Design and Development of Artificial Intelligence Powered Multipurpose Robot for Agriculture using Arduino Uno, ESP8266 & ESP32cam

Rohit S. Gavali[1]
Department of Electrical Engineering
Padmbhushan Vasantraodada Patil Institute of Technology
Budhgaon.
Sangli, INDIA
[1]rohitgavali60@gmail.com

Vaishanvi D. Patil[2]
Department of Electrical Engineering
Padmbhushan Vasantraodada Patil Institute of Technology
Budhgaon.
Sangli, INDIA
[2]vaishnavidpatil1008@gmail.com

Kashim R. Basaragi[3]
Sangli, INDIA
[3]kasimbasaragi@gmail.com

Abstract- In this paper we present about the multiple agricultural tasks done by the single robot. To increase the efficiency of the agricultural tasks we have to find the new ways. This project deals with an innovative approach for cultivating lands in very effective way. In agriculture there are so many things that have to take actions on daily bases like pesticide pumping, irrigation, fertilizer dumping, and very important task is monitoring. The project goal is designing a system which is based on AI powered and that can handle all these task very smoothly.

Keywords- Artificial intelligence (AI), Artificial Neural Network (ANN), Internet of Things (IoT), Robotics Technology.

INTRODUCTION

Agriculture is the very strong support of India. Today, India ranks second worldwide in farm output. The special machinery play a major role in various fields such as industrial, medical, military applications etc., [1] The special machinery field are increasing its productivity in agriculture field. Some of the major problems in the Indian agricultural are rising of input costs, availability of skilled labours, lack of knowledge of water management and crop monitoring. To overcome these problems, the automation technologies were used in agriculture.

There are some automation and some robots are available in market which is done plugging, sowing, but these are single system and these robots required some person to control them and also our task is increases by this robot so these are not efficient. In our system we are using very simple line follower robot which is controlled by self and self-guided. By using line following technic robot will maintain its path on track. For monitoring we using ESP32cam this is WIFI module based wireless camera it will help us to see the farm at any place of world. For controlling pesticide and fertilizer dumping we using ESP8266 nodeMCU.

BLOCK DIAGRAM

For designing this AI-powered agriculture robot we are using an Arduino uno kit for computing. In this paper, we are using a machine learning technique for teaching our machine. On the input side we using two types of sensors which an Infrared sensor & Humidity sensor. ESP32 CAM is used for camera operation. ESP8266 NodeMCU for controlling pesticide and fertilizer dumping. In this system we are use another ESP8266 for irrigation controlling and sending feedback to owner. And at the output side we are connecting motor drivers to providing higher power to motors fig.1shows block diagram and fig. 1 shows circuit diagram.

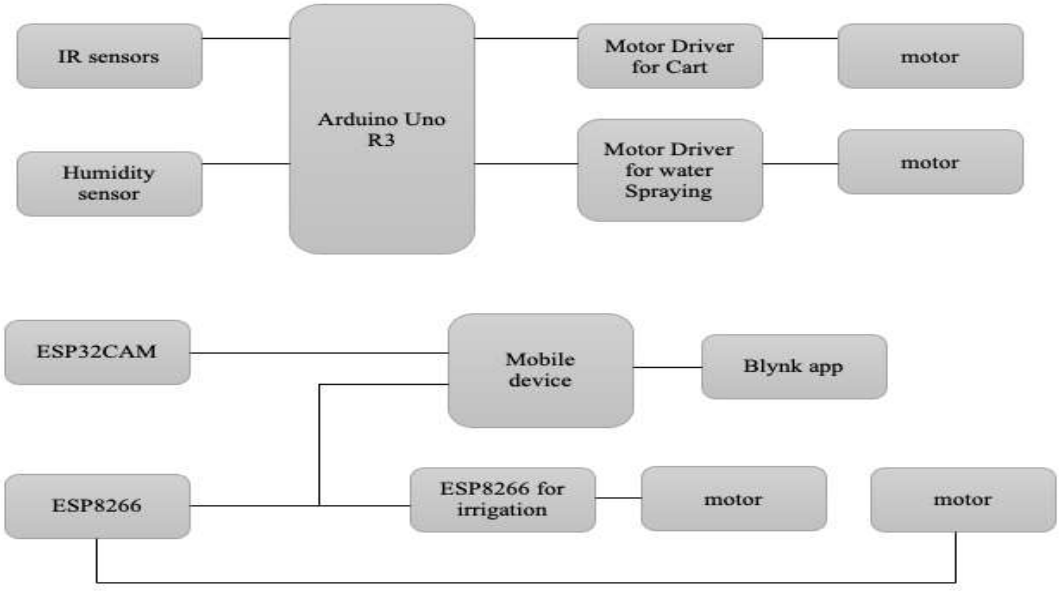


Fig. 1 Block Diagram of Control unit

CIRCUIT DIAGRAM

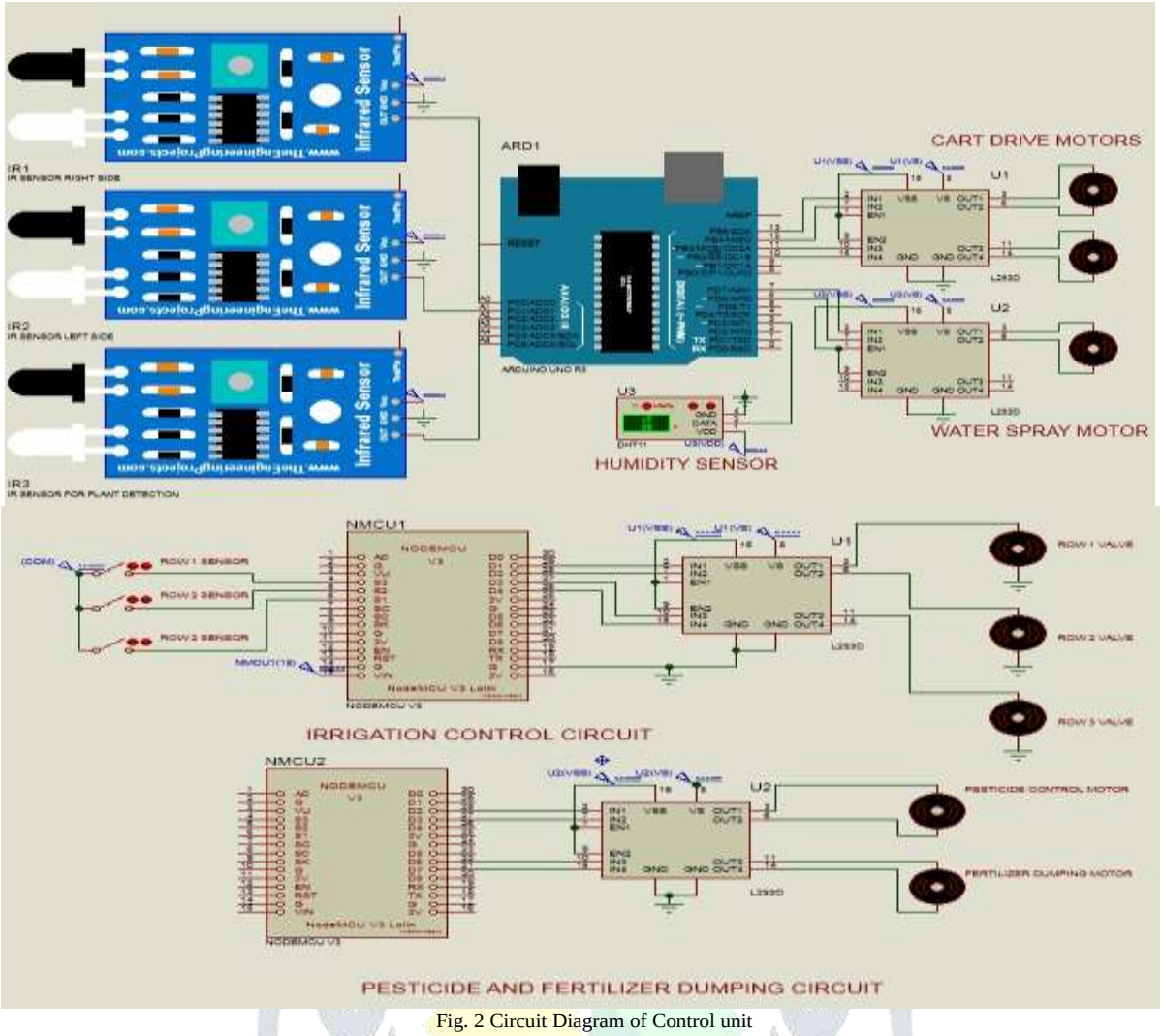


Fig. 2 Circuit Diagram of Control unit

OPERATION-

For controlling the robot, we are using an Arduino Uno R3 Microcontroller. It had a 32-bit processor. running at 16Hz, and 20 IO pins which gives us fast operating speed. In our system, we are teaching machines to act like humans this process called artificial inelegancy. In AI we using Artificial Neural Network (ANN) for machine learning [4].

Artificial Neural Network(ANN) and Machine Learning -

ANN is a processing algorithm or hardware whose functioning is inspired by the design and functioning of a human brain. Neural networks have a remarkable ability of self-learning and they had replaced many traditional methods. An artificial neural network (ANN) is a computing system designed to simulate the way the human brain analyses and processes information. It is the basics of artificial intelligence (AI) and solves problems that would prove impossible or difficult by human or statistical standards. ANNs have self-learning capabilities that enable them to produce better results as more data becomes available. Artificial neural networks are built like the human brain, with neuron nodes interconnected like a web fig. 3.

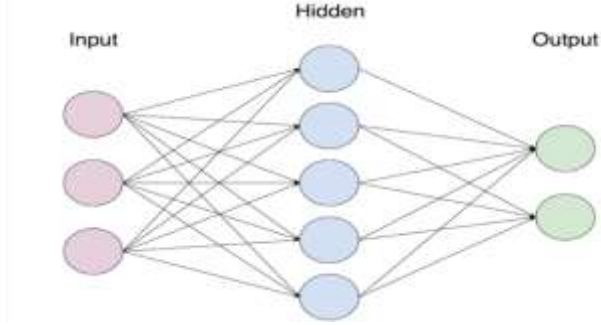
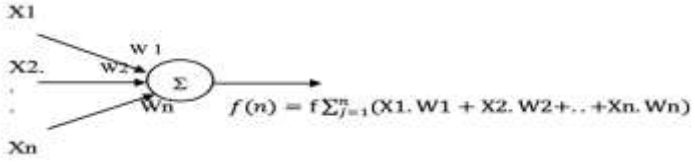


Fig. 3 Artificial Neural Network

Artificial Neural Model-



IR based robot running operation-

In our AI robot for navigation, we using an IR sensor to find a path and stay on the path in robot run time. IR sensor senses the light on the surface and gives a high low signal to the microcontroller. The microcontroller reads the data which is given by the IR sensor and controls the motoring operation [5]. We controlling a robot using raspberry Pi and we want to act this robot autonomously. After the robot reached its stop condition robot will stop for 24 hours and again it will turn on itself and start working again in the below table.1 shows how IR senses the surface and how the motor will act.

Sr. No	IR sensor surface sense	signal	Left motor	Right motor
1.	Both sensor on white	Both=HIGH	Forward	Forward
2.	Left on the black right on the white	Left= LOW, right=HIGH	Reverse	Forward
3.	Left on the white right on black	Left=HIGH, right=LOW	Forward	Reverse
4.	Both on black	Both= LOW	Stop	Stop

Table. 1 IR based robot running operation

Object detection and stopping action and Humidity sensing-

For the detection of the plant, we using a black patch to detect the plant using an IR sensor. When the robot travel in front of plants one IR sensor is connected at the side of the robot. While it passes the black patch then the robot will stop for few times. In that time humidity sensor is getting in action and it takes humidity of the soil and send data to the microcontroller. The microcontroller is deciding humidity [6]. If humidity is incorrect then the water pump will start by the microcontroller and spray the water at the root side of plants.

ESP8266 NodeMCU operation in Irrigation-

When robot sense low humidity at the soil then robot will spray the water on the terminal of placed switches at soil that send turn ON signal to ESP8266 & that time ESP8266 will turn on the respected ROWs motor. When motor turn on then we get a mail on owner's email id that is feedback mail.

ESP8266 NodeMCU operation in robot-

In this section we using ESP8266 WIFI module which directly connected to WIFI. This device is connected to the mobile using IOT technique & at the robot side pesticide & fertilizer motor are connected. When we required the pesticide the we easily tap the button in mobile & this respected motor will turn ON & OFF. In that system amazing thing is we are control this action from any place of world.

ESP32 CAM-

ESP32CAM is also a microcontroller which connected to camera which give us closed loop view of our farm. By using this camera, we able to keep monitor our farm from any were of world [7].

Results-

Motoring results-

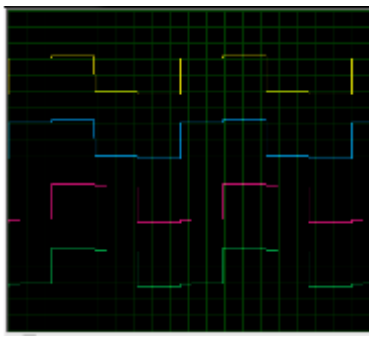


Fig.4 motors in Forward direction. Waveforms

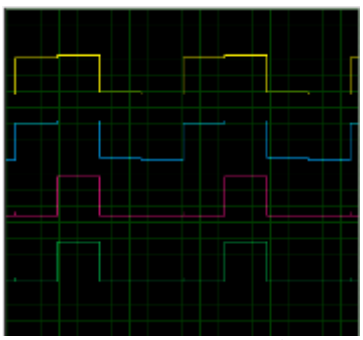


Fig.5 Right turn operation waveforms

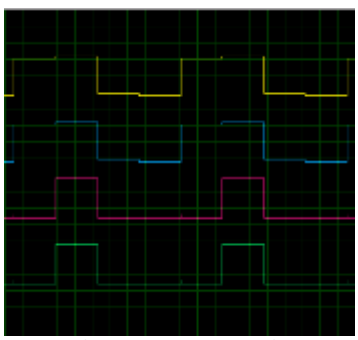


Fig.6 Left turn operation waveforms

Object detection and stopping action and Humidity sensing hardware result –

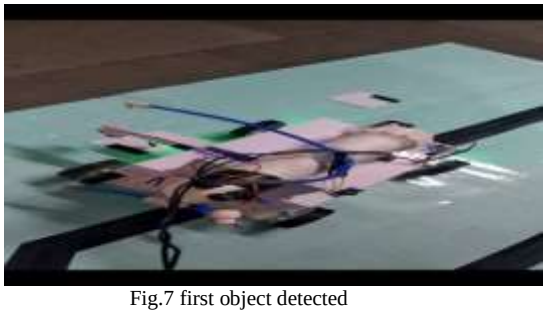


Fig.7 first object detected

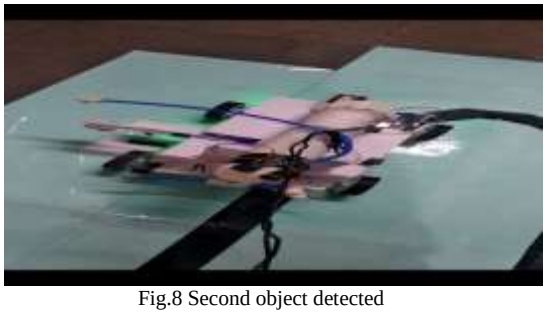


Fig.8 Second object detected

CONCLUSION

Not only do these autonomous robots improve efficiency, but they also reduce the need for unnecessary pesticides and herbicides. Besides this, farmers can spray pesticides and herbicides effectively in their farms with the robot, and plant monitoring is also no longer a burden.

REFERANCE

1) The world bank.org, "Agriculture Overview," Sep. 30, 2020. https://www.worldbank.org/en/topic/agriculture/overview (accessed Dec. 14, 2020).
2) H. Ai, "Artificial intelligence in the design of the transitions to sustainable food systems change Camarena," vol. 271, 2020, DOI: 10.1016/j.jclepro.2020.122574.
3) Robotics online, "How AI is Used in Today's Robots |RIA Blog| RIA Robotics Blog," Nov. 09, 2018. https://www.robotics.org/blog- article com/How-Artificial-Intelligence-is-Used-in-Today-s- Robots/117 (accessed Dec. 14, 2020).
4) Raspberry Pi Documentation by the Raspberry Pi Foundation.
5) L. Paul Jasmine Rani; M. Khoushik Kumar; K. S. Naresh; S. Vignesh, "Dynamic traffic management system using infrared (IR) and Internet of Things (IoT)", IEEE2017.
6) B. Harish Kumar, "WSN based Automatic Irrigation and Security System using Raspberry Pi Board" IEEE, 2017.
7) Mochammad Ariyanto; Ismoyo Haryanto; Joga Dharma Setiawan; M. Munadi; M. Sri Radio, "Real-Time Image Processing Method Using Raspberry Pi for a Car Model", IEEE 2019.
8) Hagan, Demuth, and Beale "Artificial Neural Networks slides".