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Hand Gesture Controlled Robot for Smart Agriculture Monitoring System

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***Abstract*— Harvesting presents a significant obstacle in the agricultural sector. Workers face hazards and hardships as they visit each plant to harvest fruits. Combining robotic systems with modern technology is becoming more common in order to automate or semi-automate labor-intensive tasks, including grape harvesting. To improve output per worker hour, we provide a semi-automatic system to help in fruit harvesting. The user can remotely control a robotic arm attached to a rover as it roams the orchard using a hand glove equipped with multiple sensors. The robotic arm may be remotely positioned to gather the fruits thanks to these sensors. The design of a four-degree-of-freedom robotic arm, a wireless control interface, and a sensor-equipped hand glove are all covered in this study. This project also includes the system setup as well as the testing and assessment that was conducted in a controlled laboratory environment.**

Keywords*— Hand Gesture Robot, Agriculture Monitoring, Controlled Robot.

I. INTRODUCTION

Robotic systems appear to be a game-changer in the fight for safer, more efficient, more profitable, and more focused agricultural operations; they also help overcome the problems caused by a shortage of trained workers [1, 2]. In order to accomplish these goals, agri-robotic applications are utilising the impressive advancements in information and communications technology (ICT), such as computer vision, sensors, and artificial intelligence [3, 4]. Many agricultural tasks, including spraying, weeding, harvesting, and disease detection, have found promising robotic solutions [5, 6]. In most cases, robots can follow limited, task-specific, and noninteractive instructions to complete predetermined tasks [7]. Structured conditions, like industrial steady settings, can make these preset actions perform adequately. On the other hand, agriculture deals with live, delicate produce in constantly changing, poorly defined ecosystems that are susceptible to heterogeneity and unpredictable events [8]. By integrating the cognitive capacities of humans with the repeatable precision and power of robots, human-robot collaboration offers a potential answer to these problems. In the agriculture industry, so-called human-robot interaction (HRI) is expected to bring about (a) increased system reconfigurability flexibility, (b) reduced workspace requirements, (c) enhanced service quality and production optimisation, and (d) accelerated capital depreciation [9,10,11].

HRI is just "the process that conveys the human operators' intention and interprets the task descriptions into a sequence of robot motions complying with the robot capabilities and the working requirements" [12]. That's a very clear definition. In general, the way people interact with computers—using things like keyboards, mouse, and remote controls—isn't really useful anymore. Lack of neutrality and adaptability is the fundamental cause of this. More organic forms of communication, like voice engagement and body language, are required to maximise the developing synergistic ecosystems. Because of factors such as environmental noise and the fact that various people may say the same command in different ways, the former method has its limitations [15]. Nonverbal cues, on the other hand, are seen as more trustworthy. An individual's body language can be described as a combination of their posture, facial expressions, and hand gestures. Everyone is familiar with the most effective way of natural expression—hand gesture interaction. The human-vehicle interaction (HVI) system has several uses, such as virtual mouse control, gaming technology to improve motor skills [13], identification of sign languages, and many more.

One of the most common ways to implement hand gesture detection is to use sensors embedded in gloves or in the eyes to gather data [15]. Additionally, sensors that capture the electric potential that muscles generate during contractions—surface electromyography—have been suggested. To summarise the key disadvantages of the aforementioned approaches, (a) gloves restrict natural movement and might cause skin reactions in those with sensitive skin, and (b) pain can be caused by the fact that users' hands are of varying sizes. (a) Surface electromyography often generates large and noisy datasets, which might impact the inherent characteristics of classification issues; (b) vision sensors struggle with complicated backgrounds, numerous people, and variations in lighting.

II. METHODOLOGY

A wide variety of tasks involving the movement of large objects are carried out in the agricultural sector. Workers in vegetable cultivation, for instance, should be prepared to lift heavy vegetables during harvest. Workers in the rapidly growing organic farming industry should also be prepared to lift large compost bags throughout the fertilising season. Worker power and skill are required for these tedious, repeated tasks. Research and development of numerous agricultural robots began in the 1980s. Fruit picking in the orchard was a technique that Kawamura and colleagues perfected. Grand and his colleagues created the apple-harvesting machine. Many other works followed them. A large body of literature documents the practical implementation of fundamental robotic tasks in real-world open fields, with an emphasis on structural systems design (e.g., mechanical systems design). Nonetheless, a large number of robots are still in the R&D phase and have not yet entered the dissemination phase. Locating suitable spaces is critical for improving robot performance while decreasing their overall cost. The systematic production of many things, including food, feed, fibre, and more, is what is known as agriculture. Agricultural products include not only food for people and other animals, but also ornamental flowers, building materials, fertilisers, skins, leather, and chemicals used in industry.

A. *Existing System*

- RF technology as the robot follows the path that has been previously defined using infrared and motion sensors.
- The field is accessible to humans.

B. *Proposed System*

- System and device interfaces should be rebuilt.
- Tracking the field and detecting weeds
- Boost precision
- Find Weeds
  - New advanced cameras.
  - More complicated defects will be detected.
- Build a control model for farmland.
- Human work is less

C. *Block Diagram*

User Node: User node agribot is shown in figure 1.

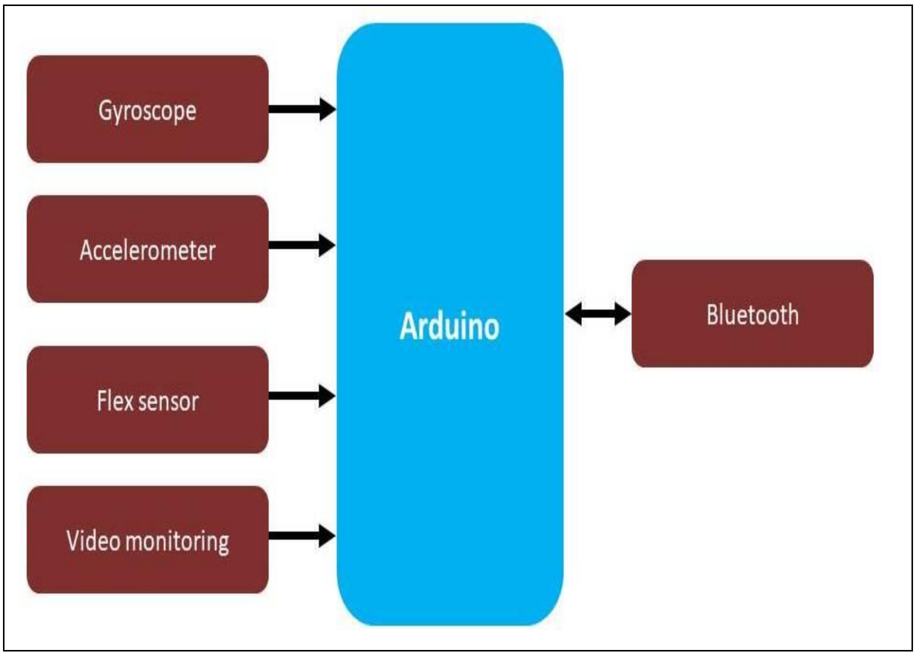


Figure 1. User node agribot

Robot node: Robot node agribot is shown in figure 2.

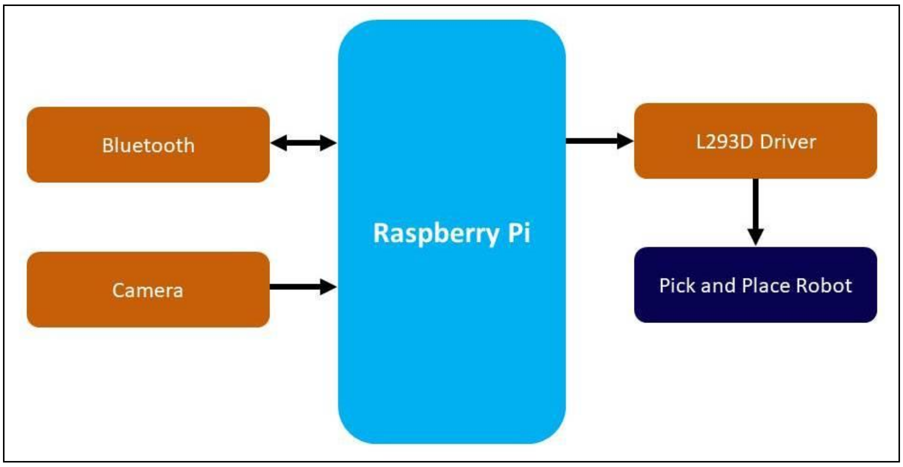


Figure 2. Robot node agribot

A schematic of the glove, harvester, and interface systems that are being considered. The glove represents the HCI, or human control interface. A flex sensor, accelerometer, and gyroscope are all built into the glove that the user wears. Both the acceleration and the tilt can be obtained from the accelerometer, while the angular velocity and orientation may be determined from the gyrometer. A rover with an arm attached to it is called a harvester. The hand glove incorporates sensors that are connected to the microcontroller unit (MCU). The cutter is controlled by two flex sensors and the three links of the four-degree-of-freedom arm by three accelerometers that are incorporated in the glove. This robotic harvester acts as a receiver, while the user HCI acts as a transmitter. All the sensors, Bluetooth, and an MCU are built into the transmitter block, making it a wearable device. The wearable gadget updates the robotic arm on the user's arm angle in real-time.

Hardware tools

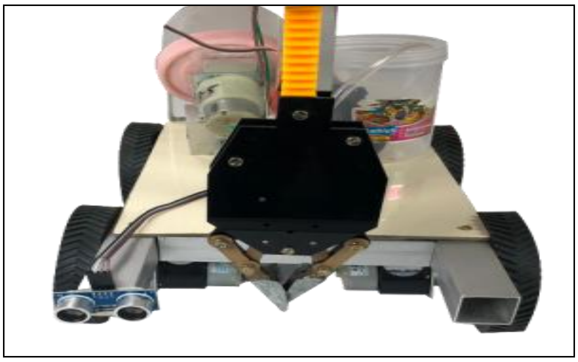
- Arduino
- Raspberry pi
- Gyroscope
- Flex sensor
- Mems?
- Camera
- Bluetooth
- Robot?

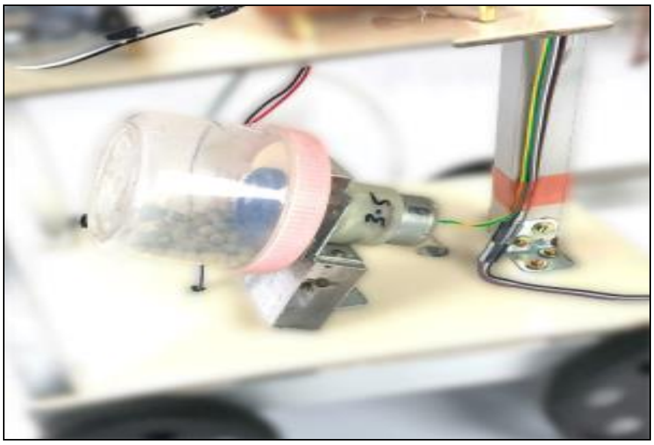
Software tools

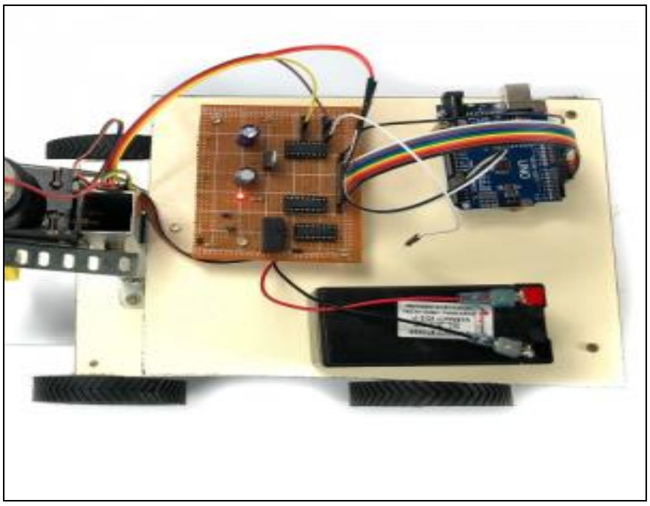
- Arduino IDE
- Embedded C
- Raspberry pi OS: Raspbian stretch
- Programming Platform: python 3 IDLE
- Programing language: python 3
- Library: OpenCV

III. EXPERIMENTAL STUDY

The following figure 3 showing the experimental setup and results.







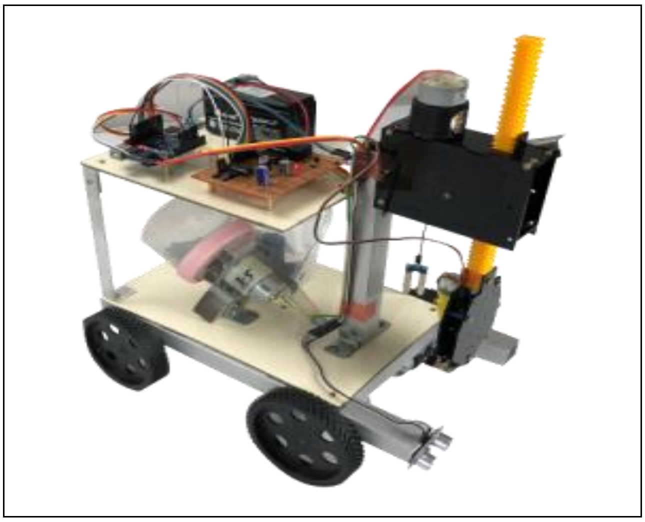


Figure 3. Hand gesture Smart agribot

IV. CONCLUSION

A flying robot that operates based on gestures is an efficient answer to the challenges that are now being faced in the field of agriculture and other fields that are related to it. To give a service to farmers by minimizing the amount of work they have to put into simplifying the activities, reducing the amount of time they have to spend, and increasing the amount of crops they harvest. In order to accomplish this, available technologies are combined with inventiveness. By overcoming the conventional agricultural procedures, the idea that has been offered contributes to the advancement of precision agriculture. Additionally, it serves as an alternative to the use of remotely controlled aircraft.

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