The Machine Punch Mulch: A Pneumatic Pierching and Control With Fuzzy Logic Control

Surfa Yondri1, Rahmat Azis Nabawi2, Eka Sunitra3, Syaiful Islam3, Nusyirwan5, Junaidi Asrul6

1 Teknik Elektro, Politeknik Negeri Padang
E-mail: surfa_yondri@gmail.com
2 Teknik Mesin, Universitas Negeri Padang
E-mail: azis1621@gmail.com
3 Teknik Mesin, Politeknik Negeri Padang
E-mail: hantu.lobe@gmail.com
4 Teknik Elektro, Universitas Negeri Padang
E-mail: syaifulislami1@gmail.com
5 Teknik Mesin, Politeknik Negeri Padang
E-mail: nusyirwan.66@gmail.com
6 Teknik Listrik, Politeknik Negeri Padang
E-mail: junaidi_8189@yahoo.co.id

Abstract— Agricultural tools and machine innovation aimed at could improve efficiency of land and labor, saving energy and resources (seed, fertilizer, water and equipment), improving effectiveness, productivity and quality of agricultural products, reducing the workload of farmers, maintaining environmental sustainability and agricultural products and increasing farmers income welfare. One of the efforts that made was using Plastic Mulch in the cultivation of horticultural agriculture. Installation of plastic mulch on cultivated plants more efficient if installed after plastic mulch was perforated. This research explained about automatic mulch punching machine used Fuzzy Logic Control intelligent system control that be equipped with microcontroller and sensor and controlled cellophane for the perforation process. Mulch punching machine that effective, save, easy to operated, cheap and affordable by the community. The test result know the response Fuzzy Logic Control of control system toward arrangement of DC motor speed, sensor function, punching blade driver solenoid, position and hole distance generated, time required and easy to operation for variation range and hole size certain for intercropping system.

Keywords— Plastic Mulch, Fuzzy Logic Control, Selenoid, Sensor, Microcontroller

I. INTRODUCTION

The innovation of agricultural tools and machinery is a real step toward realizing efficient, quality farming and improving agricultural productivity. Mechanization of agriculture aims to improve the efficiency of land and labor, saving energy and resources (seed, fertilizer, water and equipment), improving the effectiveness, productivity and quality of agricultural products, reducing the workload of farmers, preserving the environment and sustainable agricultural production, and increase farmers’ income and prosperity [1]. The main features of modern agriculture are continuous productivity, efficiency, quality and continuity of supply must always be improved and maintained [2].

One of agricultural tools and machinery innovation to optimize agricultural product is through innovation of plastic mulching machine that effective and cheap (reachable by society), making it easier for farmers in agricultural production process. The use of plastic mulch has become a common standard as a medium for high value vegetable crops, both in developed countries and in developing countries, including Indonesia. In Indonesia the use of mulch has been widely applied in the cultivation of vegetables and fruit seasonal, even palawija. Although the use of this mulch requires additional costs, but the economic value of crop yields can save costs, gain in the process of land-processing faster, easier crop maintenance and also increase production yield so as to cover the initial costs incurred [3].

The plastic mulch market is available in roller shapes that have not been punctured with varying sizes. Average weight size 10 kg and 20 kg / roll, length 250 meters and 500 meters, width 50/100 cm and 60/120 cm (folded two) and 0.35 mm plastic thickness. Mulches are grouped as organic mulch made from crop residues or parts of agricultural crops and inorganic mulch made from plastic synthesis materials [3]. Plastic mulch is a low-density polyethylene produced by ethylene polymerization process using very high pressure to seal cultivation plants intended to maintain soil moisture, suppress weed growth and disease, increase soil temperature in winter and decrease soil temperature during dry season, so in accordance with the environment needed plants.

The use of plastic mulch also maintains soil aggregates from rain-water impacts, minimizes soil surface erosion, prevents water evaporation and protects the soil from sunlight and improves soil aggregate stability [4]. Mulching is done by pulling the two ends of the mulch to the end of the bed with the direction of elongated to look flat cover the entire surface of the bed. Mulch installation can be done before and after mulch is perforated, the hole on the mulch serves as the point of planting in the cultivated plants. If the mulch is stretched before the hole, the farmer usually manually holes along the stretch by using a piece of iron pipe that has been sharpened and then pinned to the mulch and the other way with a tin filled with embers then affixed to the mulch so that it melts and forms a hole.
These lead to a long process and a low level of work efficiency. Punching the mulch when it has been spread creates problems such as waste of time and energy, difficult processes, boredom, fatigue and disruptive health that leads to not optimal production. The attitude of the peasants when puncturing the mulch by standing stooped gives rise to tiredness, pain in skeletal muscle, and low productivity [5]. The perforation of plastic mulch before it is spread will be much better and more effective than hollowing it after it has been spread, so farmers are more inclined to use mulch that has been perforated, this will have an impact on the needs of plastic mulch that has been drilled to be very high.

The explanation is behind the making of mulch mulching machine using pneumatically controlled by fuzzy logic. Fuzzy logic is a good way to map an input space into an output space [6], Fuzzy logic control is used for the motor can run constantly which will make the motor keep rotating constant even though the load is driven more weight.

II. METHOD

This research is research development or Research and Development (R & D). The research method of R & D is the research method used to produce a particular product, and test the effectiveness of the product [7].

Mulching system design Punch Machine With Fuzzy Logic Control Method described with design schemes that include hardware design, software design and construction design. The following scheme generally shows how the whole work system works.

![Figure 1 Block Diagram Punch Tool Plastic Mulch](image)

Function of each Block Diagram
1. Power Supply serves to provide DC voltage of 12 V as source of Arduino Uno and motor power window.
2. Button used as an input to the driving roll of plastic mulch.
3. Arduino Uno as a storage program that will provide input to Relay 4 Channel, LCD, and motor drivers.
4. Relay 4 Channel as a switch to solenoid valve which will give input on and off on solenoid valve.
5. Solenoid Valve as water cylinder controller which will give forward or backward command.
6. Photo Diode Sensor as a reader of motor speed which later gives signal to arduino mega.
7. Driver Motor as a power window motor controller that serves as a mulch plastic roll driver.
8. Motor Power Window as the output used to drive mulch plastic rolls
9. Air Cylinder as output is used to drive the knife pit, where his on and off depending on the signal given by the relay 4 channel.

III. RESULT AND DISCUSSION

A. Results of Design Machine Punch Mulch

Design specifications mulch punching machine comprises some design work into one solid system. Where the mulch plastic piercing machine design consists of
1. The place of perforation
   Place of perforation is used as a medium of perforation of plastic mulch, since most plastic mulch to be used on plants have perforation, so to three blades will move stoke down and back to up to perforation this mulch.

![Figure 2 The place of perforation](image)

2. Rolling Place
   In this rolling section is a medium used for mulch plastic rolling process, where here there are 2 pieces of motor-driven windings power windows. The first scrolls that contained the initial plastic or plastic parts that have not been perforation, then it moves toward the plastic perforation. After the plastic mulch perforation and rolled back on the rolls of the second.

![Figure 3 The rolls Plastic Mulch](image)

3. Design of Engine Drive
   Serves as a propulsion engine power window motor attached. The rolls will move on when the power window motor in a state on, thereby punching blade lever actuated by pneumatic air cylinder will move up and down on the plastic mulch.
4. Designing LCD (Liquid Crystal Display)
   Functioning as the appearance of digital data. Pin connection LCD (Liquid Crystal Display) to the microcontroller.
5. Design Buzzer
These tools work on the system use as an alarm *buzzer* sounds button and arduino. Buzzer will sound an alarm when the button is pressed and arduino button is activated.

6. Designing Relay
In the work system of this tool, the relay serves as a switch to provide input voltage to the solenoid valve, which later when the active solenoid valve will open air entering the pneumatic cylinder so that the pneumatic cylinder piston will move forward and when the solenoid valve is inactive, the pneumatic cylinder will return to its original position or move backwards.

7. Design Software
Software design begins after the hardware design is done. For the preparation of the software that controls the equipment, the programming language used in this final project is the C language for the reason that it is easy to understand and is designed because C language is already a high level language.

In order for the software design is done quickly, it first has to create a flow diagram to illustrate the overall flow of the program to the system. Flow diagram of the control system is designed for automated punching plastic mulch with Fuzzy Logic control system.

After designing flow charts, then the next is the programming language and Arduino. The programming process starts with writing the source program (source code). Source code then be compiled and will generate code that can be understood by the microcontroller (format *.ino). Files with * extension. This ino which will be downloaded to the microcontroller.

8. Manufacture Program
Making the program for this microcontroller is using the C language using the Arduino. The process of designing the program in Figure 7.

Researchers conducted an C language program in which the Arduino software program listing that has been typed will be saved in the format *.ino program in C language Compile listing programs already typed then compiled that will generate a file with the extension *.ino to be downloaded to the micro later. The download process is done by clicking on the microcontroller to download the software. The downloaded file will be in the extension *.ino.

Results punching machine construction design of plastic mulch can be seen in Figure 8.
a. Testing 1 Active Relay

In this test, the researchers conducted tests 1 active relay fruit. This test is performed to move a piercing knife. Controlling knife mulch pit is controlled via a relay that has been programmed on the Arduino Uno. Here is a snippet listing program in testing 1 piece of active relay.

b. Testing 2 pieces of active relay

In this test, the researchers tested two pieces of the relay is active. This test is performed to move two piercing knives. Controlling knife mulch pit is controlled via a relay that has been programmed on the Arduino Uno. Here is a snippet listing program in testing 2 pieces of active relay.

Information:
1. Mulch Plastic Rolls
2. Position Pneumatic air cylinder
3. Roller
4. Control panel box
5. DC motor

B. Testing of 4 Channel Relay Module as Control of Mulch Plastic Multifarious Knife

In this mulch plastic punching machine, relay functions as a switch for applying a voltage to the solenoid valve, whereas when the solenoid valve is activated to enable the relay during the 2000ms will give air to water or open a pneumatic cylinder. When the pneumatic cylinder air is provided with air, the piston of the pneumatic cylinder will move forward so that the piston tip that has been installed in the piercing blade will puncture the mulch plastic and when the relay dies, the relay will disconnect the voltage entering the solenoid valve so that the solenoid valve will close the incoming air to the pneumatic cylinder and automatic piston will move back to its original position.

On this machine, the researchers made the choice of distance and mode choice knife. The choice of blade mode is how many blades you want to puncture mulch plastic. Researchers create 3 selection hole spacing of 20 cm, 30 cm and 40 cm and 3 selection mode is one knife blade, two knives and three knives.
c. Testing 3 pieces of Active Relays

In this test, the researchers tested three pieces of active relay. This test is performed to move three piercing knives. Controlling knife mulch pit is controlled via a relay that has been programmed on the Arduino Uno. Here is a snippet of program listings in testing 3 active relays.

```
if (tindakan == 1)
  digitalWrite(relay1, HIGH);
  digitalWrite(relay2, HIGH);
  digitalWrite(relay3, HIGH);
```

The test results are perforate plastic mulch relay in accordance with number of active relays. The knife perforation can be arranged with a distance that made the arduino program. The result active relay testing three pieces as follows.

1. Distance 20 cm

2. Distance 30 cm

3. Distance 40 cm

IV. CONCLUSIONS

This mulching and tested mulching machine produces time and energy efficiency used by farmers. Control of blades mulch pit controlled by the relay that has been programmed on the Arduino Uno. The number of holes produced can vary according to the desired needs.

REFERENCES


