UNIVERSITI TEKNIKAL MALAYSIA MELAKA

MOBILITY SUB-SYSTEM FOR ROBOTIC ORYZA SATIVA PESTICIDE APPLICATION

Thesis submitted in accordance with the partial requirements of the
Universiti Teknikal Malaysia Melaka for the
Bachelor of Manufacturing Engineering (Robotic and Automation)

By

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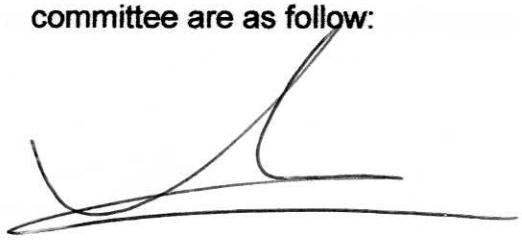

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DECLARATION

I hereby, declare this thesis entitled "Driving Subsystem For Oryza Sativa Pesticide Distributor" is the result of my own research except as cited in the references.

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ABSTRACT

The purpose of this project is to develop one automation driving system that can help the farmer to carry out the pesticide and then distributed the pesticide to the paddy field. A literature survey showed that there is a great potential for automated vehicles in agriculture as well as in many other areas. A lot of work has already been done in previous research, but no totally automated system was developed yet which is able to operate well in an agricultural environment. A mobile platform with four-wheel steering and four-wheel drive was designed, but considered to be too complex to be realized within the period of the project. Therefore, a simpler vehicle with one-wheel steering and two-wheel drive was built. Its control circuit allows the user to control it's by a joystick box. In addition, by using the radio frequency (RF) controller, the distance to control this vehicle is quite long with control distance can reach about 200 meter without any barriers. Tests with the manual control showed a good performance, the vehicle's maneuverability is very good because of a possible steering angle nearly about 170° and a short wheel base of 0.38 m. The speed approximately between 3 km/h. The manual control was easy to operate even by an unskilled person. Problems occurred at a high speed, where there are difficult to control the single steering wheel. So to reduce the difficulty, the same size of sprockets for driving and steering system was used to make sure the speed is same for both systems. The results were reasonable for a simple and not precise agricultural application. As long as the objective of this project to distribute the pesticide is accomplish, the objective of this project had been accomplished. At the end of this project, a few recommendations that can improve the maneuvering capability and automation system of this vehicle in the future had been state.

DEDICATION

For my beloved mother, father, my brother and sisters

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Assalamualaikum .....

First of all I want to thanks The Almighty God because with his permission let me finish this report with successfully even during this project I had many difficulty. A lot of tank also for my beloved parents Hj. Yosri b Yusuf , Hjh Azizah Bt Abd Latif and all my family that always gave me a lot of support during this project.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Rice has become the main meal for Malaysian people since earlier time. To produce a rice, it will go through a long and many process. Usually, a rice production in Malaysia in done twice a year. Below I have listed the process from seedling until the harvesting season for paddy in Table 1.2.

From table one, we can look that there will be 3 times for farmer to spray the pesticide. That's process will take a bout 21 days from 110 days for harvesting the paddy for one season. This process is a tired process. Now days, farmers usually will spread their pesticide using the pump that carried at their back. Usually the farmer's age is among 40 to 50 years old. To cover the paddy field for only acre, it will take the farmer to walk across the paddy field to separate the pesticide in the middle of sunlight. In addition, the pesticide also not good for human and for the farmer, they had to mix the pesticide and at the same time distribute the pesticide by them self. This are really bad for healthy especially for long term effect.

So to counter this problem, my group decided to create a kind of mechanism that will help the farmer to separate the pesticide in easy ways. From the table 1, it shows the pesticide control plays the main process is harvesting the paddy. Nowdays, a work as the

farmer also can produce a good income. For example, the table 1.3 shows the income for the farmer in 8 main producing areas for paddy in this country. For one season, the farmer at MADA area can get RM 2040.00 per hectare. One season usually will take 120 days. So, the income for the farmer also reasonable and not very bad as many people though.

So, if we look for the farmer income for one season add to the government concern for the agriculture industries especially for Rancangan Malaysia Ke 9 (RMK 9), we believe, the paddy industries will play the main factor that moves this industries. To gain the paddy production, the farmer must from the traditional ways of harvesting to the new age of technology that applied the application of automation like in the major industries. Finally we hope, on day the agriculture industries especially the paddy industries also can be among the contribution of country development.

1.2 Agro climatic Requirements

Figure 1.1

In the table 1 below is the list of the optimal condition to growth the paddy. All the data had been provided by MADA (Muda Agricultural Development Authority) [1]. The information in this table is useful for me as reference to build the driving mechanism for the pesticide distribution. For the example, the soil type, temperature and the frequency of the rainfall will affect the mechanical design. This is because the level of water and the clayey of the soil will influence the driving mechanism.

Table 1.1: Agro Climatic Requirement

Temperature	20-33°C
Rainfall	200-300 mm/month
Soil type	clay, salty clay, clay loam, sandy loam
Soil pH	5.5 - 6.5

Table 1.2: Process involved in harvesting paddy

After harvesting (days)	**Operation**	**Remarks**
0	Increase drain density	For poorly drained areas
0-1	Cut stubble	Service cutter or shredder attached to a 4-wheel tractor is used for this operation. Spread the straw and stubble evenly
1-3	Burning	To destroy weedy rice seeds on the ground and to promote new emergence of weedy rice from the soil seed bank
3-5	**Spray pre-planting herbicide (paraquat, glufosinate or glyphosate) at recommended dosage**	**Herbicide application should be carried out if burning of rice stubble cannot be carried out properly**
11-13	1st tillage (dry) after harvesting (shallow rotovation up to 7.5 cm) and major levelling if necessary	Standard seed bed preparation. Removal of perennial weeds and to encourage germination of weedy rice. Land levelling depending on plot

		configuration (cut and fill operation).
21-23	2nd tillage (wet) and minor levelling	To encourage germination of weedy rice seeds after rotovation. Skilled operator is needed for the levelling operation.
31-33	**Spray pre-emergence herbicide i.e. pretilachlor (1.5 lit. product/ha) one day before 3rd tillage, or it can be incorporated during tillage under standing water conditions**	**Standing water after tillage is important for herbicide to be effective in reducing weedy rice seed bank.**
38-40	Land smoothing/levelling/rotovation	Adequate rotovation will eliminate weedy rice emergence. Water level ± 3cm distribution as a standard reference for land levelling.
Days after sowing (DAS)		
0	Broadcast pre-germinated rice seeds. Seed rate 150 kg/ha. 200 kg/ha for water seeding (seed germination >85%).	Sowing should be carried out immediately after land levelling

	Selection of herbicide, depending on time of application, water depth and weed species to be controlled	**In normal practice, water should be flooded as early as 5 DAS.**
12-15	Apply Cyhalofop-butyl @ 100 g a.i./ha + Bensulfuron methyl @ 30-50 g a.i./ha	Wide spectrum herbicides for weed control.
30-40	Selective weeding for grassy weeds/weedy rice	Remove plants from competing with rice crop
Days after sowing (DAS)	Operation	Remarks
65-85	Cutting panicles of weedy rice	To reduce future seed bank
110-120	Harvesting	Combined harvester from areas seriously infested with weedy rice should be properly cleaned to avoid spread of weed seed.

1.3 Economics

Table 1.3: Net Income Per Hectare For Paddy Per Season

Area	Average Yield (ta/ha)	Gross Income (RM/ha)	Production Cost (RM/ha)	Net Income (RM/ha)
MADA	4.3	3861	1821	2040
KADA	3.2	2874	1539	1335
IADP P.PINANG	4.0	3592	2237	1355
IADP Krian/ Sg. Manik	3.0	2694	1685	1009
IADP Sbg. Perak	4.0	3592	1999	1594
IADP Barat Laut Selangor	5.2	4670	3097	1573
IADP Ketara	4.1	3682	1817	1865
IADP Kemasin Semarak	3.7	3823	1658	1665

Notes:

a. For direct seeding, land preparation, harvesting and transportation of paddy are by contract.
b. For transplanting, land and nursery preparation, planting, harvesting and transportation of paddy are by contract.

1.4 Objective

To help the farmer, I we had design one automation system that will help the farmer to carry out the pesticide and then distributed the pesticide to the paddy field. Our aim is to develop one mechanism that easy to operated, low cost and effective in the field. The main challenge to design this mechanism is to face the paddy field terrain with clay, salty clay, clay loam, and sandy loam of soil. Beside that, the temperature between 20 to 33 °C with the rainfall between 200 to 300 mm/month will make the condition of paddy field is wet and muddy. Refer table 1.3.

So referring to my thesis topic, I had to develop the driving system for this mechanism. Generally I had the idea to design the driving mechanism from the tractor that usually use by the farmer to lose the soil. But for this system, I had to design it in a small scale with new driving mechanism and power supply. The main criteria is to developed one driving mechanism that have a good mobility in the paddy filed terrain and at the same easy for the user to carried the mechanism where ever they want to go.

CHAPTER 2

LITERATURE REVIEW

2.1 Mechanical Design

2.1.1 Ag Bo

Ag Bo created by Tony E. Grift [2] is a flexible industrial style robot with a sophisticated steering, sensing and communication arrangement. It has independent four-wheel steering, four steering modes (including crabbing and spinning) and inclination control. A SICK laser range finder, combined with an electronic compass, was used for crop guidance. The main communication among sensors, actuators and controllers was implemented using a Controller Area Network (CAN). Ag Bo was developed as an industrial style robot for crop row applications (Figure 1).

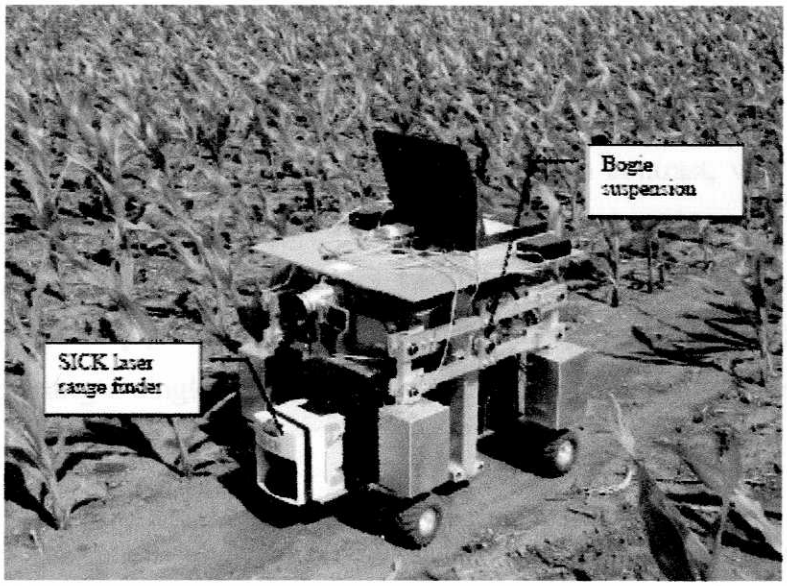

Figure 2.1: Ag Bo Robot

Mechanical layout

The width of the robot was set to fit within standard cornrow spacing of 75 cm and for simplicity of turning and cosmetic reasons, the length was chosen equal to the width. The total height was approx 80 cm. Although the majority of components were made out of aluminum, the total weight, including batteries, was approx. 100 kg.

Ag Bo was fitted with Bogie suspension (parallel linkage suspension on either side), which guarantees that all wheels are in contact with the ground at all times. In addition, inclination control was implemented which allows the robot to tilt forward and backward (used to control the angle of attack of the laser guidance unit).

Ag Bo has four steering modes

1) Front Wheel steering (used in crop guidance),
2) All Wheel Steering (enables short radius turns),
3) Zero Radius Turn (spinning in place). The steering also correctly incorporates the Ackermann principle. Each wheel was fitted with 50W DC brushless gear motor for propulsion and a 20W DC gear motor for steering.