A Project Synopsis on

"Smart farming using Multi-functional AGRIBOT"

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Introduction:

India, a developing country, possesses the world's second largest arable field. Around 60% of its population relies on agriculture, making it the backbone of the nation. Agriculture contributes approximately 20% to India's GDP and enables the country to meet the rising food demand. Therefore, the agricultural sector plays a crucial role in India's overall development. However, due to industrialization and urbanization, many laborers are transitioning to industrial jobs, while remaining agricultural laborers demand higher wages. This shift, coupled with the high cost of manual labor, poses challenges for farmers.

Over the past decades, significant technological advancements in agriculture have revolutionized various processes, including crop and livestock production. These advancements primarily focus on reducing operational and production costs, minimizing environmental impact, and optimizing the overall production cycle. Notably, advancements in field machinery and technology have provided innovative solutions to the challenges faced by modern farmers.

However, the complexity of field operations in agriculture necessitates addressing multiple issues for a successful transition to the robotic era. Developing a cost-effective robotic solution requires fulfilling specific requirements, such as small size, autonomy, intelligence, communication, safety, and adaptability. Agricultural robots, such as AGRIBOT, have been introduced to alleviate the workload by reducing human effort, saving time, energy, and money. AGRIBOT performs various functions, including field leveling, plowing, seeding, and water spraying. It also utilizes image processing to identify crop diseases, detect and remove weeds, and navigate autonomously. The robot is powered by a rechargeable battery, which is recharged through attached solar panels. Moreover, AGRIBOT can identify obstacles along its path within the field.

The AGRIBOT is deployed on a chassis equipped with wheels, with the rear wheel driven by a DC motor. The front end of the chassis incorporates a leveller, plougher, seeder, and cutter, all operated by servo motors. The plougher prepares the field before sowing seeds, and the seeds are then sown while simultaneously spraying water. These primary tasks constitute the essential functions of the AGRIBOT.

In addition to these primary tasks, the AGRIBOT employs image processing techniques to identify and detect diseases in crops as part of its secondary function. It can also differentiate between weeds and crops, eliminating unwanted weeds. Furthermore, the AGRIBOT possesses the capability to detect obstacles during autonomous navigation.

Objectives:

The main objectives of this project are to enable the AGRIBOT

1. To plough, sow, level and spray water to the field.

2. To detect the disease present in the crop using image processing.

3. To detect the weed present using image processing and cut the weed.

4. To power itself using solar panels and also establish communication using mobile application through IOT.

5. To navigate itself around field and also detect the obstacle present on the path of the AGRIBOT.

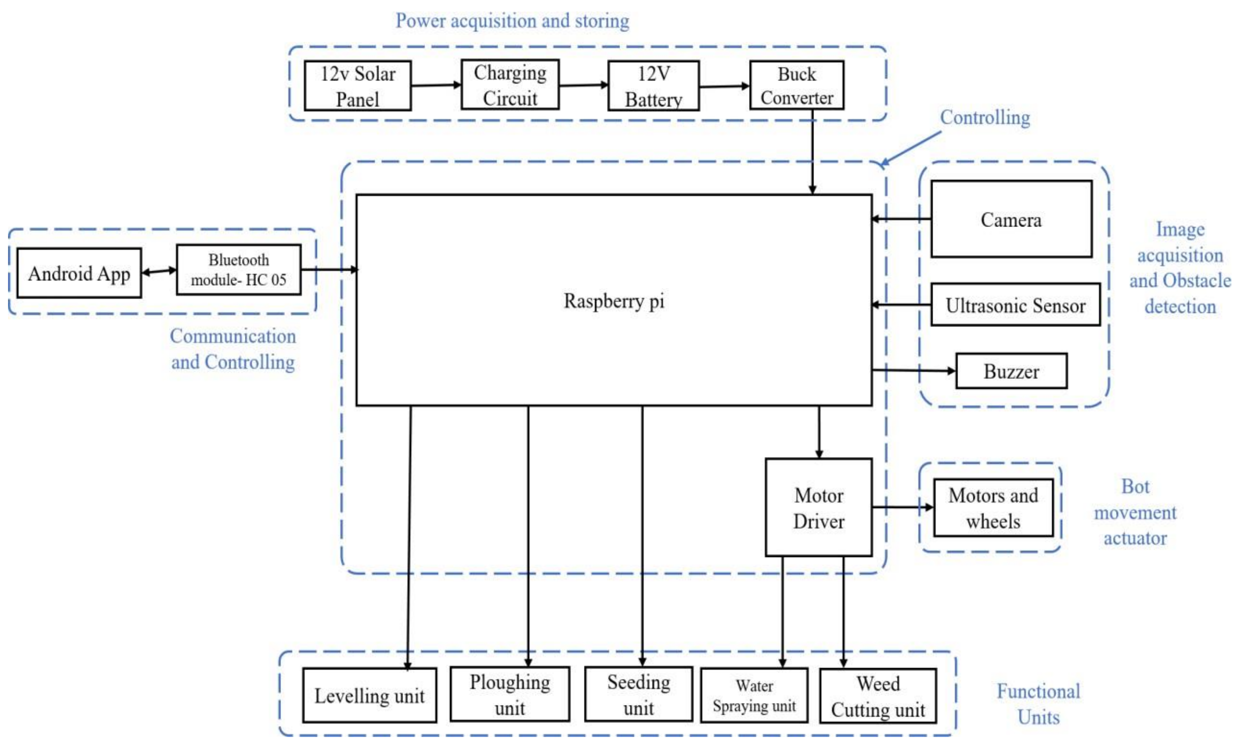
Methodology:

The project aims to develop a multifunctional bot known as AGRIBOT. AGRIBOT utilizes Raspberry Pi as the main controlling unit and requires 4 geared motors, 1 DC motor, 3 servo motors. Geared motors facilitate the bot's movement, while the DC motor is responsible for cutting weeds. Servo motors control ploughing, seeding, and leveling. Water pump connected to the spraying mechanism is used for watering. The bot operates on a 12V battery, which stores the required charge, and a 12V solar panel acquires and stores power from solar energy.

For image acquisition and processing, the project uses a Web camera and Raspberry Pi. Image processing is employed for obstacle detection, disease detection, and weed detection. The obstacle-avoiding module consists of the camera, Raspberry Pi, and motor drivers. The camera captures real-time images, which are processed by the Raspberry Pi. If any obstacles are detected, the Raspberry Pi sends signals to the motor drivers, which control the robot's movement to avoid obstacles and buzzer is turned on.

To identify diseases in leaves, a Convolutional Neural Network (CNN) is utilized with a dataset containing healthy and infected leaves. The accuracy of disease identification depends on the dataset size. After training the model, real-time leaf images are captured and compared with the dataset, providing a percentage indicating the level of disease infection. Increasing the dataset can enhance accuracy. The trained model is evaluated for final test accuracy, which estimates its performance in the classification task.

Weed detection and removal rely on image processing. The Web camera captures and processes field images. If weeds are detected, the robot moves forward and captures the next image. Weed cutting blade cuts the weed.



Results and Conclusions:

The Multifunctional AGRIBOT reduces manual labor and energy for farmers while being cost-efficient. It performs operations like ploughing, seeding, leveling, and watering the agricultural field. AGRIBOT navigates autonomously and is powered by a rechargeable lead-acid battery charged by solar panels. It detects unhealthy/diseased leaves using image processing, differentiates weeds from crops, and cuts weeds. The bot also detects and avoids obstacles. An Android app facilitates communication and control between AGRIBOT and the farmer's mobile phone.

Results show that AGRIBOT successfully performs basic agricultural activities, leaf disease detection (Level 2), and weed detection/cutting (Level 3). The app allows the user to define the level and choose automatic or manual control. The AGRIBOT can navigate the field, detect obstacles, and execute the selected level. Image processing, specifically convolutional neural networks, is used for disease and weed detection.

AGRBOT utilizes solar panel-generated energy stored in the lead-acid battery for all functions. The energy conversion and storage process enables the bot's operation. In conclusion, agricultural robots like AGRIBOT consist of navigation, vision, control, and communication systems, along with specific units for ploughing, seeding, leveling, water spraying, and weed cutting. AGRIBOT is eco-friendly, cost-effective, and suitable for small to medium-scale applications. Improvements are needed in vision systems and image processing methods, as well as efficient handling of large amounts of data. AGRIBOT is designed to be low-cost, modifiable, and efficient, bringing potential revolutionary changes to farming systems.

Scope for future work:

The future of Agribots holds great potential in revolutionizing agriculture. With the increasing global population and the growing demand for food production, Agribots can play a crucial role in enhancing efficiency, productivity, and sustainability in the agricultural sector.

Some anticipated future applications of Agribots include:

1. Precision farming: Agribots can analyze soil conditions, moisture levels, and environmental factors to optimize crop growth. This leads to higher yields, reduced waste, and improved resource management.

2. Harvesting: Agribots can be employed for efficient crop harvesting, particularly in regions facing labor shortages. This reduces labor costs and enhances overall efficiency.

3. Weed management: Equipped with sensors and machine learning algorithms, Agribots can identify and remove weeds without resorting to chemical herbicides. This approach minimizes the environmental impact of agriculture.

4. Monitoring and management: Agribots have the potential to monitor crops and livestock, detecting issues like disease, pests, or water stress. This allows for timely intervention and preventive measures.

Agribots have the capability to transform the agricultural landscape, enabling sustainable and optimized farming practices to meet the increasing food demands of the future.