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DEVELOPING AN INTERNET OF THINGS BASED ROBOT FOR ENHANCING THE EFFICACY IN SPRAYING OF PESTICIDES

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ABSTRACT

In the field of agribusiness, increasing the yield is generally significant. In any case, weeds and creepy crawlies diminishes the return by harming the harvest. This can be decreased by using a few synthetic concoctions known as biocides or pesticides. Yet, they are undependable for farmers while showering. To lessen the dangers of pesticides on human health, a robot is grown to move self-governing. The robot is controlled utilizing an open-source smartphone application known as BLYNK.

INTRODUCTION

Agriculture is the procedure of the development of harvests and domesticated animal items. But due to a lack of knowledge of using technology and modern techniques, the overall yield of farming is significantly 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 pesticides increases the agricultural yield by killing insects, but it has more disadvantages than advantages. These chemicals cause dangerous health hazards on human health, such as respiration problems, cancer, etc. Most of the pesticide sprayers are manually handled because of which this causes spinal cord pain. To overcome these entire problems, a robot is developed, which will spray the pesticide at the affected area on plants. Controlling of robot and sprayer is done with the help of the IoT concept, and an open-source application called BLYNK. A wireless camera is used for observation.

LITERATURE REVIEW

Avital B [1] suggested the use of LIDAR in agricultural robots. Farming robots require the improvement of trendsetting innovations to manage change in conditions. LIDAR is a strategy for a recognition framework that chips away at the rule of radar. However, it utilizes a light source from a laser for discovery and is used for separation estimations, planning and impediment 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 a three-row cherry orchard. The navigation and obstacle detection and avoidance are done using the 3600 virtual laser scanner. Each virtual detection covers up to 10 positions, and the shortest range is reported. The system uses a fact database and is an integrated part of a 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. The computer vision system is used to detect the fruit location, tree structure, and send it to the machine unit. Chemical sensors are used for monitoring chemicals in the air, liquids, and solids. Tactile sensors are used for the spatial position, and precise location of fruits and are also used to measure gripping pressure while harvesting. A special algorithm is necessary for detection and harvesting purposes. Mohd Ashiq Kamaril Yusoff 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 the controller and the robot. For control, the Sony PS2 wireless device is used. Four numbers of servo motors and servo wheels are attached. Acrylic material is used to make the mobile robotic arm Acrylic material easy to form, low cost, and strong enough to handle the motor weight and movement.

P.P. Ray [5] Directed a study on the Internet of things engineering and talked about Technical difficulties, such as innovation, normalization, security, and protection. One of the significant challenges for the Internet of things is the Design and administration arranged to engineer. The Internet of Things is a confused heterogeneous system, and it causes multifaceted nature between gadgets. Increasingly more examination on the Internet of Things is fundamental.

EXISTING SYSTEM

The ASETA venture [6]: ASETA is working with an arrangement of ground-based and flying vehicles. Both are automated and self-sufficient. Through a progression of steps, the robots will distinguish and limit any weed pervasions in a given field. The ASETA venture works with an instance of thorn invasions in sugar beet fields.

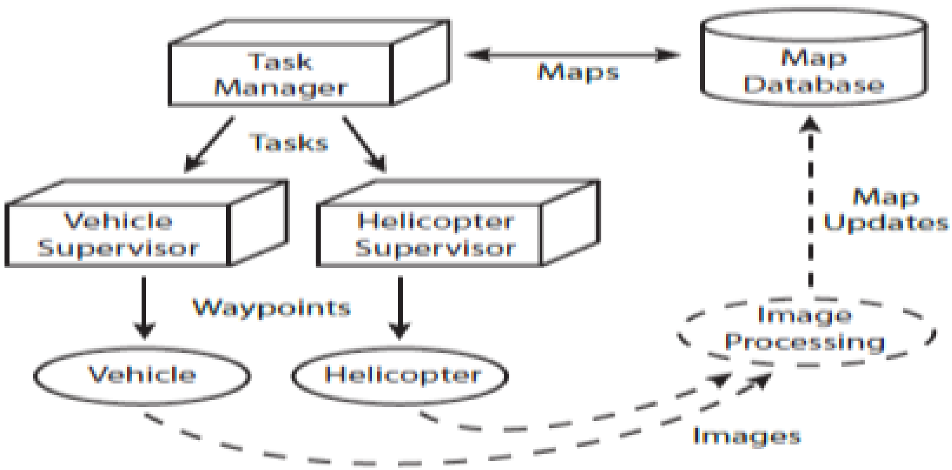

Fig 1: Concept of ASETA

COMPONENTS REQUIRED AND SOFTWARE'S USED

Components required are the NODE MCU IoT module, Dc motors 12v, Sprayer pump and nozzles, Wireless camera, Electromagnetic relays, Battery 6v, Wheels for the robot, Robot body, etc. Software 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 the rear side of the robot, and the operating voltage of motors is 3V to 12V. Therefore, 6V is supplied 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 the front side for the nozzle movement purpose. This motor operates from the L293 circuit. We can rotate it forward as well as in reverse. Only 00 to 1800 can be rotated to avoid breaking of nozzle attachment.

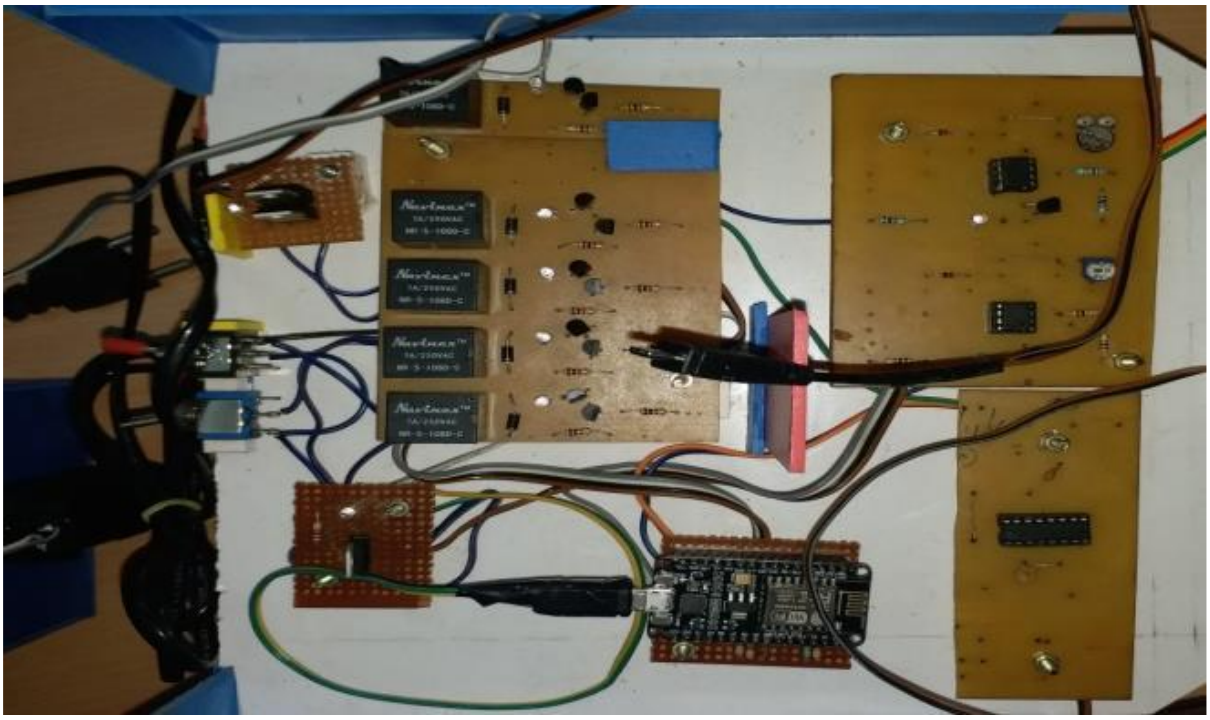

Fig 2: Top view of robot circuit

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

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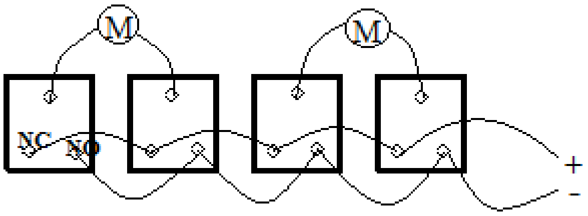

Fig 3: Wiring in Relay board

A wireless camera is mounted on the robot to view the field. This camera is connected to a receiver mobile through wifi. The 6V battery gives the power supply to this camera.

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. The following Fig shows the layout of the BLYNK app, and the table shows the function of each button.

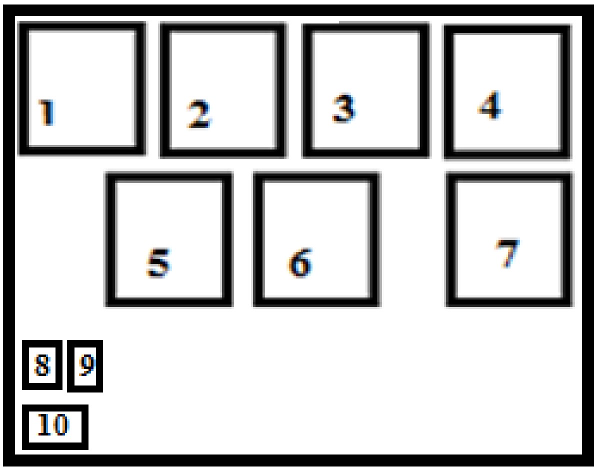

Fig 4: Layout of BLYNK app

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

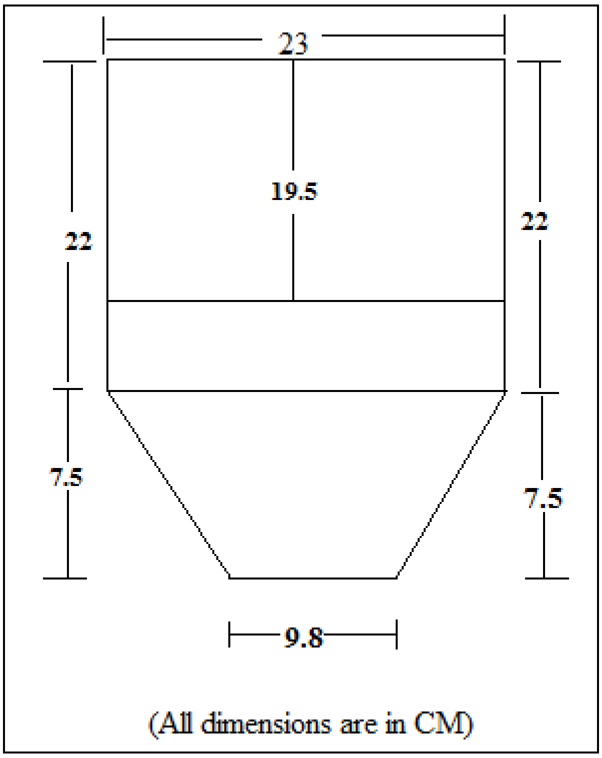

Fig 5: Dimensions of robot base

Pesticide Tank Dimensions:

Length =9 cm,

Width =10 cm,

Height =13.5 cm

Volume of pesticide tank= 9 × 10 × 13.5

Therefore, Volume of pesticide tank = 1215 cm^3 = 1.215 Litre

Fig 6: Assembled Robot

Fig shows the assembled robot. A smartphone is configured with the NODE MCU unit. This requires a specific authentication code provided by the BLYNK application. This specific authentication code must be entered into the IoT program to connect with that particular smartphone. The wireless camera placed above the robot operates on Wifi and hotspot. It is connected to other receiver devices, and live video can be seen on it. For configuration, an app by name "KEYE" is to be installed. The camera rotates about 3600. Based on the view obtained by the camera, the robot is moved as required; the nozzle can be rotated and sprayed. The following figure shows photos taken from wireless cameras, and we can see the affected leaves from a plant.

Fig 7: Photos taken from IP wireless camera

FUTURE SCOPE

Instead of a wireless camera, a Raspberry Pi camera system is installed. The system can be made entirely autonomous. A slider mechanism is required at nozzle attachment to lift nozzle from the ground level to a higher level. As the 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 the affected area only, and as the robot itself carry the pesticide tank; 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 a smartphone application with a LED indicator.