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Design of Plant Maintenance Equipment Using HMI and PLC Omron CPMIA 40CDR

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***Abstract*—Generally, plant maintenance can be done in two ways: manual (using humans with makeshift tools) and mechanical (using machine technology or robots). Plant maintenance done manually is watering and eradicating pests and diseases that do not necessarily do it and can harm humans themselves. Mechanically doing the same job has advantages, namely being faster, routine, and reducing workplace accidents. In the plant maintenance process at this time, there are still essential aspects for research, especially for the design of tools. The manual maintenance process's weakness is that performing sensory tasks in a large capacity takes a very long time. To overcome these limitations, a mechanical approach with automation technology is used to make it more effective and efficient. Therefore, the design of a watering device or plant maintenance is expected to overcome these problems. The use of human labor (manual) is not harmful but has drawbacks, including inconsistency with time and very time-consuming work. In the existing maintenance machine design research, there are various types. In this research, the design of the tool that will be carried out is to try to combine plant maintenance with a microcontroller automatic control system which is arranged using a servo motor motion system and several other motors which are expected to have an effective working system and excellent quality of maintenance results, for the cottage industry industrial enterprise. This tool can also be used to provide nutrition, eradicate pests and diseases, etc. It saves human labor because it does not need to absorb much human power with this tool. Can accelerate the provision of nutrients or eradicate pests.**

Keywords—Plant Care; HMI; PLCs; CPMIA 40CDR; Automation; Industry.

I. INTRODUCTION

Many agricultural products from our country are exported abroad, one of which is spices and vegetables. Herbs are one of the most promising types of sauces for export. One way to increase the economic value of spices, especially for the export market, is to carry out excellent maintenance and guaranteed quality[1][2]. One of the ways to maintain good plants and ensure their quality is to use modern technology that is growing all over the world. Generally, plant maintenance can be done in two ways: manual (using humans with makeshift tools) and mechanical (using machine technology or robots).

Plant maintenance done manually is watering and eradicating pests and diseases that do not necessarily do it and can harm humans themselves. Mechanically doing the same job has advantages, namely being faster, routine, and reducing workplace accidents. In the plant maintenance process at this time, there are still essential aspects for research, especially for the design of tools. The weakness of the manual maintenance process is that performing sensory tasks in a large capacity takes a very long time. A mechanical approach with automation technology is used to overcome these limitations to make it more effective and efficient [3]. Therefore, the design of a watering device or plant maintenance is expected to overcome these problems. The use of human labor (manual) is not harmful but has drawbacks, including inconsistency with time and very time-consuming work. In the existing maintenance machine design research, there are various types. In this research, the design of the tool that will be carried out is to try to combine plant maintenance with a microcontroller automatic control system which is arranged using a servo motor motion system and several other motors which are expected to have an effective working system and excellent quality of maintenance results.

II. LITERATURE REVIEW

A. General Understanding

A plant sprinkler is a machine that functions to water plants, provide nutrition, and control pests and diseases automatically. This machine uses a motor as its driving force. This machine is equipped with several sensors and a dew nozzle to prevent the watering and nutrition process.

B. Work principle

This plant sprinkler machine uses a motor as a source of moving power. The first movement is to run the pots per bed or line up until they are right with the nozzle position on the plant. Then the nozzle moves to each plant one by one and is sprayed with water or nutrient water made previously. The working principle is repeated until the crops are harvested, or the plants cannot produce again. The repeating process is regulated by the HMI AND PLC OMRON CPMIA 40CDR [4].

C. Component

In making this tool with a motor drive and required elements consisting of parts that have and the uses of each component are arranged into a single unit with more complex services and can produce as expected.

D. Electric motor

An electric motor belongs to the category of the dynamic electric machine and is an electromagnetic device that

converts electrical energy into mechanical energy. This mechanical energy is used for, for example, rotating pump impellers, fans or blowers, driving compressors, and lifting materials, and is also used in household appliances (such as mixers, electric drills, and fans).

This section describes the two main types of electric motors: DC motors and AC motors. The engines are classified according to the input supply, construction, and operating mechanism, which are further described in the chart below:

As the name implies, DC/direct current motors use direct-unidirectional current. DC motors are used in special applications where a high starting torque or constant acceleration is required for a wide speed range.

The advantage of a dc motor is that the speed is easy to control and does not affect the quality of the power supply. This DC motor can be controlled by setting: Armature voltage – increasing armature voltage will increase speed and Field current – decreasing field current will increase speed.

AC motors / alternating currents use an electric current that regularly reverses its direction over a certain period. An AC motor has two essential electrical parts: a "stator" and a "rotor." The stator is a component of static electricity. The rotor is a rotating electrical component to rotate the motor's axle. The main advantage of a DC motor over an AC motor is that the speed is more challenging to control.

The manufacture of this plant maintenance tool uses a DC motor to move the pot rotation system in rotation, given nutrients and pest control. And there is also a DC motor that is used to drive the nozzle and the water pump.

E. Sensor

A sensor is used to detect changes in the physical or chemical environment. At this time, the sensor has been made very small to the order of the nanometer. And the use of two types of sensors for this tool are as follows:

- Proximity sensor

A proximity sensor is a detection tool that works based on the object's distance to the sensor. The characteristic of this sensor is to detect objects at a reasonably close distance. This proximity sensor serves to start the pot's movement and stop the pot's direction. And it is also used in the watering section so that the nozzle movement can be stable to move left and right.

- Optical sensor

Optical sensors are electronic components that can / function to convert a visual quantity (light) into an electrical abundance. The working principle of this tool is to convert energy from photons into electrons. Ideally, one photon can generate one electron. The benefit of this sensor is that it is a tool used to detect light energy. It exceeds the human eye's sensitivity to all color spectrums and works in the ultraviolet and infrared regions.

Several types of sensors are widely used in electronic circuits, including light, temperature, and pressure sensors. Sensor types can be broadly divided into two types, namely:

1. Sensor Physics. Physical sensors detect a quantity based on the laws of physics. Included in the types of physics sensors are: • Light sensor • Sound sensor • Temperature sensor • Force sensor • Acceleration sensor

2. Chemical Sensors. Chemical sensors detect the amount of a chemical substance by converting chemical quantities into electrical quantities. Usually, this involves some chemical reaction. Included in the types of chemical sensors are: • PH sensor • Gas sensor • Oxygen sensor

III. Research Methods

In making this tool, some processes must be passed. The following are the stages of making plant maintenance tools using HMI and OMRON CP1A 40CDR.

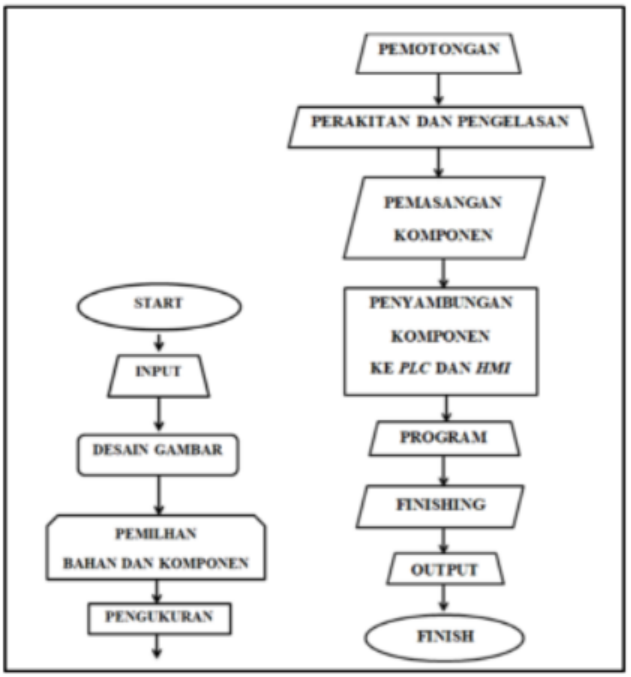

Figure 1. Diagram of the process of making plant maintenance tools

A. Image Design

The initial process in making plant maintenance tools using HMI and PLC OMRON CP1A 40CDR is to design the image before making it, where the image design functions as a language or communication tool for engineering people. In the field of image design, working drawings are one of the visual media in which there is a description of several concepts in the form of an image as a basis for reference or prototype images from planning to the final product description (Assembling product).[5]

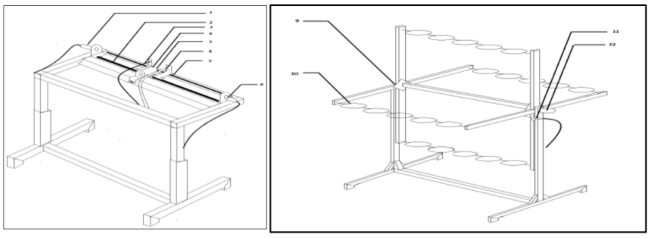

Figure 2. A series of plant watering tools

B. Material selection

In the selection of materials and components, one thing must be considered. The materials and features that will be

used must be by the work process to be carried out, and this is necessary so that the components or materials are by what the tool requires.

C. Work process

In this case, the first step taken to make a plant sprinkler using HMI and PLC OMRON is the process of forming a frame that has been designed previously.

D. Cutting Iron For Frame

Some of the pieces needed for the frame are as follows:

1. The base frame for the front and rear legs up and down.

2. Four right-angled

3. Frame Legs

4. Sensor mount frame

5. Motor mount frame

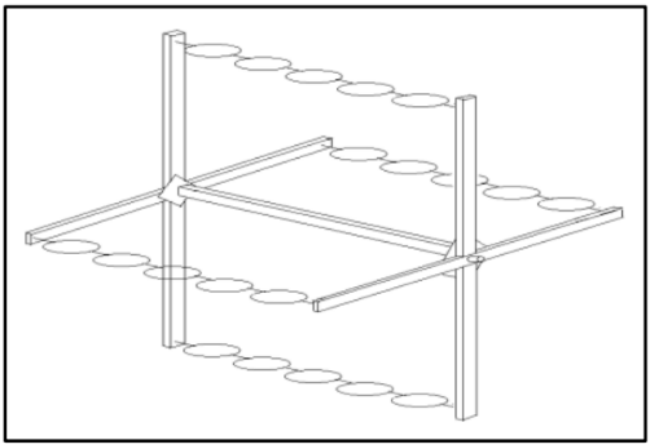

Figure 3. Pot holder frame

Installation of a 12 V Motor and Proximity sensor which is useful for moving and stopping the angle iron or plant pot.

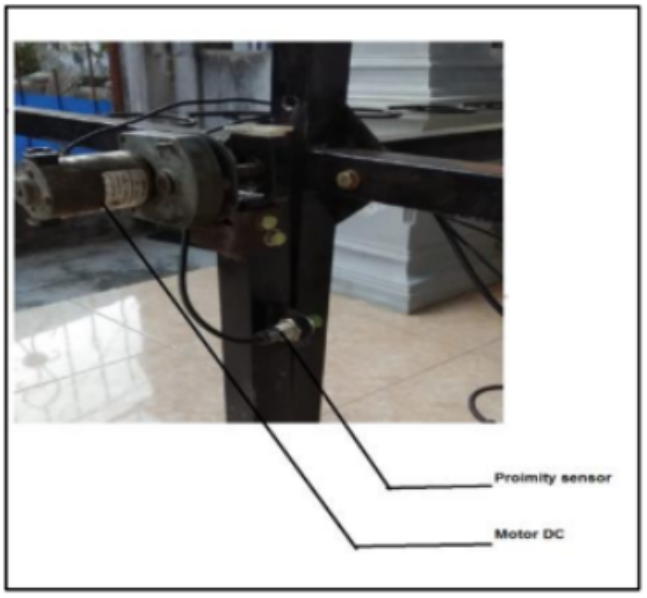

Figure 4. Installation of Electrical components

E. Finishing

After the tool has been assembled with several stages of the production process, the next step is finishing or final work. This process is the final process of the process stages. The process consists of smoothing the tools to level the welding and painting results.

IV. Results and Conclusion

Before implementing a system of plant sprinkler circuits in the application, the first test in the simulation uses only its components. The simulation is used because the electronics simulation can approach actual conditions.

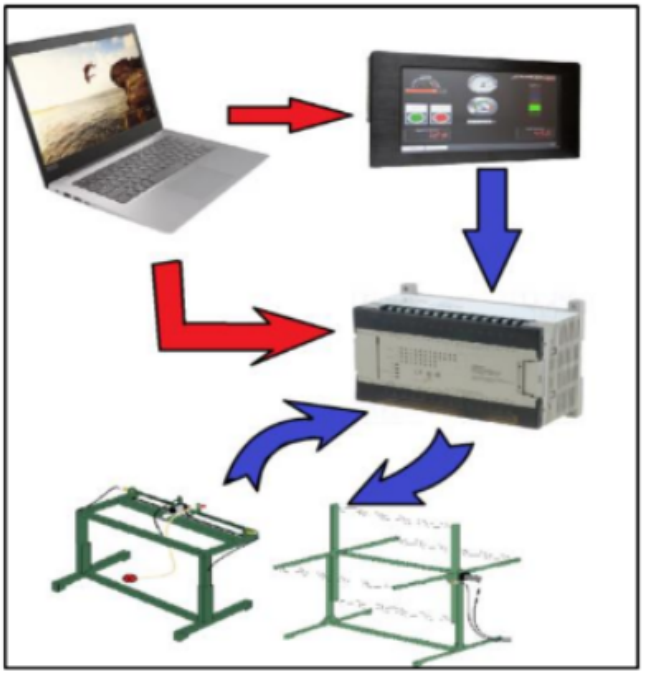

Figure 5. Installation of Electrical components

A. PLC (Programmable Logic Controller)

The PLC used is the Omron CPM1A 40CDR PLC in the shape of a

The specifications of the Omron CPM1A PLC are

PLC Power Supply: 24VDC

Number of Inputs: 24 inputs (24 Points)

Number of Outputs: 16 (16 Points)

Inputs used: 4 inputs (4 points)

Outputs used: 3 outputs (3 points)

V. Conclusion

From the results of the manufacture of plant sprinklers, several conclusions were obtained, namely: 1. They are making a tool for watering plants for the company's home-based agricultural industry. 2. This tool can also provide nutrition, eradicate pests and diseases, and so on. 3. It saves human labor because this tool does not need to absorb much human power. 4. Can accelerate the provision of nutrition or eradicate pests.

Based on the experience gained during the process of making plant sprinklers, we suggest things that need to be considered, including 1. I hope this tool can be used and its usefulness is maintained. 2. Suggest that this tool can be further developed to improve the quality, efficiency, and

economic value of the product of this tool without reducing the existing functions. 3. Design can be developed and more innovative.

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