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OPERATION OF AGRICULTURE BASED PESTICIDE SPRAYING ROBOT

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ABSTRACT

When compared to manually spraying pesticides outside, the atmosphere for operating the spray work in the green house is more enclosed. Additionally, the temperature and humidity levels in the green house are significantly higher. We are developing a prototype of a pesticide spraying robot that will be used specifically in greenhouses in order to both protect workers and decrease the amount of work that has to be done. Microcontroller PIC16F877A is what gives the robot its movement and behaviour commands. The development of the most up-to-date inverted ROBOT, which can be controlled by means of an application for android mobile devices. We are now working on integrating remote buttons into the Android app so that we may use them to control the mobility of the robot. Also, the communication between the controller and the android device is accomplished through the usage of Bluetooth. Through the use of the UART protocol, the controller may be connected to the Bluetooth module. The movements of the robot may be regulated in accordance with the orders received from the android. The production, quality, and reproducibility of a robotic system are unrivalled, and the consistency of that output is unrivalled as well. Even if the prototype's productivity is not quite as efficient as it might be, the robot is nevertheless able to fulfil the needs of spraying pesticides in the greenhouse without the need for human operators.

KEYWORDS: *Android Smartphone, Bluetooth Module, Robot, Single Microcontroller Chip.*

INTRODUCTION

Since the 1970s of the previous century, China has been gradually popularising the use of plastic greenhouses and diverse planting techniques, which has resulted in significant advantages for the country's economy as well as its social and environmental conditions. These days, China has surpassed the United States to become the nation that is responsible for the production of the most greenhouse gases. There is still potential for improvement in terms of both the management of greenhouse production and the level of automation present when compared to countries that are farther advanced in their development. For instance, in terms of production equipment in greenhouses, a substantial amount of the spraying task in China's small and medium greenhouses is accomplished by means of a manual knapsack sprayer. This is the situation in a significant portion of the greenhouses. Farmers are compelled to labour for lengthy periods of time in situations that include inadequate protection, extreme heat and humidity, and inadequate ventilation. These conditions make it difficult for them to do their jobs safely. Over 65 years old is the typical age of a greenhouse manager, which is far older than the norm in developed nations and especially Japan.

The usage of pesticides has a considerable influence on the agriculture business. The use of pesticides has been successful in preventing the destruction of more than 35 percent of the crops that would otherwise have been grown. Although the application of pesticides in agricultural settings is necessary to achieve better levels of production, these chemicals may be damaging not only to people but also to the natural environment in which they are found. Along the length of the agricultural fields, farmers make use of the backpack sprayer shown in Figure 1(a), which requires direct human intervention to operate. This strategy is the one that is being implemented at the moment. They used to manually apply the pesticides in a regulated and targeted way. In this particular instance, the sprayer is fastened to the back of the tractor, which the human operator was controlling. Insecticides were applied to the various crops that were growing in the field at the time. This strategy does not include the use of targeted spraying; rather, the pesticides are spread out throughout the field in a more even distribution.

Fig. 1 Methods for spraying pesticides

(on the left) [Figure 1(a)] Right: a backpack sprayer (seen in Figure 1b) Sprayer for tractors

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Humans are still exposed to potentially hazardous pesticides, which can result in adverse health effects despite the use of pesticide protection gear (individual head veil and focused filtration system for the manual and automated spraying tactics, respectively). This exposure can have a negative impact on the health of the human population. Both automated and human spraying procedures have a range of downsides, in addition to the health hazards that are linked with them. The motorised spraying does not have a particular objective in mind; rather, it is meant to sprinkle a harvest strip with a changed stature (e.g., for spraying only the grape bunches the rancher will show the shower spouts to shower a strip 0.5 m wide with no thought of the natural product area). In addition, because there is a shortage of labourers available in the horticulture business, manual spraying is a form of labour that is monotonous, somewhat strenuous, and confined.

The management of greenhouses in Japan has reached a high degree of automation, and the sector as a whole is advancing in the direction of becoming entirely unmanned and completely automated. They have created what is being referred to as the "plant factory," which is the greenhouse production model with the most cutting-edge degree of sophistication available anywhere in the world. The whole manufacturing process is orchestrated by computers, and the model makes use of additional artificial illumination in order to get the desired effect. Because the cultivation is done by robots or robotic arms, it is completely free from the constraints that are imposed by natural circumstances [1-2]. Because of this, it is of the highest necessity for us to develop agricultural technique equipment and increase the level of automation that is present in our greenhouse production equipment in order to satisfy the demands of the new era.

Smart phones in the modern world are becoming increasingly powerful as a result of the inclusion of more powerful central processing units (CPUs), higher storage capacity, more robust entertainment capabilities, and an expanded number of communication channels. The transfer of data is Bluetooth's principal usage, and because of this, users of smart phones are able to access extra features thanks to this technology.

In 1994, the Swedish telecommunications firm Ericsson was the first to create the Bluetooth technology [1, and the technology has since shown its worth by getting integrated with smart phones].

Fig.1: Pesticide Spraying Robot Working in Greenhouse

People now utilize digital devices differently at home and in the workplace, and traditional wired digital devices have been replaced with wireless digital devices as a result of this transformation. A host Bluetooth device has the capacity to communicate with as many as seven Bluetooth modules at the same time throughout the course of a single link [2]. Due to the fact that its regular operating area is within eight metres, it is particularly helpful in the context of a domestic setting. Because of Bluetooth technology and other similar approaches, and thanks to the huge growth in the number of people using smart phones, smart phones have progressively evolved into an all-purpose portable gadget that people may use for their day-to-day activities [3-4]. Android is an open-source operating system that has been increasingly popular in smart phones over the past several years [5].

LITERATURE REVIEW

The ARM-Based Pesticide Spraying Robot has proposed a system that will have a wireless camera mounted on it and it will be connected to the central system. The bot will scan every plant completely and sends that image to the central station. The people who are in the station will inform the robot the plants that are defective and the robot will immediately spray the pesticides on it. The primary advantage of this robot is that it will scan the plants completely and it was built using the ARM.

Because of its snake-like shape, the bionic electric spraying rod that has been constructed is capable of performing not one but two functions: first, it will sprinkle insecticides throughout the entire farm; second, it will spray water across the entire farm. For the purpose of spraying pesticides, a snake arm is utilised, which is attached to the spray nozzle. The snake bot has a bone arm and muscles that are made up of many sets of tiny wires, and it can be controlled by the driver module.

At this point in time, the farmers are playing a pivotal role by toiling away in the fields of agriculture and producing crops in order to provide the communities that reside in various regions with the means to meet their fundamental requirements. The percentage of people who use pesticides is far greater in India, at 70 percent, but the percentage of people who use pesticides globally is just 44 percent.

In order to do this, work is being done to establish a system for the intelligent sensor-based monitoring of the environment. This project will help us monitor the weather, temperature, and any other climatic conditions with the assistance of an IOT device because it is not always possible to monitor the weather in areas with low populations, such as rural areas and agricultural areas, for example. Because of this, the project will help us.

People in the 21st century are faced with a number of challenges, one of which is "Precision Agriculture." It is mostly dependent on the soil's compactness and the plants that have defects. As a result, they developed a system that can be purchased in a spherical shape. Because of this, it may travel in any direction in between the crops, and the amount of harm that is caused to the farmer is also kept to a minimum.

The use of robotics in agriculture has seen increasing expansion in recent years. The usage of robotic growth is quite helpful in achieving the big shifts that are now taking place in the agricultural industry. The most important thing that has to

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be taken into account is making sure that the pesticides are sprayed evenly throughout the whole crop without causing any harm. Since the early diagnosis of diseased plants is really helpful, doing this will make it much simpler to apply fertiliser.

India is a nation whose economy is heavily dependent on farming and all of its associated activities, such as planting seeds, mowing grass, and applying pesticides. In order to carry out these tasks, the farmer will want a significant sum of money to pay the employees. This is a time-saving method in which only one robot is needed to carry out all of the responsibilities detailed above, as no further assistance is required from any other source.

SMART FARM

Operating system, apps at the heart of the platform, and a layer of middleware are all included in Android's comprehensive software package. In contrast to other platforms already on the market, such as Apple's iOS (iPhone OS), it comes with its own software development kit (SDK), which includes all of the necessary applications and tools. The concept of using a smartphone as the central processing unit of a robot is already an active area of study that is home to a number of untapped potentials and exciting prospects. In this article, we give an overview of contemporary robots that can be controlled by a mobile phone and explain a closed loop control system that makes use of the audio channels of mobile devices such as smartphones and tablet computers. In our work, we use an android application like Arduino Bluetooth RC Car to drive the robot in many directions, including forward, backward, left, and right. The following is the structure of this article: In Section II, we explain what inspired us to do this study; in Section III, we describe how our experiment was set up; in Section IV, we illustrate a conversation about how our experiment was set up; and in Section V, we offer our findings and findings from the discussion.

Integrating cutting-edge technology into farming software may bring both increased production efficiency and improved product quality in the agricultural sector to a higher level. This is made possible by the adoption of smart farming practises. By reducing the amount of labour that is required, it brings the ranchers a continually increasing level of personal pleasure.

"We are obligated to offer a solution to the problems pertaining to the development of the population, changes in the environment, and employment." In addition to this, these factors have accelerated the emergence of a component that is crucial to innovation.

Fig 1.1 Smart Farming

The advent of technology helps to improve every part of farming, such as planting and watering for the aim of maintaining the health of the crop. The primary three categories of technological advancements in the agricultural industry today include autonomous robotic systems, drone technology, the Internet of Things (IoT), and sensors.

AUTONOMOUS AND ROBOTIC LABOUR

In a number of different industries, including agriculture, human work is being supplanted by that of machines. The majority of the duties involved in agriculture farming are considered to be work, with the majority of this labour consisting of repetitive chores.

Fig 1.2 Agricultural robots

There is currently a market for agricultural robots, often known as AgBots, which can carry out a variety of duties in the agricultural industry, including planting, watering, harvesting, and sorting crops. This innovative kind of intelligent machinery will make it possible to produce food of a higher quality, and it will also minimise the amount of labour that is performed by humans.

REDUCING LABOR

The primary objective of the use of autonomous robots in the agricultural sector is to lessen the sector's dependency on manual labour, which, in turn, will result in improvements to the sector's productivity, output, and overall quality.

In days gone by, the majority of a farmer's time was spent out in the field, working to boost productivity through

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hard labour. In contrast, in the not too distant future, farmers will spend their time on tasks such as troubleshooting coding for robotics, analysing and planning agricultural operations, and repairing machinery.

The sensors and Internet of Things that are integrated into the essential architecture of the ranches were identified as the fundamental spine of these Agbots. The equipment and sensors are the essential components of precision agriculture, and they are able to communicate not only with the farmers but also with one another and with each other, even when they are operating independently.

PROPOSED SYSTEM

In order to put the One Target-One Shoot (OTOS) spraying technique into action, a moveable spraying device known as an ASD was constructed and put to use as a trial instrument. The device is attached to a flexible mechanical sprayer and provides pressurised insecticide.

- The basic concept of the ASD may be broken down into the following:
- Position the nozzle of the syphon so that it faces the harvest (opposite to the yield)
- Determine the distance between each harvested object.
- Determine the placements and widths of the target.
- For each objective play out the accompanying daily practice. Direct the ASD toward the objective focus;

Adjust the measurement of the spout so that it gets closer to the final hover distance over the target; and Turn on the electric sprayer valve for a certain, specified amount of time.

This project's primary objective is to develop a pesticide spraying system that, when combined with the most recent advancements in mechanical technology, will be of great assistance to the rancher in the course of his regular spraying activities. This job consists mostly of a robot that has a combined spraying device attached to it, and it is divided into two distinct halves.

Robotic Mechanism

Pump engine with spraying instrument

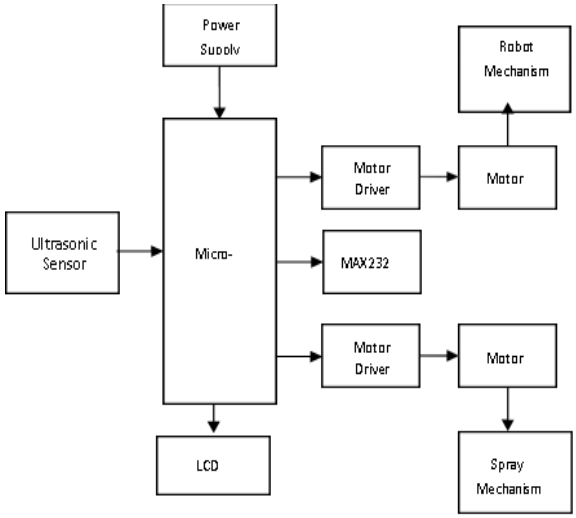

Fig.4.1TransmitterModule

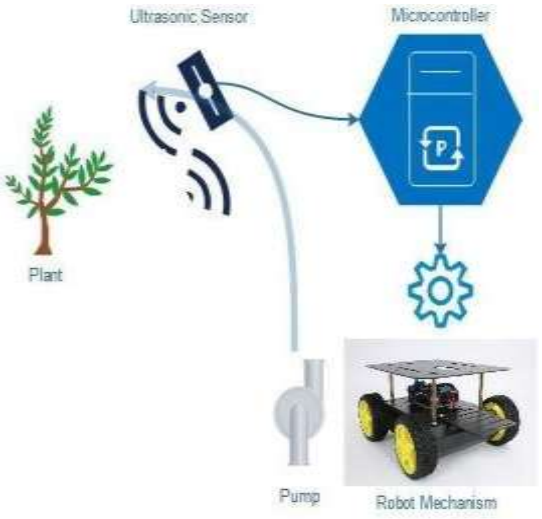

Fig. 4.2 Architecture Diagram

In the beginning, work was done on the blueprints for the robot's casing and undercarriage. Our first objective is to design a container that is capable of transporting loads weighing between 2 and 5 kg. As of right now, we have been using iron as the primary metal for the skeleton. However, the framework or casing weighs around 1 kilogram.

Iron was not used as the metal in the skeleton of the device because the designers wanted to avoid the excessive load that would be caused by the device. Instead, tough aluminium was used in the majority of the suspension, and iron was used in only a few spots in place of aluminum because iron is a more robust metal than aluminum.

The solution to the spraying problem is provided by the system that has been proposed. The spraying problem centers on the need to find a spraying solution for articles with a vague variable-shape and size importance to sprinkle singular targets specifically by setting the detachment of the spraying according to the shape and additionally the degree of the goal.

SYSTEM IMPLEMENTATION

PIC16F877A Microcontroller

PIC 16F877, a member of the Microchip family, is the microcontroller that will be utilised in the project. This particular microcontroller was chosen for a great number of different reasons. It operates at up to 20 MHz and features a core with 14 bits and a DIP with 40 pins. In addition to that, it contains rewritable memory stored in its flash memory. This microcontroller is incredibly simple to put together, and it is also very simple to write programmes for. In addition, it is quite affordable. The amount of time spent wiping data is nearly imperceptible due to the fact that when new programmes are put into the PIC, the previous programmes are quickly wiped automatically.

PIC16F877A has 368 bytes of Random Access Memory (RAM) built into it during the manufacturing process. The runtime memory (RAM) is used to store any temporary variables that are utilised within the application, which eliminates the need for any additional memory to be kept outside. Inside of the PIC16F877A ROM, the maximum amount of computer code that can be stored is around 8k words. The size of a single word is 14 bits, which is more than

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sufficient for the system. There is a range from DC all the way up to 20 MHz for the speed of the crystal oscillator that may be attached to the PIC microcontroller [11].

HC Serial Bluetooth

Both a Bluetooth serial interface module and a Bluetooth adapter are included in the HC Serial Bluetooth package. For the purpose of converting serial ports to Bluetooth, a Bluetooth serial module can be utilised. This module may operate as either a master or a slaver device depending on the situation.

The device with an even number in its name is predetermined to be either a master or a slaver when it leaves the manufacturer, and it cannot be switched to operate in the other mode. Users can set the work mode (master or slaver) of the device that is named after an odd number by using AT commands, but only for the device that is named after an odd number.

HC-06 Included in particular are the following: Master device: HC-06-M, where M stands for "Master"; Slaver device: HC-06-S, where S stands for "Slaver"

The replacement of the serial port line is the primary purpose of the Bluetooth serial module. For example, one module connects to a Bluetooth master device, while the other module links to a Bluetooth slaver device. After they have been paired up, they may next work on developing their bond. This Bluetooth connection is analogous to a serial port line connection and includes RXD and TXD signals as part of its functionality. In addition to this, they are able to talk to one another

1. When an MCU has a Bluetooth service module, the device is able to communicate with the Bluetooth adapter of a computer or a smart phone.
2. The majority of Bluetooth gadgets now available on the market are therapeutic in nature, such as Bluetooth printers and Bluetooth GPS units. As a result, we can utilise the master module to form pairs and interact with the other members of the pair.
3. The functioning of Bluetooth serial modules does not require a drive, and they are capable of communicating with other Bluetooth devices. However, in order for there to be communication between the two Bluetooth modules, at least two requirements need to be met:

- The communication must be between master and slave.
- The password must be correct.

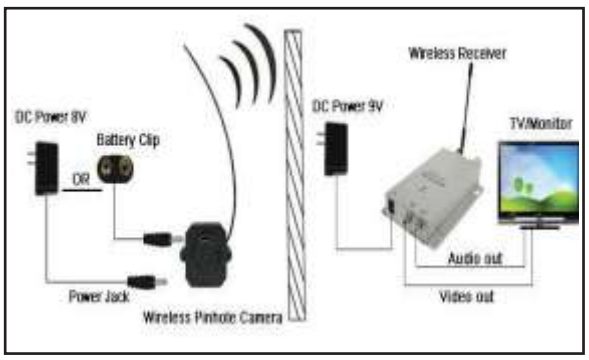

Fig.5: The wireless Camera/Transmitter

First, the camera takes a picture, then the camera sends the video to the transmitter, and finally, the transmitter transmits the wireless signal to the receiver. There is a wide variety of wireless cameras available. Adding a wireless transmitter and receiver to a camera will make it possible to turn it into a wireless camera. Power is required for both the camera and the transmitter. The power can come from either a battery or a transformer/adapter combination. The subsequent diagram shows the whole wiring configuration (Diagram 1) for the wireless camera and transmitter end.

Power is required for both the camera and the transmitter. The camera captures a picture and transmits it to the transmitter; the transmitter, in turn, broadcasts the signal into the atmosphere. The signal is picked up by the receiver, which then sends it to a TV, computer, or digital video recorder as an output. This is a straightforward diagram. Both the cameras and the transmitters used in many wireless camera systems are quite compact, and they share a single power supply. A covert wireless camera is a great illustration of this concept. IE: You can power a clock radio wireless camera by connecting the clock into an electrical outlet. The power for the camera and wireless transmitter comes from the clock radio itself, which is located within.

Block Diagram

A robot that is controlled by Android using a smart phone. Using the Bluetooth module HC-06 and the PIC16F877A microcontroller on your Android smartphone, you can now easily take control of your robot or robo vehicle. Microcontrollers are the gadgets that are in charge of controlling the entire system. The microcontroller may communicate with the Bluetooth module as well as DC motors. The data that is received from an Android smart phone via a Bluetooth module and then delivered into the controller is considered input. The controller responds in kind to the actions taken by the DC motor of the robot. The android phone may be used to provide the robot in the project the ability to move in any of the four directions simultaneously. LED indicators on the robot system are used to indicate the direction the robot should be moving in. In order to complete the work, the controller is programmed with an embedded C language software that is put onto it.

Wireless Camera

In their most basic form, wireless cameras may be conceptualised as wireless transmitters that transport camera signals. The camera is connected to a wireless transmitter by a cable, and the signal is sent from the camera to the receiver through this connection. This operates in a manner quite similar to radio. The sound that is heard on a radio is produced through wireless transmission; in order to hear the sound, one must tune the radio to a specific frequency. Wireless cameras also have something called a channel. The receiver provides a number of channels that must be tuned in before the picture can be seen. The wireless camera image is transmitted by the transmitter, and the receiver takes this signal and, depending on the type of receiver, sends it to either your computer monitor OR your television monitor.

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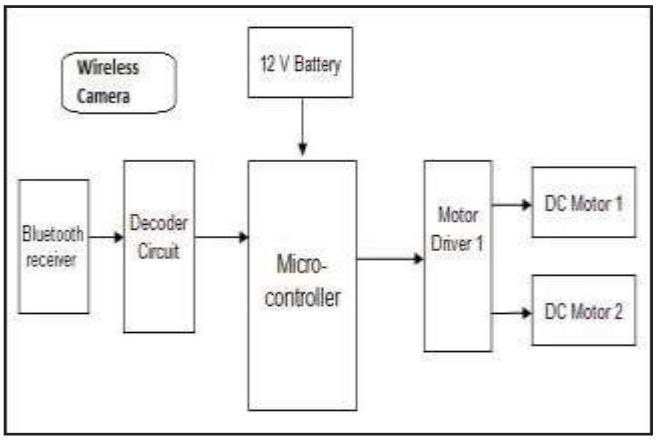

Fig.3: Block Diagram of Proposed System

CONCLUSION

Based on the results of the trial, it was determined that the robot is capable of essentially finishing the operation of automated control and satisfying the spraying criteria in the greenhouse. The control system is quite stable and has a high degree of dependability. When the robot is moving at a speed of less than 0.5 metres per second and has a turning radius of more than 0.5 metres, the wireless camera bases tracking function works very well. The spraying element has the ability to modify its position within a given range based on the height of the target, with the goal of minimizing the amount of leaky spray and heavy spray that is produced. The robot system has not been perfected yet and still has certain flaws. For instance, there is no locating system for the nozzle, and when the robot is in operation, certain manual instructions must also be followed in order to use the remote control. The system does not come equipped with any mechanisms that can automatically alter the amount of spray. Given the current state of affairs, which is characterised by the rapid development of technology for precision agriculture, we ought to exert more effort to create variable automated spray on the target.

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