Journal of The Gujarat Research Society

ISSN: 0374-8588
Volume 22 Issue 1, January 2020

An Intelligent Agriculture Prototype for Agricultural Field Monitoring and Management

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ABSTRACT: India's agricultural output has gradually decreased as a number of natural catastrophes have devastated agriculture and unpredictable climatic patterns have interfered with crop rotation. Furthermore, the elderly farmers are lowering their commitment and attempts to sell their agricultural property that inevitably impacts the production of food crops and dairy products. The agricultural environment and serious development need more robust frameworks with quick progress. The unstructured concept of the outside world creates chances of deception. In addition, the devices are usually operated by low-tech professors. Inherent safety and reliability is therefore an important aspect. Food handling is also a problem that requires mechanised frameworks to be cleansed and reliable against contamination discharge. The agricultural mechanisation frameworks referred to in this study involve field machinery, irrigation frameworks, greenhouse technological advances, animal automation structures and automation frameworks for organic produce. Each section shows numerous frameworks for automation, different applications and current developments in the field.

KEYWORDS: Agriculture, Greenhouse, Harvester, Intelligent Farming, Irrigation.

1. INTRODUCTION

Over time, agricultural efficiency has grown substantially through escalation and motorisation. This includes farming equipment robotized in fields, animal contexts and methods. Automation in agriculture has reduced production costs, reduced physical labour, increased fresh crops and improved environmental management. In contrast to basic, dreary, highly characterised and inferred mechanical applications, automation in agriculture requires cutting-edge innovations in order to manage and produce the complex environment that is extraordinarily important. Agricultural items are natural objects that, due to environmental and hereditary factors, have serious fluctuation.

The farming environment is unpredictable and organised around with huge varieties between fields and even within a similar field. Central innovations should all address the constant changes in circumstances, changeability in matters and the environment (dimensions, form, region, earth quality and temperature), sensitive matters and hostile environmental situations. Sophisticated control mechanisms are essential for the dynamic, continuous translation of the environment and object. Compared to mechanical instruments and frameworks, implementations of agricultural automation can have less accuracy requirements. Since the object is very simple, the cost of the automated system should be small to make it financially justifiable. The rare concept of agriculture makes it difficult for the high use observed in assembly companies to be achieved[1].

1.1 Self-Sufficient Agricultural Vehicles:

A vehicle that is self-sufficient should be able to work without an administrator. Besides controlling, different orders should be performed by a human administrator: recognising and staying away from obscure items while driving, one should work at a safe speed and perform tasks. It takes a lot of effort to develop human knowledge for something like the self-governing car. Vehicles self-sufficient and operating in an unorganised agroecosystem should use refined detection and check frameworks to react spontaneously to any occasions. An animal or human appearance in front of the car is a common spontaneous occurrence. Enhancing defensive vehicle frameworks is the way to self-sufficient organisation. Several advances have been examined for the protection of the vehicle. To distinguish a person, two ultrasonic sensors were used. The reliable location ranges for moving objects was close to 4.6 m & 7.5 m for stationary objects under field settings.

A binocular camera was used to distinguish a person who was left before a vehicle. The framework was able to detect the relative movement status (speed and heading) of the individual when compared to the vehicle on a good distance between 3.4 and 13.4 m. The laser rangefinder was used to evaluate the overall movement of a snag truck. Ultrasonic sensors are minimal, but their recognition is limited. Audio system cameras are difficult under shifting illumination circumstances. The laser range is now the most trustworthy technology, but its application is limited to vehicle stadiums, due to the high cost[2].

Several degrees of framework recurrence have to be incorporated into the car, which often involves the use of several protective sensors. As part of self-sufficient cars, technical field operations must be improved. Terms should be robotized in order to use a self-regulating vehicle. Agricultural equipment has evolved over the long term to oblige robotic control of commands. Chip based hardware management is replacing mechanical control, and electro-hydraulically powered actuators are preferable to finely regulated versions.

Automation assignment models can be found in many state-of-the-art agricultural machines. The model includes headland management systems for scheduled operations on working vehicles usually linked to headland bends and guideline-based planned dung showering and synthetics on dispensers. Autonomous agricultural vehicles and technical field tasks are not now reliable and long-lasting enough to meet the needs of the agricultural industry and its clients. In any case, various autonomous vehicle frameworks were established as a verification of the ideal machines which can then be marketed quickly. Some worthy systems are presented momentarily below[3].

1.1.1 Harvester Combine:

The 'combined harvester' is an automated method that combines the way to produce, sew and inspect crops using a solitary machine. It is helpful for ranchers to collect large crops such as rice, maize, wheat, sunflower, beats and other products and to harvest them directly in the field. These machines increase agricultural yield, as the collection is done more effectively, thus making agriculture more productive. The combined harvester has a broad front header that accumulates the yield in the combination.

A reel in the header moves the output to the shaper bar at the base. The grain is then taken to the screening drums, where it is isolated from the stalks. A collection tank accumulates each grain as it passes through the strainers. The paw walkers transport the waste to the back of the combined harvester at that point. When the grain tanks are filled, they are drained by a side line called the unloader into a trailer. The remaining debris is either fanned out absurdly or is folded into a ball for further use.

Combines detachable heads that are altered by the yield that is harvested. A solitary combiner can therefore be used to harvest a variety of crops. A standard header can be used to collect wheat, which acts as a blade shaper bar, which cuts the harvest so that the drill is secured. Corn heads have an exclusive snap roll that removes both the ear and stalks from the leaves. Additionally, unusual combinations with accompanying tracks are present and capable of reaping rice[4].

When soybean is harvested, it takes a flexing stage with a more powerful shaper bar to cut soybeans that are low. Combinations for slope crops are fitted with an outstanding hydraulic framework that helps them perform great during collection. The flex head can also be used to collect cereal crops. Draper heads increase efficiency and reduce power consumption.

1.1.2 Autonomous Tractor:

John Deere & Autonomous Solutions Inc. have been involved in the construction of an autonomous tractor for computerised plastering, cutting and cultivation in plantations. A robot prototype was the John Deere 5000 configuration tractor with crucial adjustments. The truck, a transportable control unit and a base station all formed part of the structure and were all supplied over a remote frame. The car included direction, braking, grip, three-point fitting and choking functions.

A long-range hitch location framework was developed for vehicle protection. One of the major developments in the project was the methodology and mission planning, which incorporated a dynamic revision of vibrant help events. The framework was constructed using a joint architecture for the industry's concept of unmanned ground systems (JAUGS). A proof of concept framework has been developed and adequately demonstrated, but the decision to produce has not yet been taken, mainly on safety grounds[5].

Over time, companies such as the Autonomous Tractor Corporation and John Deere have actively developed and refined their technology, but self-employed tractors have become no longer a concept. Autonomous Tractor Corporation was one of the first companies to try to develop an autonomous tractor and succeeded by 2012. Your first model is called SPIRIT, and the main tractor is to be followed. The organisation is still developing a model that can drive alone without being tied to a lead tractor. Companies such as Fendt and Case IH now work on their own tractors.

1.2 Advanced Systems of Irrigation:

Irrigation is the use of additional soil moisture to help crop growth. It is mostly used to replace missed rainwater for cultivable plants and to supply water to crops filled as greenhouses under controlled conditions. The primary objective is to provide a crop with the right amount of water at the right time. The different types of irrigation systems differ in the distribution of rainwater in the field. Water passes through the ground gravitationally and penetrates the soil in soil irrigation systems.

Wrinkle, linear strip and funnel irrigation are all examples of designs for surface irrigation. Water is flunked into networks by compression in limited irrigation structures and is selectively applied to the crop and the field. Restricted frameworks include the frameworks of the shower, sprinkler, trickle and air pocket. Automation allows for effective water use and work on all strategies through the empowerment of adaptive recurrence, rate and water span of the irrigator supply at the correct point of application[6].

Sprinkler irrigation is the irrigation water management process that simulates the effects of typical rainfall. Siphoning is a way of spreading water through a wire network. It is sprinkled into the air by sprinklers which fall to the surface in small water drops. The supply framework for syphon, sprinklers, and working conditions should be designed to facilitate a consistent use of water. Sprinkler irrigation framework enables the use with the help of a syphon of water under high tension. It releases water as precipitation via a small spread in the lines.

Water is appropriated by arranging lines, sprinkled in air, and flooding, mainly due to the large extent of the release limit. Irrigation by sprinkler is suitable for most lines, fields, including forest resources and water is applied over or under a cultivated canopy. In the watering of sensitive crops, such as lettuce, massive sprinklers are not recommended, as the large water droplets of sprinklers could affect the output. Irrigation with sprinklers can be used on any pharmaceutical path, whether regular or meandering. The parallel lines that water supply to the sprinklers should be spread over the earth at all times. This minimises the fluctuation in the pressure factor somewhere at sprinklers and provides consistent watering[7].

1.2.1 Greenhouse Automation:

The greenhouse setting is a fairly simple place to learn about computer machinery due to its planned character. The robotic framework should now manage the inconsistency of the agricultural product. Improving frameworks is therefore easier and less complex. Greenhouse automation frameworks manage the environment, seedling creation, splashing and collection as listed in the accompanying segments.

In the 20th century, greenhouses were invented to maintain sun-driven infrasound radiation, to protect goods against many dangerous common environments and to protect insect pests and to provide appropriate habitats for plants with 100 m plastic laminates or 2-3 mm adhesive labels. Modern greenhouse operations combine plant environmental management, irrigation and supplementation to create ideal circumstances for germinating seeds in concise form, due to progress in sensors and microprocessors. Environmental management enables cultivation throughout the year and shorter development times. This section follows greenhouse control and automation.

1.2.2 Regulator of Temperature and Humidity:

Greenhouse heating and cooling have important effects on plant growth. Control is important because of the amount of energy spent on these tasks. Electric heaters are used when warm neighbouring regions, for example when seedlings are produced, are expressly needed. Increased air temperatures in greenhouses which use the sun can be caused by radiation. In the future, cooling will become more and more important.

Window ornamentation, infrasound synthesis glass (80% transport around as well as 20%), irrigation on glass roofs, covering material lighting, airflow and cushion structure, fan and fog structure, fan and fan structure and other methods are used to decrease the cost of cooling. A thermocouple sensor measures air temperature, whereas both a thermo-camera and other sensors measure brilliant energy by means of plant components or bodies of substances[8].

Natural devices that are available as moisture sensors for electric blockages, capacities or resistance changes with variations in humidity. The sensors can detect relative adhesiveness within 10% to 90%. Air temperature control, crop transpiration, soil water evaporation and other factors influences the adhesive residue of greenhouses. For example, a mist and a fan system may reduce the temperature of 2°C and increase humidity by 20 percent compared to outside air.

Sometimes an artificial cooling machine is used to reduce humidity, while air ventilation is the simplest method. As a result, moisture management also requires compensation for changes in temperature. When greenhouse conditions are regulated, both warmth equilibrium and humidity spending plan must be considered. Temperature and moisture management systems that are flexible have been developed.

1.2.3 Flow of Air:

For the proper cultivation and consistent growth of plants, the greenhouse must maintain a consistent temperature, wetness. Wind current can be generated in a variety of ways depending on the greenhouse architecture. Regular ventilation is generally used due to its low costs. In any case, wind current control is restricted with regular ventilation. In this respect, it is important to investigate properly characteristic ventilation and increase the productivity of ventilation. Regular ventilation is supported by pressure differences created by both airflow and temperature differences during ventilation openings. Given the connectivity and non-linearity within the energy balance systems, air trading prices as well as simplifying the greenhouse strategy require complex models. Additional crossover controls remember the management of fan ventilation structures, side openings and water distributors with recent rates improvements achieved through flawed rationalisation management[9].

1.2.4 Automatic Sprayers:

In regulated circumstances, compound management is required for crop production and the automation of compound splash appeals to restrict synthetic openness. Until now, people were fascinated by robots splashing. Autonomous control of vehicles is one of the most important innovations of robots. The forward pivot can rotate freely along an A-B hub that is diagonally mounted on something like the body. This front wheel is centred around O1-O2 and anticipates a rapid rise in the demand for just one edge on one side alone.

At the same time, the second front wheel slides down and down. As a result, the next control point causes the vehicle to slip away from the edge and changes its travelling port without the involvement of others. If a front and a rear tyre are running simultaneously on the edge, the impact of a heading revision will be reduced because the control point β can be smaller. The back track is 35 mm more limited than the front track for a suitable control point.

Another approach is the use of electromagnetic approvals of various kinds. In the vicinity of edge routes and headlands, enlistment wires are laid down, and a vehicle equipped with an admittance sensor that detects the attractive force of the wires could naturally travel along them if it was equipped with such a sensor. When vehicles travel to the succeeding edge path in narrow headlands inside greenhouses, several strategies have been considered, including a rotating shaft that extends to execute the shift four-wheel steering, an additional rail structure to move the car onto another corridor, and a manual method. During the years 1993 and 1994, plantations experimented with programmed speed sprayers equipped with enlisting wires and acceptability pipes. Another technology, which makes use of a remotely operated helicopter, has become increasingly popular in the fields.

1.3 Fruit Harvesting Robots.

Agricultural robotics is thought to have begun with something simple like the tomato-gathering machine, which was invented in the early 1900s. Bots that harvest organic products such as tomatoes, fresh tomatoes, cucumbers, aubergines, and strawberries have been extensively studied. Also being investigated were vegetable-gathering robots, although no business robots have yet been developed. The inability to achieve high accomplishment rates due to a wide range of plant characteristics, slow operational speeds, and high costs associated with infrequent impact are the primary impediments to the commercialization of collection robots. Later on, however, it is normal to see a reasonable amount of reaping robots in use[10].

2. DISCUSSION

Agriculture has existed for nearly as long as mankind has existed. In addition to hunting, fishing, and putting things together, agriculture and development have been widely refined since early-stage times and have been regarded as important contributors to the economy in every era of human progress. Despite the fact that it is an age-old movement, contemporary agriculture is undergoing rapid and significant changes as a result of the interaction of various cultural components and mechanical patterns. Due to the expansion of the world's general population, a flood in food demand has resulted, increasing the cost of agricultural produce, re-examining exchange strategies, shifting stock chains, and reshaping traditional food conveyance routes.

Regardless of the general development of the total population, the number of agricultural specialists continues to decline, indicating a more desperate labour shortage in the industry for a considerable period of time to come. Additionally, a generally felt affinity towards natural and reasonably created food sources, which is particularly detectable in western nations, means that more attention is being paid to developing and gathering, which results in the addition of new features to the definition of cutting-edge farming practises. At the end of the day, modern farming is forced to choose between two equally bad options. Ranchers are attempting to deliver higher-quality crops in greater quantities, but the number of available hands required to do so is constantly decreasing, with little hope that this will change in the foreseeable future. With the influx of labourers into agriculture having petered out, the only option left is to invest in more efficient agricultural machinery.

Automation is widely regarded as the most important factor in today's society. Many different fields, from office furniture and home-grown environment automation to medicine and other endeavours, make use of this material. A good example of this is farming, where modern farming equipment and agricultural automation may help smooth out the crop production cycle, resulting in a more efficient and less labour-intensive crop production cycle.

This trend toward farming automation has been especially visible in the new century, as more money has been channelled into agricultural start-ups and automated homesteading structures. TechCrunch estimated the capital interest in such organisations at a surprising $1.5 billion in the year 2017, a figure that is seven and a half times higher than the figure from ten years earlier. It is encouraging to see a significant increase in the number of new businesses, with 160 agriculture automation companies competing for financing, compared to only 31 in 2007.

The list of modern farming procedures is comprehensive and includes all aspects of yield creation. A few organisations provide programming that allows for efficient seed and manure application across the board, as well as soil and irrigation management down to the expectation of yield. Robots are being offered by a variety of new businesses that can be used for observation purposes as well as to apply crop medicines from better than other sources, such as composts, pesticides, herbicides, and the like.

However, there are still others who plan and use computerised ranch equipment, which can include anything from grain drills, combines, and mechanised tractors to natural product picking robots. Though coaxing such possibilities may appear to be possible, ranchers understand that robotized agriculture begins not with current farming equipment but rather with legitimate knowledge and observation, which is information gathering.

3. CONCLUSION

However, despite the challenges associated with incorporating automation into traditional food production paradigms, a variety of automation approaches have been developed and are now widely used in agricultural operations. As a result of technological advancements, agricultural production processes have become more productive and diverse. Many regions of the world, however, have a long way to go before they can fully automate or robotize their agricultural production. Because of the limited resources available in developing countries, a significant portion of the work in agricultural processes is still done physically. Despite the massive capital investment required to purchase the hardware, automation will most likely be introduced into these underdeveloped countries in order to aid in the expansion of production as well as the development of terrestrial competence.

Because the production trend in developed countries is toward large-scale ranches, automation will be advanced and encouraged in order to make this possible. Ranchers must produce food at a low cost in order to stay in business, and mechanisation of agricultural innovation is the only way to ensure the future of the industry. With the advancement of sensors and computers, as well as the lower cost of automation equipment, this is becoming more feasible, and innovative solutions will be provided to meet the needs of the industry. The automation and mechanisation of household chores will almost certainly make significant strides forward in the twenty-first century. Agriculturists of the future may employ a combination of improved sensors, controls, and intelligent software to provide practical solutions to the complex problems of the agricultural economy.

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