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SEKTROO: Smart Automated Pesticide Sprinkling Bot

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Abstract

— In today's world, the farmer plays a vital role by working hard in the fields and growing the crops for the people that are living their life in various places for earning their basic necessities. In India use of pesticides is 76% as against the world's average of 44%. Pesticides application on plants pollutes water and air. This can be reduced using improved field maintaining techniques. The effectiveness of proposed system is shown by its ability to successfully navigate the bot into the rows of plantation type of farm. When the bot sprinkles pesticide, covering all plants in the farm, it also provides a proper notification time by time with the help of GSM Module. The working of bot depends on the heart i.e Arduino Mega 2560, it combines all the other modules and make

synchronized for the proper functioning of bot. The Raspberry Pi and Camera Module is used for the detection of infected plants. Ultrasonic Sensors are used for object detection, Wi-Fi Module for accessing the images of infected plants, Pumping Motors and Sprinkler Nozzles are used for sprinkling pesticides on the infected plants.

Keywords

—Arduino Mega 2560, Accelerometer, Bluetooth Module, Camera Module, GSM Module, Gyroscope Sensor, Micro-SD Card Module, Pumping Motors, Raspberry Pi, Sprinkler Nozzles, Ultrasonic Sensors, Wi-Fi Module.

INTRODUCTION

An embedded system is a special purpose computer system designed to perform one or a few dedicated functions with real-time computing constraints including hardware, software and mechanical parts[1]. India is an agricultural country, Indian agriculture sector contributes 18% of India's gross domestic product (GDP), hence it plays a vital role in the process of economic development of the country. This forms the main source of income. Farmer plays a vital role by working hard in the fields and growing the crops for the people that are living their life into the crowd place for earning their basic necessities. The contribution of agriculture in the national income in India is more, where 70 per cent population is dependent on agriculture hence, it is said that agriculture in India is a backbone of Indian Economy[2]. According to survey of World Health Organization (WHO), 1 million pesticide cases are observed resulting in more than one lakh deaths every year[3]. As observed, farmer's health is adversely affected, when they spray pesticides in farms. Even after covering their body they still suffer from various diseases that are related to skin and respiration. In order to reduce the problems such as health effects of farmers, finding the labours, managing the resources. The proposed embedded system is the automated bot which works on Arduino IDE. It is developed mainly for plantation and intensive type of farming..

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Bot has multiple functions, it performs various operations such as scanning, detecting the infected plant, sprinkling pesticides, storing location of infected plant and notifying the farmer about the same along with keeping thearmers health into consideration. The effectiveness of this platform is shown by the platform ability to successfully navigate the bot into the rows of plantation farm. While the pesticide spraying, system efficiently covering all plants in the farm. The idea of proposed system serves as a helping hand to farmers for maintaining their fields hence this system serves a better solution by leading to negligible interaction between the farmer and the pesticides.

. PREVIOUS WORK

T. Chen, et al.[1], proposed a system which is an automatic guided vehicle and it controls the unwanted spraying of pesticides on the plants. The height of the plant is calculated with the help of depth sensor. S. Spoorthi, et al.[2], proposed a system which is a drone i.e. a quadcopter is controlled by farmer via application connected to smartphone using Wi-Fi. Drone sprays pesticides evenly on the crops in field. E.Ozgul, et al.[3], proposed a system which is X-bot robot composed of different sections spraying mechanism, insect repellant mechanism. Z. Diao, et al.[4], proposed a system which is robot designed for spraying the pesticides crop on wheat, they used camera module for the process of the image capturing. S. Pilli, et al.[5], proposed eAGROBOT robot system is built in order to spray the pesticide along with the prediction of the diseases. A. Naik, et al.[6], proposed wireless technology using the arduino as a base microcontroller, in order to detect the moisture of the soil and sprinkle water with the help of water supplier pump. The farmer is notified by the message as the plants are watered. S.S, et al.[7], proposed a robot that detects the moisture level, pressure humidity and light that the plant requires along with sprinkling pesticide or fertilizer only by detecting color of leaf. Ratan Lal, et al.[8], proposed a system that robot may find the way to travel through the field to spray the pesticide to all the plants that are been infected in the field. M. Ko, et al.[9], proposed a robot which consists of steering and speed motor too. This paper presents work on strategic navigation research and implementation of advanced automation and control schemes in mechatronics design context of robot. Y. Yang, et al.[10], proposed a system about the robot which is built for watering the plant. The robot will check for the obstacle and also detect the borer insect on tomato plants. An algorithm was developed to achieve high speed efficient video processing for detecting the infected plants. R. Rafi, et al.[11], proposed a system in which robot is designed for water spraying water, check the water level and count the trees along with that it notifies if the water content is below the threshold level. S. Rao, et al.[13], proposed system in which robot is built using the Arduino board that can be used for spraying the pesticide on the plants

. LIMITATIONS IN THE PREVIOUS WORK

System that are built are incapable of detecting the infected plants[1][3]. Wi-Fi Module fails to provide the long range foraccessing the live screening of the field[2]. Unwanted spraying of pesticides on the non-infected plants spoils them

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too[2][3]. It becomes mandatory to provide the line follower in order to make the robot to traverse through the field which is not feasible[9]. Another way to traverse the robot into the field is that the robots path needs to be predefined for traversing into the field which is a drawback as the robot cannot be used into the other field because it will vary in the dimensions of the field[13]. The proposed system does not understand the terminating stage since there is no such specific condition given to it so it continues to work even outside the field[11]. Even if the function of path planning is given to the system but the system doesn't consider the distance to reach the plant which acts as a drawback as it wastes the battery and time of the end user[8]. Every plant requires individual sensor for performing operation of sprinkling pesticide on each plant so here the system becomes costlier hence cannot be afforded by the common people, along with that the detection of the infected plants depends purely upon colour of the plants leaves which results in degrading the accuracy of the system[5][7]

. EXPERIMENTAL SETUP

The proposed system is automated bot whose working depends upon the various components. The components that come together and work in synchronized format in order to make it a successful bot are as follows: i.. Arduino Mega 2560 : It is a microcontroller board. It has 54 digital input and output pins. It is heart of bot. It keeps all the components well synchronized for the proper functioning of the bot. ii. Accelerometer MPU6050 + Gyroscope Sensor GY-521: MPU6050 sensor module is complete 6-axis Motion Tracking Device. It combines 3-axis Gyroscope, 3-axis Accelerometer and Digital Motion Processor all in small package. In this project it is used for the purpose of rotation of bot and for tilt detection of bot

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iv. Micro-SD Card Module : The micro-SD Card Module is a solution for transferring data to and from a standard SD card. The pin out is directly compatible with Arduino, but can also be used with other microcontrollers. It allows to store coordinates of infected plants in our project.

v. Camera Module : A camera module is an image sensor integrated with a lens, control electronics, and an interface like CSI, Ethernet or plain raw low-voltage differential signaling. The camera module is used in order to capture the images of the plants and scanning for the purpose of the detection of infected plants.

vi. Raspberry Pi 3B: The Raspberry Pi 3 Model B is the earliest model of the third-

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generation Raspberry Pi. It replaced the Raspberry Pi 2 Model B in February 2016. It is used in this project for the purpose of image processing.

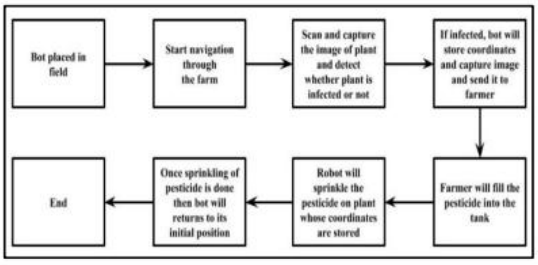
vii. Bluetooth Module : Bluetooth module is designed for transparent wireless serial connection setup. The HC-05 Bluetooth Module can be used in a Master or Slave configuration, making it a great solution for wirelesscommunication. It is used for communication between Raspberry Pi and Arduino Mega. viii. Pumping Motor : A pump is a device that moves fluids (liquids), or sometimes slurries, by mechanical action. Pumps operate via many energy sources, including manual operation, electricity, engines or wind power. It is used for pumping the pesticides present in the tank for sprinkling purpose.

ix. DC Motors and Drivers : A DC motor is any of a class of rotary electrical machines that converts direct current electrical energy into mechanical energy. In this project they act as actuators of the bot and help bot to successfully navigate through the field

PROPOSED SYSTEM

The proposed system is an automated bot. It serves as a helping hand to the farmers by replacing the manual farming technique with the modern farming technique. It reduces the workload of the farmers by sprinkling pesticides on the crops, scanning and capturing the images of the plants, detecting the infected plants, storing location and sprinkling the pesticides only on the infected plants. The bot basically consists of two modes, viz. Mode One and Mode Two. Farmer has an alternative of selecting any either of the modes. Working of bot would depend upon the mode that farmer would be selecting.

Detailed working of Mode One:



As shown above, Fig. 01 highlights all the steps that are going to be executed by the bot. In first mode, it is mandatory for farmers to fill the tank by pesticides when notified by bot. Bot should be placed into the field. Once the bot is placed in the field it will reverse itself unless and until it found a significant boundary barrier. Bot will analyze whether the tank is filled or not. If tank is filled then bot will start sprinkling pesticides on plant successively and will proceed itself towards another plant by using actuators. After sprinkling pesticide on one plant it will analyze, if the pesticide poured in tank is above threshold value or not. If bot analyses that pesticides in the tank is below the threshold value then bot will store its current location. It will move to its initial position from where it has started sprinkling the pesticides. Meanwhile it will notify the farmer by sending the notification that the tank needs to be refilled using GSM module. Once the tank is refilled by the farmer then the bot will resume the sprinkling of pesticides to plants from its last stored position. It will follow the same procedure unless and until it visits every plant i.e. Bot willstop its functioning if it visits all the location of farm and it will return to its initial position.

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Detailed working of Mode Two:

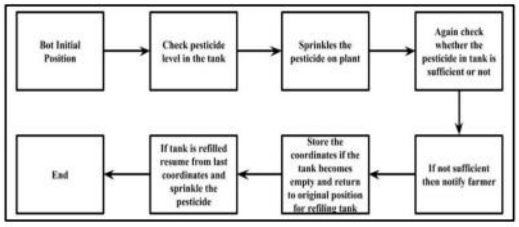

Fig 02: Block diagram of mode two

As shown above, Fig.02 highlights all the steps that are going to be executed by the bot in the coordination with the farmer. In second mode, Bot should be placed into the field. Once the bot is placed in the field it will reverse itself unless and until it found a significant boundary barrier. It will start scanning and capturing the images of plants. It will compare the captured images with the images that are stored in database. Once the bot recognizes that plant is infected, it will store current location of itself and will notify the farmer by sending the normal text message and moves towards other plant. The detection of infected plant is achieved through image processing process. The image that is captured by bot using camera module is served as an input to the Raspberry-Pi, comparison takes place through the CNN algorithm. The prediction of infected plant is done on the basis of the dataset. The bot captures image and stores location of every infected plant and returns back to its initial position. The bot will analyze if the tank is filled with pesticides or not. If bot comes to conclusion that tank is filled, then it will start sprinkling pesticides on each and every location stored earlier as the location of infected plants. Simultaneously, it will also analyze whether the pesticide in its tank is above the threshold value so that pesticides are sufficient for sprinkling on the successive plant. If pesticides are below the threshold value, then it will notify the farmer to refill the tank. To refill its tank the bot will move to its initial position. It's necessary that farmer have to fill the tank then only the bot will resume its work of sprinkling pesticides on the infected plant from the recent pesticide sprinkled plant. It will stop its working once it has sprinkled pesticides on plants on all stored location of infected plants

Condition

applicable to both modes: If bot comes across any obstacle in front of it, then it will try to overcome the obstacle by crossing it and continue its working of mode one or mode two as selected. If bot fails to overcome the obstacle by crossing it then bot will notify the farmer respectively.

. RESULTS

Bot is designed with a low-cost sensor which provides the better pesticides sprinkling system to the farmers and as a result wastage of pesticides is reduced. Bot can be used in intensive and plantation type of farm. An obstacle detection system is used which will check obstacle in a continuousprocess for preventing the bot from getting stuck. Bot navigates through the field successfully detecting the infected plants and stores it location

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Fig. 03 shows a prototype of the proposed system

Fig 03: Sektroo Bot

Fig. 04 shows the detection of the infected plants using the Raspberry pi

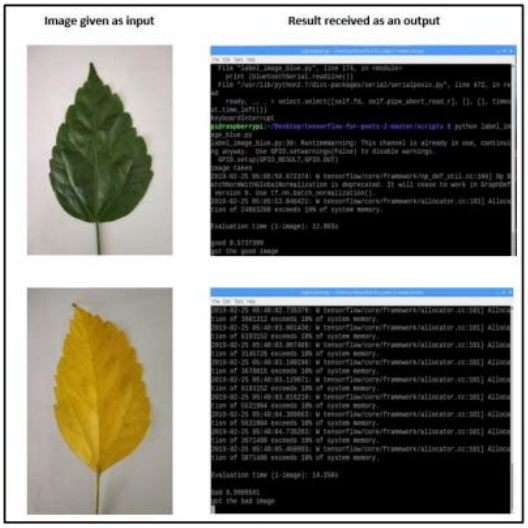

Fig 04: Detection of Infected plants.

CONCLUSIONS

This system is built by keeping the health of the farmer into the consideration, along with keeping the concepts of the resource management in mind. Thus, it is a successful implementation of the bot for assisting the farmers in the sprinkling pesticide. This method is proved as a helpful technique for farmers. Hence, we can say that system is ableto obtain more yield in less amount of resources. Bot navigates through the field, detects infected plants, stores the location of infected plants and sprinkles pesticide on infected plants, notifies farmer if it detects an obstacle in its path and it also notifies to fill the pesticide in tank.

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