed automatic sprinklers with humidity sensors [2-5], some can even be connected to mobile phones to provide warnings [6-7].

Green House UMY is a plantation area that cultivates various types of plants. Green House is also one of the facilities used by students from the Agriculture Study Program as a place to do practicum. The Green house area is quite large which consists of 4 garden houses (nurseries), 2 ponds, 4 rice

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fields. This large area is only managed by an officer. This labor shortage hinders the increase in the number of plantings at UMY's Green House.

In this study, we propose to implement automatic plant sprinklers to reduce the workload of managers and to increase the number of plantings and planting results from UMY's Green House. The proposed tool is built on the basis of the soil moisture sensor. The amount of soil moisture is adjusted to the plants to be watered. The plant object that will be observed to apply this tool is onion plants.

## 1 Methodology

The implementation of this PKM program is carried out through several stages, namely as can be seen in Figure 1. The first stage is observation, tool design, tool development, tool testing and training on the use of tools on land, performance and success analysis, and tool implementation on onion plant land.

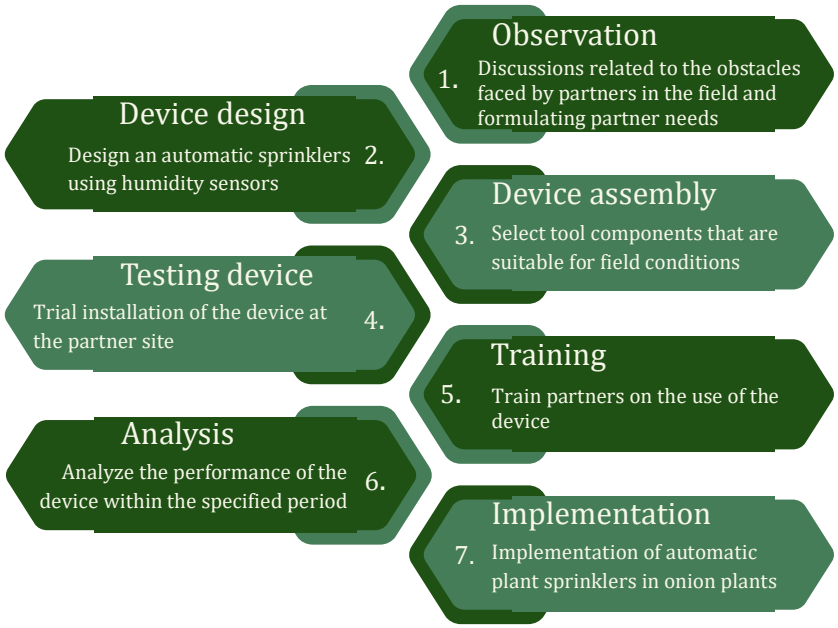


Figure 1. Flow Chart Design Research

### 1.1 Program Implementation

*1.1.1 Observation dan Program socialization*

This stage is the initial stage where data collection will be carried out directly in the field to find out the problems that exist in UMY's Green House. In addition, there is also the formation of a program implementation team consisting of lecturers and students according to program needs which will then be given a briefing as well as an introduction to the program and related parties when collecting data directly in the field to find out the problems that exist in the UMY Green House.

*1.1.2 Tool Creation and Usage Training*

At this stage, it is divided into three main activities, namely the process of designing, making, and installation of automatic watering devices using soil moisture sensors.

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a. The first step taken is the design of the tool. The team made voltage usage estimates for the equipment which included the water pump and microcontroller used and the length of time used in one day. The output of this daily load estimation is electrical energy and water as plant media that must be provided every day. The next step is the calculation of the amount of energy that must be provided using calculations so that the tools used remain efficient. The next stage is the use of water as a planting medium so that plants get a sufficient amount of water (no more and also no less). After the design of the tool is carried out, the procurement of tool components is held. The next step is the installation of the Tool at the partner location. Partner involvement is required when determining location. Partners can play an active role in monitoring the use of such tools at night.

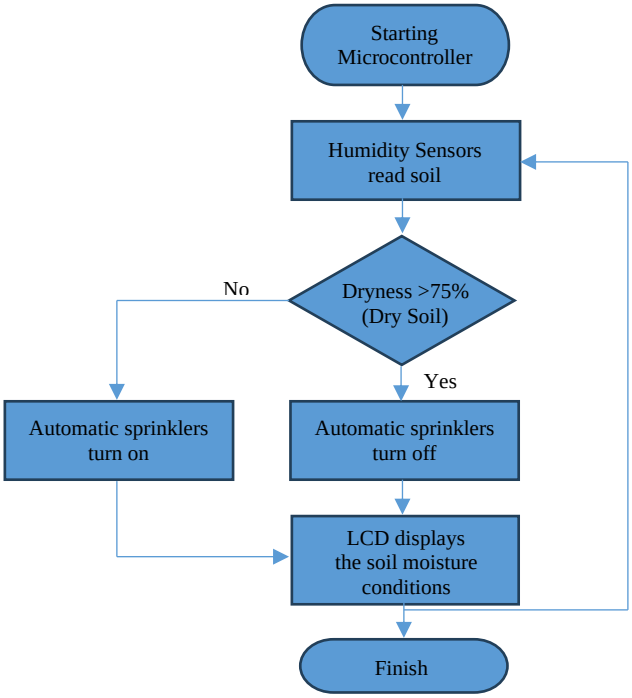


Figure 2. Automatic sprinkler design flowchart

b. Partners need to be equipped with operational and maintenance systems including Arduino components, batteries, sensors and equipment installation. Therefore, partners are given guidelines on the operation of the tool work system and how to inspect and maintain it. This step is very useful because Mitra does not yet have special knowledge about automatic Plant Sprinklers. This assistance can anticipate errors in the operation of the Tool. If there is excessive watering, it will be able to disturb the plant. The way this circuit works is very simple, namely the analog value of the measurement results from the soil moisture sensor will be read by Arduino, Then based on the measurement results we make a coding where If the analog value < 500 then the relay will turn off so that the water pump does not function, but if the analog value is more than 500 then the relay will work so that the water pump will turn on which results in the plants will be watered.

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### 1.2 Monitoring dan Evaluasi Program.

Results of monitoring of automatic sprinklers:

a) Monitoring sensor performance of watering systems
b) Monitoring the amount of humidity that has been regulated whether it really suits the needs of plants.

The program monitors tools that have been made and tested in the field. System settings are made based on field needs. Installation conditions were also a concern at the time of this experiment. Some photos of activities in the field related to experiments and monitoring tools that have been made can be seen in Figure 3.


Figure 3. Experiment and Explanation of Tool Installation

Figure 4. Monitoring and Testing Tools on Site before implementation

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## 2 Results and Discussion

The program that has been implemented is in the form of installing automatic plant watering devices. Tools are installed for onion crops. Farmers choose onion plants as land to be used for the implementation of tools.

### 2.1 Testing Tools

Before applying the tools that have been designed, it is necessary to try out the tools developed in the field. This must be done to adjust to the environment related to the consumers using it. The sound effect of this activity is that the tool can be adjusted to the needs based on field conditions. The program that has been implemented is installing an automatic plant watering device. The tool is installed for onion plants with an area of 10×10 meters. The tool is designed with six upper sprinters mounted on a pipe above the field. For the sprinter to reach the area on the entire field, the sprinter is installed at a distance of 2 meters on each sprinter.

### 2.2 Monitoring Result

Table 1 shows the dryness level data and monitoring time the automatic plant sprinklers monitored based on conditions on Tuesday, June 06, 2023, and Wednesday, June 07, 2023. The tool runs 24 hours to water the onion plants in a 10×10 meter area with six sprinters to spread the water. Sprinters were installed with a distance of 2 meters between each sprinter. The recording was done during the hottest part of the day. The device was monitored from 4:25 p.m. on June 06, 2023, to 3:11 p.m. on June 07, 2023. Tool monitoring is based on the level of dryness in the field. The story of the dryness of the land before the tool works until the dryness level after the device works. The results of watering equipment monitoring are shown in Table 1.

Table 1. Soil dryness data read automatic plant watering tool

| DATE | HOURS (WIB) | BEFORE THE TOOL WORKS | AFTER THE TOOL WORKS | STATUS |
|---|---|---|---|---|
| | | DROUGHT LEVEL (%) | | |
| 06 Juni 2023 | 16.25 | 76% | 49% | Successful |
| | 17.25 | 76% | 54% | Successful |
| | 18.25 | 75% | 51% | Successful |
| 07 Juni 2023 | 5.52 | 75% | 46% | Successful |
| | 12.47 | 76% | 49% | Successful |
| | 13.26 | 76% | 55% | Successful |
| | 14.01 | 76% | 56% | Successful |
| | 15.11 | 76% | 53% | Successful |

On the first day, monitoring will be carried out on June 6, 2023, the day after the equipment is successfully installed on the land. Monitoring is carried out in the afternoon because the onion field

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is still wet by flushes from the land owner. At the beginning of monitoring, the tool detected drought at 16.25 WIB with a drought rate of 76%. After the tool automatically works, the dryness in onion fields drops by 49% so it can be said that the tool works well or successfully. At a later time the device detected drought at 5:25 p.m. and 6:25 p.m., changing the drought rate from 76% to 51% and 54 respectively.

On the second day, the first monitoring was carried out at 5.25 WIB on June 7, 2023 with a successful status. Further monitoring was carried out at noon at 12.47 WIB with a drought rate of 76% and a decrease of 49%. In subsequent observations, the tool worked well and succeeded in reducing the level of drought in onion fields. The last monitoring was conducted at 15:11 WIB with a successful status, reducing the drought rate from 76% to 53%. Monitoring is completed on the second day.

Based on monitoring data, the tool can work well in overcoming drought in the field. High drought in onion fields of 75%-76% drops to 46%-56%, and the soil becomes moist again. During the monitoring carried out the tool successfully succeeded in watering the field automatically. The condition of the sprinkler that has been running for 24 hours is in good condition and is still suitable for further use. It can be concluded that the tool can work well according to the initial plan and design as can be seen in Figure 5. As the next implementation, the pipe is installed in the lower area and requires a springkle with a smaller output so that water and moisture can be distributed more evenly in the field.

a) LCD displays the soil moisture conditions

b) Soil dryness >75 (76%)

c) Automatic sprinklers turn on

d) Soil dryness ≤75 (74%)

e) Automatic sprinklers turn off

Figure 5. Tool (Product) Implementation

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## 3 Conclusions

This research can be implemented in the field with good results and help farmers. The tool works well to water onion plants automatically according to the needs of dry fields. This service program is still in the progress of monitoring and evaluation using the tools that have been designed. As a further implementation, pipe tools are installed in the lower area, using different types of sprinkles or types with smaller output. So that it works more effectively where water can be distributed more evenly on the land. In addition, the replacement of pipes and springkles can save water use.

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