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Development and Automation of Robot with Spraying Mechanism for Agricultural Applications

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Abstract: This paper presents a technological solution to the current human health hazards involved in spraying of potentially toxic chemicals in the confined space of an atmosphere. This is achieved by the design and construction of an autonomous mobile robot for use in pest control and disease prevention applications in commercial Farm. The effectiveness of this platform is shown by the ability to successfully navigate itself down rows of a Farm, spray the pesticides effectively while the farmer controls it from a far distance. And this pesticide spraying system efficiently covers the plants evenly with spray in the set dosages.

Keywords: Autonomous Mobile Robot, Pesticide Spraying System, Human Health Hazards.

I.INTRODUCTION

In the very early years the fields were cleared of weeds and prepared for planting by hand at great effort, using primitive hoes or digging sticks. The invention of the plough was started about 6,000 years ago and it was a great labor-saving device for humans - the beginning of systematic substitution of other forms of energy, in this case animal power, in replacement of human muscles.

In india after the independence the demand of food increased drastically and in order to meet the heavy demand of food the farmers had to increase the productivity of the crops so that they can be made market ready as fast as possible.To meet this need the farmers had to use more amount of fertilizers. Fertilizers are mainly classified as organic and inorganic fertilizers. The organic fertilizers (animal wastes and plant residues) must be broken down into inorganic forms in the soil before plants can take up the nutrients required for growth and reproduction. They are relatively inefficient because they contain low concentrations of nutrients and hence, large volumes of material need to be transported and spread over fields to overcome deficiencies. Also, organic fertilizers take time to breakdown into inorganic forms and become available to plants. In contrast, inorganic fertilizers have a high concentration of nutrients that are rapidly available for plant uptake. Relatively small quantities of inorganic fertilizers are required and transport and application costs are low. In addition, inorganic fertilizers can be formulated to apply the appropriate ratio of nutrients to meet plant growth requirements.

1.1 Disease caused due to Pesticide

Due to the spraying of pesticides the farmers get infected towards various type of diseases like soil borne, air borne and water borne. These diseases are very contagious and can cause severe health hazards. Below we have described some of the types.

1.2 . Soil Borne

Out of all the diseases the most prone diseases is soil borne because here the farmer will think that everything is going right or he is doing everything right and yet the plant becomes sick, stunned and ultimately die. Soil borne disease is caused by the microorganism that moves in the soil. Most cannot be seen by the eye and goes undetected, until the plant is affected by it.

1.3 Air Borne

In air borne disease farmers are exposed to many chemicals that affect exposed skin and may cause respiratory problems through inhalation. Ammonia (NH3) is used as a fertilizer and reacts with water to form a strong alkali that may damage the respiratory glands and air activity. It can reach toxic levels and can lead to chronic bronchitis, bronchial reactivity, pulmonary fibrosis or bronchiolitis obliterans. Oxides of nitrogen (NO, NO2, N204) are found

in freshly filled silos and may cause death from asphyxia, laryngospasm, or delayed pulmonary edema.

Pesticides pose serious threat to agricultural workers because of toxic effects on the nervous and other organ systems at high exposure levels. They enter the body by inhalation through the nose and mouth into the lungs, absorption through the skin, or through the digestive tract.Some pesticides may produce respiratory center failure and/or respiratory muscle weakness by their irritant effects on the airway.

1.4. Water Borne

Water Borne disease are any type of illness caused by the drinking water which is contaminated by human or animal fasces, which contain pathogenic microorganism. Farmers are least affected by this type of disease as they don˝t stay too much in water.

II. DRAWBACKS OF PRESENT FARMING TECHNIQUES

In the present Indian farms the farmer has to spray the pesticides manually. The manual spraying makes them easily susceptible to hazardous disease mostly like air borne and water borne.The process of pesticide spraying involves large amount of human labor thus making more number of -humans to get prone by the diseases. There is no other alternative to manual spraying in Indian open farms.

Over usage of pesticides can cause degradation in soil. This happens mostly because the farmer hires labor for the work and the labor is unskilled.
Until now the technologies used in farms are outdated and the present farming needs revolutionary technique of farming.

III. PROPOSED SOLUTION

"Automation as a part of solution"

1) The actual concept is to make an automated robot using ARM7 controller which will eliminate all the health issues.

2) This robot is expected to be an all terrain robot.

3) Efficient and health conscious operation due to remote control.

2.1 Hardware Component

1) Battery.

2) ARM7(lpc2138) controller.

3) 4 DC Motors.

4) Robotic Chassis.

5) Tires.

6) Relay Board.

7) RF Module for wireless control.

8) Spraying Pump for pesticide spraying.

9) Storage Tank

2.2 Block Diagram

There are three main units namely:

1. Input unit.

2. Spray and Control Processing unit.

3. Output unit.

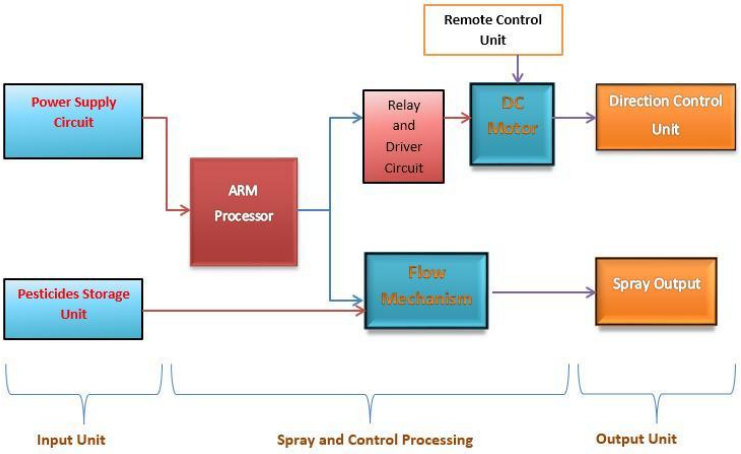

Fig1 .Block diagram of system

IV. IMPLEMENTATION

Pesticide spraying mechanism with the help of current robotics technology is the main purpose of this project which would help the farmer in his day to day spraying activity. This project is basically a robot with an attached spraying mechanism and is divided in two parts.

1) Robotic Chassis
2) Robotic Arm with spraying mechanism

First we started by designing the chassis for our robot. Our main challenge was to design an adjustable chassis which could carry a load of 20-25 Kgs, so for it we used iron as the metal for chassis. But the chassis itself weighed 5Kgs, so in order to avoid excessive weight of the device, iron has not been used as the only metal in

the chassis of the device; whereas aluminum is used in most part of the chassis and iron has been used only in some places instead of aluminum as aluminum is a brittle metal. The image of chassis made with optimum use of iron and aluminum which runs of four wheels is shown here.

Two D.C. motor are fixed in the backside with torque of 30Kg.cm. Two free wheels are fixed in front portion of the chassis. The shaft of these four wheels has been attached to a 7 cm diameter small wheel. The small wheel cannot run directly on field because in doing so, it is not possible to get complete ground clearance as the field is uneven. Hence, small wheel is attached with a bigger wheel of diameter 22 cm with the help of a chemical solution, Araldite. It should be noted that the motor shaft cannot be attached directly to the bigger wheel, therefore small wheel is used.

Having connected the four wheels to the shaft of the motor, 80*60 cm fiber sheet is placed on the chassis of robot with a view to making room for placing any material thereon. The sheet also acts as the base to the entire components placed on the chassis

. Now moving forward to robotic arm, the arm is fixed in the centre of front portion of robot. In order to facilitate smooth spraying of pesticide in any direction, the arm is fixed in the centre of the front. Two aluminum strips of 2 feet each are penetrated at parallel distance of 6 inch on the big wheel. Holes are made at a distance on 2 inch in both the strips to give support with an 8 inch nut-bolt.

Further a small wheel is joined with araldite to the bottom of big wheel, which is placed parallel on 7 kgcm motor shaft. The motor cannot be place directly on the chassis so in order place it we have welded a hollow iron pipe to the aluminum strip and have also attached screws to the welded portion. Moreover one thing should be clear that the robotic arm is not able to balance itself properly so in order to solve the balancing problem we have used four wheels, each of 7 cm in the bottom portion of the arm. These small wheels will rotate on the fiber sheet.

V.MERITS

1. Wireless operation will eliminate the health issues and would even save them from tedious work.

2. It will have less use of manpower.

3. Efficient and health conscious operation due to remote sensing.

4. With the help of live feed of spraying the farmer is expected to control the robot wirelessly from a distant place.

5. This Robot is expected to be an all terrain robot.

VI. FUTURE SCOPE

1. The spraying mechanism can be closely observed by using a camera which would be mounted near the robotic arm giving the farmer live feedback of the spraying.

2. Integrated GSM module which could control the start/stop and run operation of the robot.

3. SMS based system to start and stop the service

4. Preprogrammed GUI based navigation system

5. Android interface to navigate the robot

6. Programming based on crop type and amount.

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