Agricultural Robots and Robotics - Aspects, Emergences and Concerns

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ABSTRACT

Robot is a machine that is powered by Artificial Intelligence and allied technologies. The Robot is run with a programmable computer and does various tasks and activities automatically. The robotics systems are normally considered as integrated systems built inside of the systems and also associated with the external controlling mechanism. It is important to note that a robot need not always looks like a human being.It is applicable in diverse areas and among these important are healthcare, business, agriculture, transportation, manufacturing, etc. In the field of agriculture, Robotics is dedicated for various pre and post production activities of agriculture and similar sectors. Previously only harvesting considered as important regarding the robotics applications in agriculture but currently, there are many concerns where robotics and artificial intelligence (including similar systems) can be adopted such as drone for the applications in weed controlling, plant seeding, environmental assessing and monitoring, soil mapping and analysis, etc. Information Technology in agricultural practices is also supported with various allied technologies viz. Cloud Computing, Big Data, HCI, Usability Engineering, Robotics, and AI, etc. According to the market, this growth of robotics is increasing and will be high very soon. This paper is a kind of review on robotics including its role in the field of agriculture and discusses the issues and challenges of AI and Robotics in the context of developing countries.

Keywords: *Agricultural Informatics, Robotics, AI, Artificial Intelligence, Agricultural Sciences, Development, Sustainable Growth in Agriculture*.

1. INTRODUCTION

Agriculture sectors emerging as a leading commercial sector and as high-tech industry, and internationally many organizations are involving in such biggest industry, and even new investors are also increasing with this field [1],[21]. The advancement of the production as well as farmers assistance become possible with IT and Computing applications and here use of Robotics and automation technology can be considered as worthy. Agricultural Robotics is becoming an important part of Robotics and also in allied Artificial Intelligence [4], [6], [27]. Today there are many tools and technologies being involved with the Agricultural Robotics practice and among these few important are Drone for weed controlling, Plants seeding, Environmental assessment, environmental monitoring, Fruit Picking, Smart and automated Spraying Systems, Sheep sharing Robots, Automated horticultural system, Automated Intelligent soli mapping, etc. Internationally the robotics market in Agriculture is growing and Market Research Consultancy firm (Verified Market Research) expressed that it will reach to $11.58 billion by 2025. Agricultural Robotics task is done with initial machine learning and program fixing using AI and emerging tools. The machine normally needs to get knowledge of different factors for performance. Robotics is also very important in livestock management including post production and transportation in some cases. Agricultural Robotics is empowered with several benefits in the agricultural sector like-

- Increasing efficiency,
- Enhanced productivity,
- Minimizing production cost,
- Minimizing manual labour and
- Manpower involvement, etc [10], [13], [29.

The basic technologies in Agricultural Robots are Artificial Intelligence, Expert Systems, Deep Learning, Machine Learning, including allied technologies like Cloud Computing, Big Data, Analytics, etc.

2. OBJECTIVES

The present work entitled 'Agricultural Robots and Robotics—Aspects, Emergences, and Concerns' deals with the following aim, objective, and agendas—

- To know about the basics of Agricultural Informatics with various kinds of emerging technologies for helping and making smart agricultural systems.
- To learn about the basics of Artificial Intelligence such as its evolution, features, and functions.
- To get a picture of the use of AI and Agricultural Robots in modern days contexts in different areas and roles.
- To propose and suggest the future potentiality of the Agricultural Robots in a brief manner.

3. ROBOTICS AND ARTIFICIAL INTELLIGENCE: AN OVERVIEW

Robotics is another branch of technology which is rising rapidly and involves the design as well as the construction of robots. Robotics could be used in different systems, products, and services, where it perfectly ensures the allied systems more intelligent way with day-to-day lives becomes easy. However, safety is another major concern. Robotics is associated with many subjects and among these important are Mechanical Engineering, Electric Engineering, Computer Engineering, Information Technology, etc. Robotics is dedicated in development of the machines i.e., substitute for humans and replicate human jobs and applicable in many situations like dangerous environments, manufacturing processes, space, underwater, in high heat, materials, clean up, etc. Furthermore, Robotics are applicable in replicating of walking, lifting as well as other human activities [7], [8], [22]. Moreover, many robots are inspired by nature and towards sustainability with their superb performance.

Artificial Intelligence, in short, called as AI, this is a kind of human intelligence here programs are basically acting like humans basically exhibit traits connected with a human brain viz. learning including problem-solving, etc. AI Systems also have the nature of the ability to rationalize to take actions to reach a desire and predefined goal. Artificial Intelligence and robotics are not same but well connected, though there is a misconception that both are the same. Artificial intelligence is a kind of human intelligence and here the mimic machine basically executes tasks or work with the following intensions-

- Learning
- Reasoning, and
- Perception [11], [23].

At the beginning, machines were only responsible for calculating or recognizing text through optical character but gradually scenario becomes changed, and it is using cross-disciplinary subjects and areas like Mathematics, Computer Science, Linguistics, Mechanical Engineering, Psychology, and more [9], [30].

4. AGRICULTURAL INFORMATICS: THE FUSION OF AGRICULTURE WITH IT/ INFORMATICS

Informatics is about the information activities with the technologies i.e., IT and Computing. The rising role of Informatics led many other branches of Informatics and among these Agricultural Informatics isan important one, this is the application of Information Technology in the Agricultural space and

sectors. Simply this is the subject and field of IT with proper applications in Agriculture with interdisciplinary in nature and applicable in diverse areas. Here various Information Technology parts or components become widely used viz.-

- Database Technology,
- Software Technology,
- Multimedia Technology,
- Web Technology,
- Networking Technology, etc.

Agricultural Informatics is the use of IT and also documentation, Information Management in the field of Agriculture and allied sector. Latest IT and allied technologies like Cloud Computing, Big Data, HCI, Usability Engineering, Robotics and AI, etc., doing a pivotal role in developing Smarter Agricultural systems [3], [17]. The applications of Robotics, AI, and Machine Learning in the Agricultural systems give us many Smart agricultural systems and among these Agricultural robots are important with enhanced productivity of the yields for the farmers. Among the uses important are drones, harvesting machines (as depicted in Fig: 1), autonomous tractors, robotic arms, spraying machines, IoT and AI based systems, etc. Such kinds of systems are helping, directly and indirectly, the food requirement of the growing populations.

Fig: 1 An example of Agricultural Robot (Representative)

It is important to note that the population may rise to 9.7 billion in the year 2050 from7.3 billion as per United Nations. Therefore, more foods and agro are to be cultivated to think beyond the traditional systems keeping in mind future demand. Therefore, Agricultural Informatics and allied subjects like Agricultural Information Systems, Agricultural Information Technology, Agricultural Computing, Agricultural ICT, etc., will play a great role in preparing required manpower that will be worthy in more agricultural development. Robotics and AI can lead to healthy, techno enabled, and smarter agriculture and cultivation practices in this regard.

5. AGRICULTURAL ROBOTS TOWARDS HEALTHY AND SMARTER AGRICULTURAL SYSTEMS

Agricultural robot is able to do multitasking or doing the task automatically and therefore farmers can put their best and further concentration in the field and more agricultural production [2], [15], [24]. There are many kinds of works that are possible with Agricultural robots and among these, an important one is depicted in Fig: 1.

Fig: 1-Uses of Agricultural Robots and Basic Applications with back up technologies

Robotic applications not only applicable in harvesting and picking but also offer moreaccuracy and speed in the agricultural systems. Therefore, Agricultural Informatics or Agro Robots isnot only improving the size of yields even helps in reducing the waste from crops. It also helps infindinga location and to get product irrespective of the situation such as dust, temperature, movement of the wind and ultimately Robotic applications helps in the agricultural industry with proper automation. The current and future demands for food in many ways may be solved by robotic applications in agriculture. Robotics is associated with the various pre and post production of agriculture and similar services and therefore following activities, in particular, may be benefited—

- In enhancing and increasing the efficiency
- In enhanced productivity and amount
- Reducing basic production cost
- Minimizing and reducing in manual labour
- Higher Industrial development
- Proper and modern harvesting
- Adequate manpower involvement, etc [8], [12].

6. AGRICULTURAL ROBOTS INTO SPECIFIC APPLICATIONS

Agricultural robots are increasingly useful in many sectors due to their contemporary role in robots and artificial intelligence in food crises and future food demand. Due to the international growing population, the role of Agricultural robots is important; directly and indirectly [6], [31]. Apart from the developed countries in developing countries, the Agricultural robots are noticeable these days due to their variety of jobs and performances. According to the study, Agricultural robots and allied systems in agricultural sector mat reach up to $ 35billion within 2025.Traditional farming and efficiencies therefore many ways possible to way out from Agricultural robots. There are plenty of works that can be done with Agricultural robots such as—

Regarding Planting

Agricultural robots are very important and required in planting and nurseries. Here planting of different vegetables including crops and plants, nursery plants can be considered as important.

Regarding Seeding of the Corps

Agricultural robots are useful in the seeding of the corps and here many seeds around the field can be the right place by the tractor throughout, here intelligent robots and geo-mapping can be considered as important.

Regarding Monitoring and Managing Corps

In the monitoring of the agricultural sectors and production sensor and geo-mapping technologies are helpful lto increase the good amount and quality of the crops. Moreover, here field-based robots and drones can also be considered as important to collect the data autonomously and in this respect the robotic hardware including the analysis software, the drone is considered as important to get data with proper analysis; and this can be done using a tablet or smartphone. Therefore, it can be used for closer monitoring of the crops, plants, weeding, and fertilizing, etc, and hence Agricultural robots or AI based systems may be considered as worthy.

Fig: 2- Samples of a few Intelligent Agro Machines and robots (Representative)

Fertilization Affairs

Agricultural robots are perfectly useful in irrigation and fertilization for wider vegetables, crops, plant productivity. It reduces wastage of water and helps in crop and pour water directly and hence, agricultural robots are much useful in traditional Agricultural systems even if some machines are so worthy in collecting the plants as well as plants to grow as much as possible [14], [22]. The effective irrigation is also becoming possible with smarter AI based agricultural systems.

Weeding of the Corps

Agricultural robots are widely used in spraying with pesticides in the fields of agriculture. The difficulties of the weeding of the corps may be solved using robotsas an efficient method. The micro-spraying usefulness is noticeable in this regard and reducing herbicide used in crop growing. Here computer vision technology can be used to detect plants as it is pushed by a tractor [16], [22].

Proper Harvesting

Harvesting of the items viz the crops, plants are can be possible using an automated and intelligent combine harvester, except the soft fruits. Moreover, automated harvesting is also needed in some of the areas like in apple harvesting, grape picking, and sweet pepper picking.

In Thinning and Pruning

As far as thinning is concerned Agricultural Robots and Systems can be deployed. Herewith this, plants can grow using Pruning, here agro robots are useful and in many of such activities uses computer vision. In Pruning also agricultural robots are widely useful and increasing day by day [18], [25].

Intelligent Tractors and Transportation

Intelligent tractors and transportation are worthy of using Agricultural robots for various kinds of agricultural pre-production activities including cultivation and growth of corn, vegetables, and plants, etc. Therefore, inthe process of reducing manpower and managing difficult situations, agro robots are widely used.

In Shepherding and Herding

Agricultural robots are increasing in shepherding and herding, where farmers can be used drones even to locate or tracking of the animals. In New Zealand and Ireland, such a scenario is noticeable. Moreover, remote-controlled, cattle-herding drones are rising in their use.

In Process of Milking

The applications of robotics are important in the milking process and therefore an important gift in dairy farms. The UR5 is useful in spray disinfectant on the cow's udders in preparation for milking and this practice rising gradually [24], [26].

7. ISSUES AND SUGGESTION

Agricultural robots are increasing gradually, however, the root was backed in the 1920s regarding the designing and development of automatic vehicles for agriculture activities. In between the 1950s and 60s, different automated vehicles were in operation in agricultural sectors. The development was notable during the 1980s due to various AI based tools including the development of computers including machine vision with the initial operation of harvesting of oranges considered as an important development [18], [26]. Initially, only the agricultural firms and in scientific organizations uses AI and Robotics, and later AI and Robotics become common in other applications. The USA and Japan played a lead role initially in Agricultural Robots and similar applications and gradually other countries like Germany, Ireland, South Korea, China, India, etc. Agricultural robots are having different kinds of characteristics but there are many other concerns, issues, and therefore following measures can be taken in order to fulfill more about the systems.

- Agricultural robots are costly, therefore proper support may be undertaken particularly in developing countries context by the Government, departments, agro firms, NGOs, and Charitable Trust, etc.
- Agricultural robots are not suitable for all kinds of fruits as well as products and in this regard research and development undertaken in these areas.
- Agricultural robots need proper manpower and therefore formal education, training programs, etc. be developed accordingly.

- As it involves various kinds of machines and operations therefore proper workshop, training may be organized for the benefits of the cultivators as well as agro industry professionals as a whole.
- Agricultural robots need proper maintenance for important and proper effective uses and also for better productivity.

8. CONCLUSION

The use of Agricultural robots is worthy and in developing countries also it is important. Due to the effective role of agricultural robots, it is applicable in wider scale business and this becomes possible wider in other areas too. In farming, in milk bot, in Horticulture and Environmental monitoring and management, Agricultural Robots are worthy and gaining importance day by day. RV 100 is an important robot in this regard for transportation of the products inside and outside and gradually it is started operation in diverse areas. Due to the sophisticated development of Research and Development, Intelligent devices and machines, emerging Information Technologies, etc., agricultural robots and AI applications in the robots may be considered as prime importance in agricultural systems. In Agricultural Informatics, the Agricultural robots are gaining popularity and even may be started as an educational specialization. Handling and solving the issues to agricultural development can effectively possible with Agricultural Robots.

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