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Design and Implementation of Artificial Intelligence Powered Agriculture Multipurpose Robot

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***Abstract*: The agriculture sector faces many challenges such as crop diseases, pest infestation, water irrigation, weeds, fertilizer dumping, and many more. These problems lead to substantial crop loss, economic loss and also cause severe environmental hazards due to the current agriculture practices. The AI and Robotics Technologies have the potential to solve these problems competently. As agriculture is a dynamic sector, the problems in agriculture are not mid-core by AI and robotics, and a specific solution is provided to an expressly daedal problem. Diversity of systems have been developed to help these challenges and provide a better approach worldwide. This paper contains significant contributions used to address the challenges that agriculture faces and through AI and robotic techniques we can eliminate problems.**

***Keywords*: Artificial Intelligence, Robotics technology.**

1. Introduction

Agriculture is one of the most important fields of the economy. According to Worldbank.org, agriculture accounted for 4% of the world's GDP in 2018 and can account for about 18% of the nation's GDP for countries like India [1]. Agriculture faces many threatening remarks right from sowing to harvesting. Significant factors such as climate change, global warming, water scarcity, insect and disease infestation, overuse of pesticides, weeds, under-irrigation, and drainage, along with these labor deficits is another conclusive problem. One of the reasons for labor deficits is that the current age group of farmers age is rising, and when they go out of farming activities, the new age group is less likely to supersede them, and this gives rise to remarkable concern.

Established farming methods are incapable of producing food to feed the future population of the world. It also risks people's health and the planet. These threats have driven the agriculture sector into finding more innovative ideas and technology for improving crop outturn. Over the past century, agriculture has moved from labor-rigorous to mechanization and power- rigorous production systems. Although, agriculture has begun to digitize over the last 15 years. AI and robotics are a sturdy unification for automating any tasks. In recent years, AI has become a progressively universal presence in the robotic sector, instigate learning and adaptability in until now rigid applications [3]. Agriculture is a sundry sector, which means a common approach can-not advise for every state. The AI and robotics techniques help one to collect the data of each condition and feed a required solution to a given problem. AI and robotics-based technologies have the inherent to solve these threats efficiently. These technologies can improve crop outturn efficiency, irrigation by using less water, crop monitoring, quality of the crop. AI and robotics-based technologies can authorize the farmer to produce more and better outturn with minimize manufacturing cost and increase their profit.

2. Methodology

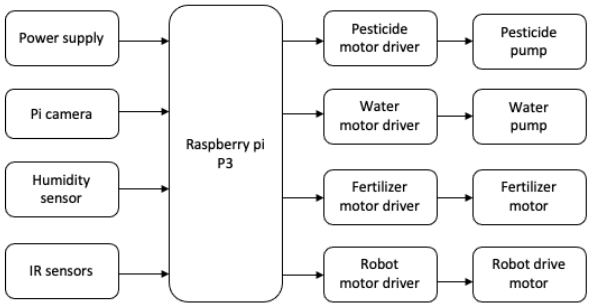

Fig. 1. Block diagram of control unit

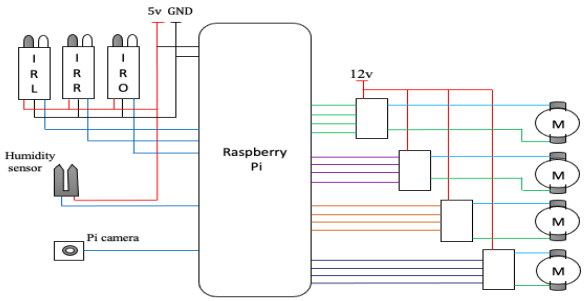

Fig. 2. Circuit diagram of control unit

For designing this AI-powered agriculture robot we are using a Raspberry Pi P3 CPU kit for computing. In this paper, we are

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using a machine learning technique for teaching our machine. On the input side we using three types of sensors which a Pi Camera, Humidity sensor, IR sensor. On the output side pesticide motor driver and pesticide pump for pumping pesticide. For control, a Humidity water motor driver and water pump will be installed. For dumping solid fertilizer, we using a motorized ON/OFF valve. For moving robots autonomously on the path, we use an IR sensor for detection of the path, and as output action motor will run as per IR sensed the path.

A. Operation

For controlling the robot we are using a Raspberry Pi P3 CPU. It had to boast a 64-bit quad-core processor running at 1.4GHz, dual-band 2.4GHz and 5GHz wireless LAN, Bluetooth 4.2/BLE, faster Ethernet, and PoE capability via a separate PoE HAT, 1GB LPDDR2 SDRAM, 2.4GHz and 5GHz wireless LAN, Bluetooth 4.2, BLE, Gigabit Ethernet over USB 2.0 (maximum throughput 300 Mbps) 4 × USB 2.0 ports, and 40 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].

B. 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-organization, and adaptive learning. It has replaced many traditional methods in numerous fields. An artificial neural network (ANN) is the piece of a computing system designed to simulate the way the human brain analyses and processes information. It is the foundation 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.

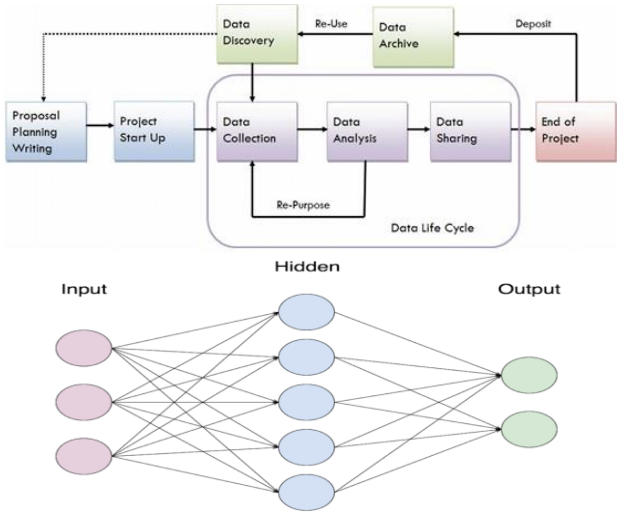

Fig. 3. Artificial Neural Network

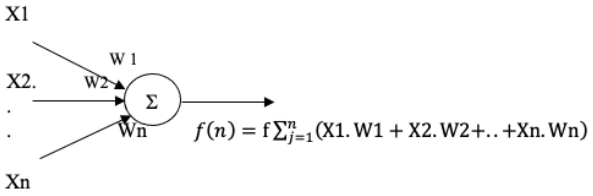

Fig. 4. Artificial neural model

1) 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.

Table 1
IR based robot running operation

S. No.	IR sensor surface sense	Signal	Left motor	Right motor
1.	Both sensor on white	Both=1	Forward	Forward
2.	Left on the black right on the white	Left= 0, right=1	Reverse	Forward
3.	Left on the white right on black	Left=1, right=0	Forward	Reverse
4.	Both on black	Both= 0	Stop	Stop

2) 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.

3) Image processing

A Pi camera is connected on the top of the robot to monitor the area for spraying pesticide it takes pictures of the area and sends them to the microcontroller continually. The microcontroller is doing a comparison between plant, soil, and grass if there is the grass is detected our microcontroller will give the order to spray the pesticide otherwise it will keep monitoring [7].

3. 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.

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