Pesticide Spraying Robot using Wireless Camera and Internet of Things (IoT) Concept

Kartik Deshapande[1], Rajesh Anawal[2]

[1,2]*SDM College of Engineering and Technology, Dharwad, Karnataka, India*

ABSTRACT:In the field of agriculture increasing the yield is most important. But weeds and insects reduces the yield by damaging the crop. This can be reduced by using some chemicals and are known as biocides or pesticides. But they are not safe for farmers while spraying. To reduce hazards from pesticide on human health, a robot is developed so that it can move autonomously. The Robot is controlled using an open source Smartphone application known as BLYNK.

KEYWORDS: *Agriculture, pesticides, Robot, Internet of Things*

INTRODUCTION

Agriculture is the process of cultivation of crops and livestock products. But due to lack of knowledge of using technology and modern techniques, the overall yield of farming is very less. One of the researches suggests that Indian farming practice must focus on using advanced technologies such as precision agriculture and robotic systems to get more yields.

The use of pesticide increases the agricultural yield by killing the insects but it has more disadvantages than advantages. These chemicals causes dangerous health hazards on human health such as respiration problems, cancer etc and most of the pesticide sprayers are manually handled this cause's spinal cord pain.

To overcome these entire problems, a robot is developed, which will spray the pesticide at affected area on plants. Controlling of robot and sprayer is done with the help of IoT concept and an open source application called as BLYNK. Wireless camera is used for observation.

LITERATURE REVIEW

Avital B [1] suggested about the use of LIDAR in agricultural robots. Agricultural robots require the development of advanced technologies to deal with change in environments. LIDAR is a method of detection system which works on the principle of radar, but uses light source from a laser for detection and is used for distance measurements, mapping and obstacle detection and avoidance of obstacle.

Jens Christian Andersen and et al [2] modified a tractor for autonomous operation. This intelligent vehicle was designed to navigate in three row cherry orchard. The navigation and obstacle detection and avoidance is done using the 360^0 virtual laser scanner. Each virtual detection covers up to 10 positions and the shortest range is reported. The system uses fact database and is an integrated part of software platform known as MobotWare.

Andrejs Zujevs et al [3] al proposed the combination of sensors for fruit harvesting and the fruit harvesting robot must have the Computer vision system, chemical sensors, tactile sensors etc. Computer vision system is used to detect the fruit location, tree structure and send the same data to machine unit. Chemical sensors are used for monitoring chemicals in the air, in liquids and in solids. Tactile sensors are used for spatial position and precise location of fruits and are also used for measurement of gripping pressure while harvesting. Special algorithm is necessary for detection and harvesting purpose.

MohdAshiqKamarilYusoff et al [4] developed a wireless mobile robotic arm. It is a combination of hardware and software functions. They have used Arduino Mega2560 as the interface between controller and the robot. For the purpose of control Sony PS2 wireless device is used. Four numbers of servo motors and servo wheels are attached. To make the mobile robotic arm Acrylic material is used as it is easy to form, low cost and strong enough to handle motor weight and movement.

P.P. Ray [5] conducted a survey on Internet of things architecture and discussed about Technical challenges such as technology, standardization, security and privacy. One of the big challenges for Internet of things is the Design and service oriented architecture. More over Internet of Things is a complicated heterogeneous network and it causes complexity between devices. More and more research on Internet of Things is necessary.

EXISTING SYSTEM

The ASETA project [6]: ASETA is working with a system of ground based and aerial vehicles. Both are unmanned and autonomous. Through a series of steps, the robots will identify and localize any weed infestations in a given field. The ASETA project works with a case of thistle infestations in sugar beet fields.

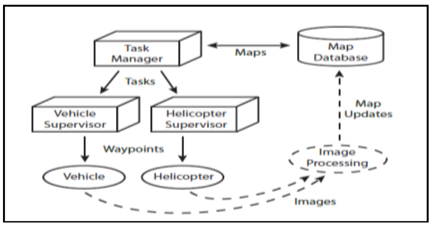

Fig 1: Concept of ASETA

COMPONENTS REQUIRED AND SOFTWARE'S USED

Components required are NODE MCU IoT module, Dc motors 12v, Sprayer pump and nozzles, Wireless camera, Electromagnetic relays, Battery 6v, Wheels for robot, Robot body etc. Software's used are Express PCB (used for designing the PCB) and Arduino Sketch 1.8.5 is used for IoT programming.

CONSTRUCTION OF ROBOT CIRCUIT

Initially a 230V supply is connected to a step down transformer which converts 230V to 9V (AC to AC). The output of step down transformer is full wave rectified to get DC supply and is connected to a 6V, 4.5Ah rechargeable battery.

Two 100rpm motors are used at rear side of robot and the operating voltage of motors is 3V to 12V. Therefore 6V is supply is given to both motors. The 6V supply is connected to the 7805 fixed voltage regulators to get 5V output. Most of the components require only 5V. Two regulator circuits are used; one is single and another of two regulators of parallel connection (To reduce heat effect). NODE MCU and sensor circuits operate at 5V and hence output from regulator is connected to these components. One more motor of 10 rpm is used at front side for the nozzle movement purpose. This motor operates from L293 circuit. We can rotate it forward as well as in reverse. Only 0^0 to 180^0 can be rotated to avoid breaking of nozzle attachment.

A pump is used for pesticide spray purpose. The operating voltage of pump is 5V to 12V and minimum of 1amp. Two sensors (moisture and temperature detection) are connected to LM3582 comparator. LM3582 (moisture detector) is connected to NODE MCU (D1 input) and in between a zener diode is added to reduce output of comparator (5V) to 3.3V. Another LM3582 (thermistor) is connected to same NODE MCU (D2 input).

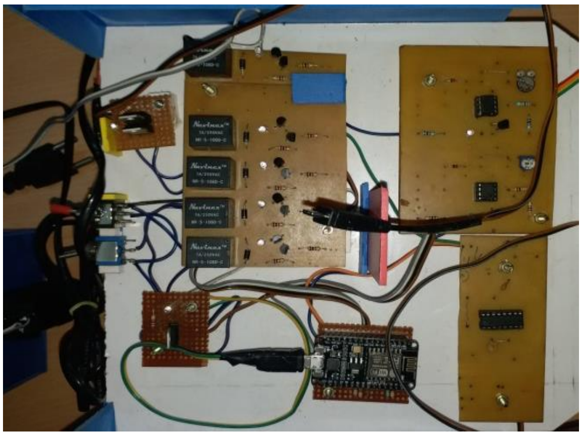

Fig 2: Top view of robot circuit

The outputs of controller are connected to relays to control the motors. The wiring in relay board is shown in fig. Usually the relay connection will be in Normally Open (NO) state, when it becomes normally closed (NC) then the supply through circuit takes place.

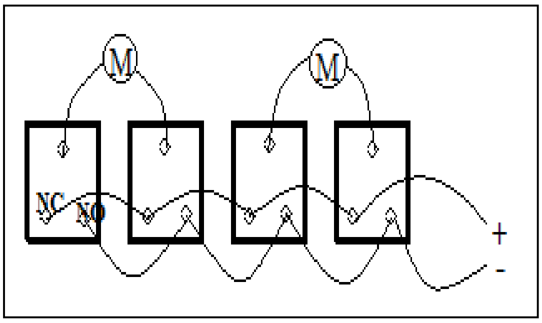

Fig 3: Wiring in Relay board

A wireless camera is mounted on robot to view the field. This camera is connected to a receiver mobile through wifi. Power supply to this camera is given by the 6v Battery.

IOT PROGRAMMING AND BLYNK APPLICATION

IoT program is written on Arduino sketch 1.8.5 using C language. BLYNK application is an open source application designed for internet enabled devices. Following Fig shows the layout of BLYNK app and table shows the function of each button.

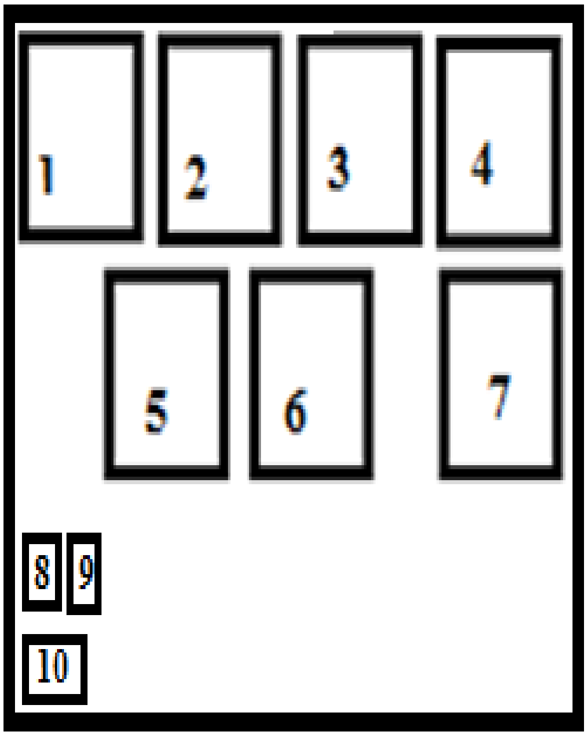

Fig 4: Layout of BLYNK app

Table 1. Function of each button in BLYNK app

Number	PIN value or number	Function
1	gp13	Forward wheel 1
2	gp2	Forward wheel 2
3	gp16	Reverse wheel 1
4	gp15	Reverse wheel 2
5	gp14	Nozzle motor (fwd and rev)
6	gp12	
7	gp0	Pump on/off
8	L293	Temperature indication
9	L293	Moisture detection (Pesticide level)
10	NA	Notification

ROBOT DETAILS

Thickness of plywood = 0.8 cm

Length of nozzle attachment = 11.3 cm

Diameter of wheels = 6 cm

Level of nozzle tip from ground level (Height) = 24 cm to 30 cm

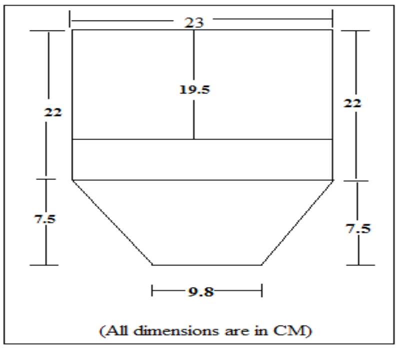

Fig 5: Dimensions of robot base

Fig shows the Robot base dimensions. It is made of white plywood.

Pesticide Tank Dimensions:

Length =9cm,

Width =10cm,

Height =13.5cm

Volume of pesticide tank= $9 \times 10 \times 13.5$

Therefore, Volume of pesticide tank

= 1215 cm^3 = 1.215 Liter

Fig 6: Assembled Robot

Fig shows the assembled robot. A smartphone is configured with NODE MCU unit. This requires a specific authentication code provided by BLYNK application. This specific authentication code must be entered in IoT program to connect with that specific smartphone. Wireless camera placed above the robot operates on Wifi and hotspot. It is connected to other receiver device and live video can be seen on it. For configuration an app by name "KEYE" is to be installed. The camera rotates about 360^0. Based on view obtained by camera, the robot is moved as required, nozzle can be rotated and spray can be done. Following figure shows photos taken from wireless camera and we can clearly see the affected leaves from a plant.

Fig 7: Photos taken from IP wireless camera

FUTURE SCOPE

Instead of wireless camera, a Raspberry Pi camera system is installed and the system can be made completely autonomous. A slider mechanism is required at nozzle attachment to lift nozzle from ground level to higher level. As height of crops varies from one another this must be adopted.

CONCLUSION

From the robot built, it is possible to reduce the wastage of pesticide by spraying at affected area only and as the robot itself carry the pesticidetank; manual handling of sprayer system is avoided. The operator can operate the robot from a maximum distance of 50 meters. When the pesticide storage tank gets empty, it is shown in smartphone application with a LED indicator.

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