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Agribot: The Agricultural Robots

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Abstract- *An agricultural robot or "Agribot" is a robot used for agricultural purposes. The introduction of robots in agriculture has dramatically increased agricultural productivity and production in several countries. In addition, the use of robots in agriculture has reduced the operational costs and lead time of agriculture in various fields of agriculture. Agriculture is the most important and important economic activity of all time. Pre-industrial agriculture was usually a household/subsistence where farmers grew most of their crops for their own consumption rather than for trade. But now a structural change is taking place in agriculture, which is leading to a crisis situation. The growth rate of agricultural production has gradually slowed in recent years due to labor shortages and rising costs. Also, the prices of seeds and chemicals are increasing, which creates the need for their effective use. A recent study shows that the world should double agricultural productivity to feed a growing population by 2050. At that time, effective management of natural resources meets the growing demand by adopting modern technology in agriculture to increase agricultural productivity. So, as farmers struggle with higher prices for seeds and chemicals, labor shortages and global food demand are forcing them to think about innovative and more efficient farming methods.[1]*

Keywords- Agribot, BoniRob, GPS, Robot, Weeding Crops , Spraying Drones

I. INTRODUCTION

The idea of robotic agriculture (an agricultural environment served by intelligent machines) is not new. Many engineers have developed driverless tractors in the past, but they failed because they could not accept the complexities of the real world. Most of them adopted an industrial farming style where everything was known in advance and the machines could work in a completely predetermined way, just like a production line. Globally, the need to increase food supply is a serious problem. 7.4 billion people live in the world as of now. The amount of available labor in agriculture is steadily declining as a result of expanding opportunities in other industries. In actuality, 58 is the typical age of a farmer in the United States. It is an increase from the 55 it was five years ago. The younger generation simply wants to stop farming. Agribot use began gradually replacing the necessity for human labor in agriculture. According to the IEEE Robotics and Automation Society, robotics and automation can significantly contribute to society's ability to meet the demands for agricultural production in the year 2050. In the six decades that robots have played an important role in increasing efficiency and reducing costs in the industry, agricultural productivity must increase by at least 25 to meet the global demand for food. Thus, the use of robotics and automation in agriculture would soon become inevitable all over the world. [1]

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II- METHODOLOGY

The agricultural revolution began in 1752 and came to a conclusion in 1900, when agriculture in America saw a significant transition. The invention of the machineries is the primary cause of the agricultural revolution that has occurred. Around this time, a well-known machine by the name of Eli Whitney's cotton gin was introduced. It was the first agricultural machine ever utilized. On March 14th of that year, 1974, Eli Whitney unveiled this device. This machine has a record of producing up to 50 pounds of cotton in a single day and has the ability to separate the cotton seed from the cotton fiber. This daily amount of fifty pounds equates to roughly a hundred man hours. The cotton gin was the first machine in agriculture, and it paved the way for many more contemporary ones.

In the early 1920s, robotics was originally developed in the agricultural sector. The research was conducted to lay the groundwork for the automatic vehicle guidance system, which was about to take shape. Between 1950 and 1960, developments were a result of this research. The development led to the development of autonomous agricultural vehicles. The necessity for a cable system to guide the cars along their line of travel made this specific concept less than ideal. Agricultural robots have continued to advance as technologies in numerous other industries. The guidance for the machine's vision became conceivable in the 1980s after the invention of computers. Additional innovations appeared in the years that followed, such as the use of agricultural robots to pick oranges in nations like the USA and France.

Agricultural robots have been utilized for decades in indoor sectors, but integrating them outside has always been challenging because they are thought of as the more difficult ones to build. The usage of these robots is unpredictable due to worries about security, the difficulty of harvesting crops, and changing environmental circumstances.[4]

III- LITERATURE SURVEY

ACTIVITIES

They are used for many applications in agriculture as they are versatile. Some of the uses are:

A. Seed mapping

Seed mapping is a concept where the geospatial location of each seed is passively recorded as it goes into the soil. In practice, this is relatively easy, since RTK-GPS is installed on the seedbed and infrared sensors are installed under the seed trough. When the seed falls, it cuts off the infrared beam and triggers a data logger that records the location and direction of the planter. A simple kinematic model can then calculate the actual seed location. The seed coordinates can then be used to target subsequent plant-based actions. Although a high-precision positioning system was used, field results were initially poor due to the small dynamic gradients of the seeding operation .

An inclinometer that measures pitch and roll was fastened to the GPS antenna pole in order to counteract this effect. The data logger captured and time-stamped all of the logged data from the optical sensors, inclinometer, and GPS at a resolution of 400 Hz. The GPS data was captured at 20 Hz in UTM coordinates. Based on time-tagged seed detections and the 501 ms GPS data intervals, a temporal interpolation was done to determine each seed's location. A kinematic model was used in the data post-processing to determine the seed drop positions, remove inclination errors, and provide heading information. [2]

B. Weed mapping

Weed mapping is the process of record the location, density (biomass) and preferably species of different weed using machine vision. For automatic detection of grasses. Several studies have been conducted using different separation and classification techniques. A weed survey is a hypothetical scenario in the sense that most farmers do not conduct a systematic survey of their crop fields. Farmers or practice. Traditional farming with conventional spraying or organic farming with mechanical weed control. That comparison assumes that an alternative to autonomous weed mapping is manual weed mapping, which requires a farmer to manually record and map weeds in the field using a handheld GPS.

There are several methods that can capture unwanted plants without chemicals. These can range from complete removal to simple slowing down. A classic example would be to promote weed wilting by disrupting the soil-root interface and connecting the soil-root zone. Basically, there are three main areas in the growing environment that need different treatment: the inter-row area (the space between the crop rows), the inter-row area (the space between the plants in the row), and the inter-row. Area real area crops... which are inside the leaves and root sheath.[3]

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C. Micro spraying

Mini spraying takes the concept of a spray boom down to the centimeter level. It apply highly embattled chemicals and can pleasure small areas by selectively switching the jets on and off. It is part of a superior system that can be familiar with individual weed plants and establish their leaves for treatment. Within the close-to-crop area, great care must be taken not to spoil the crop or bother the soil. One method of slaughter weeds close to the crop plants is to use a micro spray that delivers very small amounts directly onto the weed leaf. Machine vision can be used to identify the position of an individual weed plant and a set of nozzles mounted close together can spray an herbicide onto the weed. Tests have shown that splashing can be condensed when a gel is used as a carter rather than water.[3]

TYPES OF AGRICULTURE ROBOTS

A. Demeter

There are agricultural robots that are designed to work around the clock to quickly harvest the crops. You'll notice that in many instances, it would take between 25 and 30 workers to do the same task.[5]

B. Weed Control Robot

The agricultural robots that have been created to control weeds are capable of autonomous navigation in the field and can spray herbicides on the weeds that need to be avoided or removed. This method helps to limit the growth of weeds that are herbicide-resistant while reducing the amount of pesticide exposure to crops.[5]

C. Forester Robots

A semi-autonomous device called Robotic Forester will handle all of the major regeneration tasks, including soil preparation, planting, and early tending/cleaning. Throughout the first five years of forest regeneration, it has been designed to address all essential activities, such as:

1. Mineralization of the planting place (soil preparation)
2. The planting process
3. Cleaning efforts (weeding) .[5]

D. Fruit Picking Robot

The agricultural robots at the initial were used to gather the fruits along with the crops. The harvesting is a bit tricky for agricultural robots. So, new agricultural robots have been designed which are organized with the system of vision which is advanced so that they can classify the fruits and pick them without causing any damage.[5]

E. Drones

A drone is basically a flying robot that may be distantly controlled or flown autonomously using flight plans that are controlled by software in implanted devices. That co-operates with a global positioning system and onboard sensors (GPS). UAVs were repeatedly connected to the military.[5]

IV- IMPLEMENTATION

The beginning of agricultural robotics and automation has altered the food business. The primary source of food is agriculture, and automation in this sector is strengthening it. The use of drones and agricultural robots is anticipated to rise by 30 billion in the next five to six years. Modern agriculture faces a number of serious problems. The old farming practices will make it difficult to achieve the efficiency required by the market's current trend. The farmers who are component of the countries which are previously developed have been suffer due to the unavailability of the workforce. The improvement in the farming which is automated is used as an effort to get the solution to all these problems with the help of robotics and the sensing which is one advantage of it.[1]

1 Nursery Planting

Nurseries are the places where childish plants are produced from the seeds which are planted in the outdoors afterward. The plants in the nursery are mostly sold to the customers and gardeners directly, but they are also a foundation of the journey of food for few crops. There is a necessity of the automation in a nursery. HETO Agrotechnics and Harvest automation are the companies which are given that solution for seeding, warehousing the plants which are living in greenhouses, and also potting in an automated way.[1]

2 Crop Seeding

In an agricultural field, seeds are the first stage of the life of the plants that provide sustenance. The conventional methods for planting the seeds involve dispersing them with a broadcast spreader that is mounted to a tractor. While the tractor assists by driving steadily and following a single path, the spreader helps by scattering

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numerous quantities of seeds around the field. The seeds are squandered using this ancient method, hence it is not thought to be very effective. Robotics and remapping can be combined with precision seeding carried out automatically. A map will be produced that details the characteristics of the soil at each and every location within the agricultural field, including its quality, density, etc. To give every seed a greater chance of growing, a robotic tractor attachment with a seeding attachment will start planting the seeds in precise positions and at the appropriate depths.[1][2]

3 Monitoring the crop and giving analysis

It's incredibly challenging to keep track of the crops cultivated in large fields. Geospatial mapping and new sensor technologies are assisting farmers in obtaining extensive information on the crops they are cultivating. Ground-level robots and drones will provide an autonomous means to collect this data. Businesses that produce drones, like Precision Hawk, are providing packages to farmers that include robotic gear and analysis software. This will make it easier for the farmer to fly the drone over his or her farm, launch the program using a Smartphone or tablet, and observe the crop that has been harvested in real time. As they can get quite close to the crops, ground-based robots like BoniRob will be able to give farmers detailed insights. Several of these agricultural robots can also be used for weeding and fertilizing, among other things.[1]

4 Fertilization and Irrigation

The traditional method of fertilizing and irrigating crops is thought to be ineffective because it uses a lot of water. By concentrating on a few select plants, precision irrigation, supported by the robot, will reduce water waste. Ground-based robots will autonomously move through the rows of crops and spray water right at the roots of each plant. Robots would have the advantage of being able to access locations that traditional agricultural machinery could not. For instance, corm growers frequently have problems since the plants develop quickly and there isn't enough time to fertilize them effectively.[6]

5 Crop Weeding and Spraying

Taking weeds out of a field is known as weeding. It works well for managing crop yield and crop protection before harvest. Weeds must be eradicated because they may interfere with the crop's growth and reduce the yield by competing with it for resources such as nutrients, light, water, and other necessities for growth. There are numerous methods for weed control. Herbicides, crop rotation, hand weeding and hand hoeing, water management, and soil preparation are all part of weed control. Prior to planting the seeds for the primary crop, land preparation aids in the weeding out and seed removal of unwanted plants. It is exceedingly laborious and time-consuming to physically weed by hand.[7]

Fig : Weeding Crops [7]

Fig : Spraying Drones[7]

V- APPLICATIONS

1. The advent of agricultural robotics and automation has changed the food business. The primary source of food is agriculture, and automation in this sector is strengthening it. The use of drones and agricultural robots is anticipated to rise by 30 billion in the next five to six years. Modern agriculture faces a number of serious problems. The old farming practices will make it difficult to achieve the efficiency required by the market's current trend. Due to a lack of labor, farmers in wealthy nations have been suffering.

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2. Young plants are created in nurseries from seeds that will eventually be put outdoors. Although most of the plants at the nursery are sold directly to consumers and gardeners, they also serve as the starting point for some crops' food chains. An automation necessity exists in nurseries. Companies that offer automated systems for seeding, storing plants that are kept in greenhouses, and potting include HETO Agrotechnics and Harvest Automation.
3. Food-producing plants begin life as seeds in agricultural fields. The conventional methods for planting the seeds involve dispersing them with a broadcast spreader that is mounted to a tractor. While the tractor assists by driving steadily and following a single path, the spreader helps by scattering numerous quantities of seeds around the field. The seeds are squandered using this ancient method, hence it is not thought to be very effective.
4. Graphical passwords take advantage of the fact that humans are visual beings who process and remember visual cues better than most other forms of data. It can be freeing to not have to memories or type down a long, challenging password!
5. As a result of the development of mobile agricultural robots. Large amounts of the heavy, huge tractors would be replaced by slow, light, and small robots that don't need human labor. The soil wouldn't be compacted, the plants would receive more care, and it would also cost less to maintain them. The soil is compacted when the machineries are enormous, which is bad for the plants. By using the GPS devices that are controlled, this specific issue will be solved. But, there is a still better answer now that mobile agribots have been introduced.[4]

VI - ADVANTAGES AND DISADVANTAGES

A. Advantages

1. Since agricultural robots handle the majority of the work, labor can be eliminated.
2. The main farm tasks that need labor, such as weeding, seed planting, fruit picking, etc., can all be handled by robots.
3. A single farm robot can do the duties of about 30 employees. Robots are capable of performing tasks like manure collection and even the milking of cows on dairy farms.
4. When their reliance on labor declines as a result of the deployment of agricultural robots, farmers will have a sense of independence. The investment just needs to be made once, and as operating costs fall, earnings will soar.
5. There would also be less use of pesticides and other dangerous chemicals, which not only injure plants but also poison the environment by releasing dangerous substances into it.
6. There are other ways to cut back on water usage. The volume of crops produced will dramatically increase. Agriculture will never be a demanding profession that attracts young people into it, increasing global food supply.
7. The agricultural robots will provide information on the soil so the farmer may choose what kind of crops to cultivate.[4]

B. Disadvantages

1. Robotics implementation in agriculture is quite expensive.
2. The farm becomes more complex, and if the controller does not exercise sufficient caution, there is an equivalent risk.
3. The labor hired to maintain the farm should be technologically skilled.
4. Because that robotic farming equipment relies on electricity, the power outage issue in India would be a tremendous nightmare for farmers utilizing this technology.[4]

VII- CONCLUSION

The potential for robot-enhanced productivity in agriculture is enormous, and farms are seeing an increase in the quantity and variety of robots in various forms. With the right technology, the additional issues relating to auto farm equipment can likely be solved. These devices could be a part of our future, but there are compelling arguments against the idea that they would simply substitute computers for human drivers. It can entail re-evaluating the methods used in crop production. A vast number of little machines may be more effective and less expensive at producing crops than a few large ones. The fact that the smaller machines might be more popular outside of agriculture is one of their benefits. Because agricultural activities are tedious, risky, and necessitate quick, repetitive judgments, robots can effectively replace human labor in this industry. Machines are capable of correctly sensing the attributes of higher-quality items (color, firmness, weight, density, ripeness, size, and form). There are drawbacks to using robots, even though they can make human lives better.

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