Robotics Farming: THE FUTURE OF INDIAN AGRICULTURE

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INTRODUCTION:

Agriculture contributes a very large part in the Indian economy. Almost two-thirds of the population is either directly or indirectly dependent upon agriculture. Life depends on agriculture because it gives us food, fuel, and other necessities. To meet the needs of the estimated 9.8 billion people by 2050, agricultural scientists, farmers, and growers must find sustainable ways to produce more food from less land. One of the most recent developments in agriculture is precision farming, which aims to increase the productivity of agricultural inputs by optimizing their usage based on site-specific requirements for plants, soil, and the environment. The use of automation, mechatronics, and robotics has greatly enhanced agricultural output by improving effectiveness, efficiency, dependability, accuracy, and minimizing human interference.

A robot is a mechanical, artificial agent and usually an electromechanically system. It is a device, because of software programming, makes complicated task easy to perform. Robotics is a branch of engineering that combines computer, electrical, and mechanical engineering to develop intelligent machines that simulates human activity. Agriculture uses robotic technology for a variety of tasks, including planting, spraying, weeding, harvesting, and post-harvest activities. Robotic technology not only eliminates drudgery in farm operations but also protects farmers from working in hazardous environments.

Automation in agriculture has recently been popular to address the manpower shortage in the industry by automating agricultural tasks including cultivation, inspection, spraying, trimming, and harvesting. Any machinery or equipment that is intended to eliminate manual labour in agriculture is referred to as automated agriculture. The work of agricultural automation is primarily focused on autonomous vehicle applications, such as robot or tractor, where it is being used to reduce the difficult, fatal, risky, and prolonged working conditions experienced by farmers while at the same time offers a precise and efficient operation and control system. In order for the product to be of acceptable quality and suitable for human

consumption, the output quality and quantity must also be maintained. Therefore, to ensure the sustainability of food security in the near future, current agricultural research is becoming engaged in the development of an effective automation system in agriculture. Precision agriculture and digital farming have both benefited greatly from the use of agricultural field robots and manipulators.

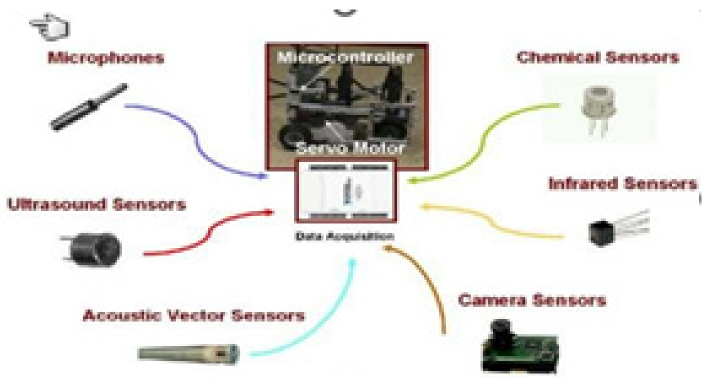
AGRICULTURAL ROBOTICS AND DIGITAL FARMING:

A possible approach to tackling the issues of digital farming, a lack of labor, and decreasing profitability is agricultural robots. Farming techniques are entering a new era because of modern agricultural robotics, which are getting smarter, identifying sources of variability in the field, using less energy, and modifying their performance for more flexible jobs. They are now a key component of the overall strategy to produce vegetables as well as other crops in the future, such as the creation of robotized plant factories to grow vegetables in Antarctica or in space. The trend in food production is toward robotic arms and mobile platforms to replace trained laborer's and compact Agri-cubes, cultivation systems, and automated farming methods that require the least amount of human interaction. Digital farming includes the collection of high-resolution field and weather data using ground-based or aerial-based sensors; transmission of this data into a central advisory unit; interpretation and information extraction; and provision of decisions and actions to the farmers, field robots, or agro-industries. Examples include the development of information maps (such as yield and density maps) and data sharing. Thermo-RGB imaging systems are used to monitor plants and soil in order to determine their health. When digital farming techniques are used, production becomes efficient, stable, and yields grow significantly. The Internet of Things, big data analysis, smart sensors, GPS and GIS, ICT, wireless sensor networks, UAV, cloud computing, simulation software, mapping applications, virtual farms, mobile devices, and robotics are a few of the technologies used in digital farming.

ROBOTS USUALLY HAVE FIVE PARTS:

Sensors:

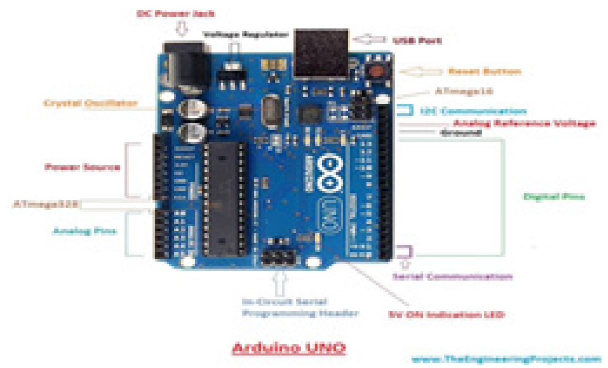
Sensors send information in the form of electronic signals back to the controller. They can give robot controller information about its surroundings. Robots can be designed and programmed to get specific information that is beyond what our senses can tell us.



Type of sensors.

Controller:

It is also called as computer. Controller functions as the brain of the robot. Controller also allows the robot to be networked to other system, so that it may work together with other machines, processors, or robots.



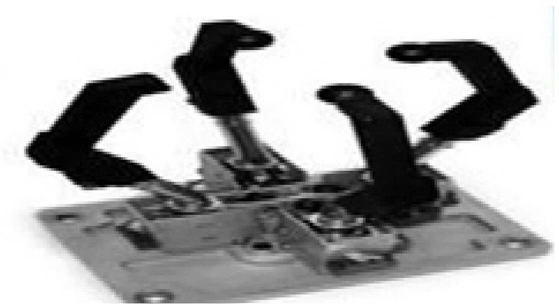
Controller

Arms:

Usually, a robot arms are like human arms with a shoulder, elbow, wrist, and fingers. The arm is a part of robot that positions the end-effectors and sensors to do their preprogrammed business

End effectors:

End effectors are the last link (or end) of the robot. In a wider sense, end effectors can be seen as the part of a robot that interacts with the work environment



TYPES OF ROBOT IN AGRICULTURE:

Demeter:

Demeter is a Robot griper. The importance of determining the labor requirements to grow and produce the yields through mechanization cannot be overemphasized. In agriculture, harvest time is when robots perform their most obscene functions. Alfalfa and wheat can both be harvested by Demeter. The Roman goddess of husbandry is honored with the name of this robot. Demeter is a natural phenomenon that does not require any human intervention. As a result, agricultural productivity decreases because it becomes exhausting to work nonstop. On the other hand, a robotic harvester can operate around-the-clock and never stop doing the job. Demeter has cameras installed, and these enable it to distinguish between crops that are being sliced and those that are not. This information explains where to drive, where to put the cutting section, and when to go close to the end of a crop cord so that it can spin everywhere. It also provides a position for a motor supervisor. It is made from a structure that provides tractors, then reapers, with three phases of mechanization. The first one is the "sail control" phase, which drives, steers, and guides the cutter part while also being offered to its operator.

Weed control Robot:

Regular farm work involves challenging conditions like defined field boundaries and soft, loose, or uneven surfaces. This has led to the development of novel weeding tools that can reduce labor costs for naturally grown sugar cane and vegetable crops by up to 100% while reducing herbicide use by 75% to 100% in high-value yields. They are applicable to vegetation, which is regularly removed. This process involves using robots to replace extra workers on third-class weeds on the farm. Eliminating weed is the focus of the weed-eliminating device. By using a weed control device between the rows of crops that are planted in rows, weeds can be removed. Herbicide usage is greatly reduced when weeds are seen in a smart way that can understand how harvests are arranged and guide itself specifically between them.

Forester robot (Treebot):

Researchers are keeping an eye on ecological changes in the woods because to a courageous portable robot. Treebot is the first of its kind to combine networked sensors, a wireless internet connection, and a webcam. It is the high-tech Tarzan of the robot world. It is motorised and has wheels that allow it to move up and down when tests and other projections for in-depth research are taken. Developed by the US Center for Embedded Network Sensing in California, Tree bot. Pinpoint, a Linux operating system, was used for programming.

Fruit picking robot:

Fruit reaping is a periodic activity that takes place when fruits in areas being farmed in orchards are ready for harvest. Since the early 1980s, the fundamental concepts of fruit-picking robots have been defined as shown in Figure 9. These ideas started with different approaches to agricultural harvesting. Fruit picking, on the other hand, is entirely robot enabled; high-tech employment, farm tool manufacturers, and agricultural invention must be necessary. The fruit-picking robots are designed to select ready-made fruit without damaging the tree's leaves or branches.

CHALLENGES OF ROBOTICS FOR PRECISION AGRICULTURE: DIGITALIZATION, AUTOMATION, AND OPTIMIZATION:

After 20 years of research, there are now several types of sensors for capturing agronomically important parameters, in addition to various farm management systems. Modern technology includes robots and machines that are operated electronically. However, it still cannot be claimed that precision agriculture has been widely established in crop production. There is still the benefit of time savings. Thus, the goal of agricultural robotic engineering research is the development of "smart" systems that are both clever and easy to use. Crop plant sensor systems that assess, propose a treatment, and then apply it all at once, like the so-called N-Sensors, are clearly the most effective. In contrast, an off-line technique like yield mapping requires additional processing steps and PC-based data analysis. The challenges for sensor development and agricultural robotic technology include the high temporal and spatial resolution data that are needed, which are extremely varied and challenging to measure parameters under the majority of adverse situations.

ISSUES AND SUGGESTION:

Agricultural robots are becoming more popular globally and have a variety of distinct natures and qualities, yet there are various problems.

1. Agricultural robots are expensive, both in terms of the initial investment and ongoing maintenance. Therefore, appropriate help from the involved nations, divisions, agricultural companies, NGOs, Charitable Trust, etc. is required in the developing countries.
2. Some fruits and products are not ideal for agricultural robots, so further research and development may be provided in this area.
3. Agricultural robots require adequate people for their development, repair, and advancement; hence, adequate formal education is needed for further progress in the following decades.
4. Farmers need receive sufficient training on these machines as they entail many different types of operations and machinery. As a result, workshops may be set up where cultivators and agro industry experts may receive this instruction.
5. Robots used in agriculture require periodic maintenance to ensure their productivity and utility.

ADVANTAGES:

Seeing to the above mention crisis that Robots will make a remarkable perfect entry into the agriculture, following are the advantages of robotics farming.

1. Elimination of labor.
2. It brings us an opportunity of self-employment for those who are unemployed.
3. It is one time investment then the expenditure of the farming will drastically.
4. The use of fertilizer, pesticides, insecticides, herbicides, and water consumption can be reduced in very large percentage.
5. It brings revolution in the farming, agriculture, and cattle grazing.
6. Productivity will be increased to a lot extent.

DISADVANTAGES:

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APPLICATIONS OF ROBOT IN AGRICULTURE AND ALLIED AREAS:

A. Drone for the weed controlling.
B. Plants seeding.
C. Environmental assessing and monitoring.
D. Fruit Picking.
E. Automated Spraying (Man/ Driverless).
F. Sheep sharing Robots.
G. In horticultural activities.
H. Automated washing and castrating.
I. Soli mapping and analysis, etc.

CONCLUSION AND WAY FORWARDS:

The past ten years have seen a considerable increase in the amount of research being done to create agricultural robots that can efficiently execute laborious field activities. However, the fastest prototype robots for weeding and harvesting are nowhere near fast enough to be able to compete with a human operator. With the decline of the labor force and the rise in production costs, robotic weeding and harvesting research has received increased attention in recent years. As the development of robotic systems in agriculture is typically focused on imitating the behavior of human labor in the completion of agricultural operations, operations like planting, inspection, spraying, and harvesting will be conducted efficiently with minimal operational costs and human labor. A robust and effective agricultural robotic system that can be widely adopted by farmers around the world with the primary objective of producing a high amount of agricultural output in order to maintain food security in the future may be designed in the future by combining all the technologies developed for each operation.

Due to the introduction of mobile agriculture robots, there would be a large replacement of heavy, large tractors will slow, light and small robot which do not require manpower. There would be no compaction of soil the plant will get more attention and it is these are also less in terms of cost. If the machine is large then the compaction of soil takes place and plants do not like it. This problem will be eradicated by the usage of GPS machine which are controlled but with the introduction of mobile agribots there is still a better solution.