Crop Monitoring using Industrial Technology 4.0 In Smart Agriculture

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Abstract - *In Agriculture Sector, Industry 4.0 is the industrial fourth upheaval which focused on automations in manufacturing innovations, for example, cyber physical systems, Internet of Things, artificial intelligence and cloud and cognitive computing.Cultivating is playing a significant job in the endurance of world. Currently, agricultural industry is facing so many challenges. These challenges can be reduced or removed by using automation in the agricultural tools and techniques. The improvement and development of the connectivity between farming apparatuses is leading to significant progresses in the agricultural practices. Advancement and automation of the technologies such as Internet of Things (IOT), replacing traditional agricultural methodologies which causes wide range of improvements in the fields. The principle motivation behind this paper is focused on the review of basic concept of Industry 4.0 in agriculture sector, the number of new tools and techniques used by smart agriculture for the improvement in the fields and the list of benefits of smart agricultural solutions.*

Key Words: **Industry 4.0, Precision Farming, Agriculture, IoT, drone.**

1. INTRODUCTION

Main income of source in India is an agriculture sectors because over half population depend on farming and related works. So agriculture in India is a backbone for Indian Economy. Hence, improve traditional farming into accuracy or smart farming industrial development reaches to fourth level is initiated to use this revolution in agricultural sectors on large scales so that it can be effectively utilized to improve the farming yield effectively.

Industry 4.0 has focused in the developing smart environment within production system. Industry 4.0 has the current trends of automation and data exchanges in the manufacturing technologies. Industry 4.0 includes cyber physical systems, cognitive computing, cloud computing and Internet of Things. Industry 4.0 is also called industrial fourth revolution. It is enabled the development of precision and transparency in agricultural industry. Smart Agriculture has using advanced technologies such as sensors, devices, machines and Information Technology, robots, GPS technology which will be allow farms to be more profitable, efficient, safe, and environmentally friendly.

It has characterized as the crosscutting effect of information and communication technologies, especially the Internet of Things (IoT) in various industrial sectors translates itself into a phenomenon. Its motivation is to revolutionize the industry through "smart factories" that will permit more flexibility in production needs, efficient allocation of resources and integration of processes from equipment monitoring to final delivery with the use of technologies for example integration of Cyber-Physical Systems (CPS), IoT, IOS, and the real time interaction between machinery, software and individuals. The idea of Industry 4.0 is a reality in consolidation and has become a new milestone in industrial development, which has undoubtedly set significant changes in the way of production and trade during the upcoming years. This upheaval is upheld by the development of systems that transfer the ubiquitous advantages of the Internet and information systems towards physical systems the core of the revolution has the interaction of digital systems with physical production systems.

It is provide great flexibility and robustness, along with the highest quality standards in engineering, management, manufacturing, operations and logistics processes. Industry 4.0 is explode dynamic value chains, optimized in real time and with an automatize organization, which is consider various variables such as costs, availability, and use of resources and market demand.

The revolution in 4.0 concepts revamping abilities of production of industries along with the agricultural areas. This revolution in agriculture equipment uses the key technology of Internet of Things (IoT) which depends on connectivity of all system with equipments. Figure 1 has show revolution takes place first since 1782 to smart automation in 2015.
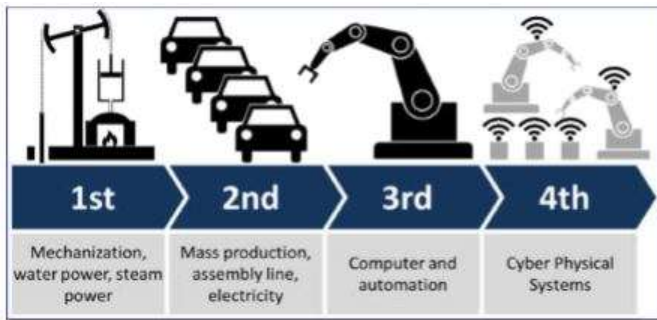

Fig. 1 The 4th Industrial Revolution – Industry 4.0

Industry 4.0 pattern is viewed as a changing power that will deeply impact the industry. The structures of Industry 4.0 will consisting of following digital technologies for example Big Data Analytics, Artificial Intelligence and Internet of Things (IoT). This revolution is uses some of digital practices like open innovation, cooperation and mobility. In fourth industrial revolution transform agriculture infrastructures into connected tractors and machines. Also, connected farm and new production equipment. These outcomes are productivity improvement, environmental protection and quality of agricultural products. Some of procedure improvement in esteems chain modification and business models based on analysis, exchange and collection of knowledge.

The slogan of Agriculture 4.0 draws on the expression "Industry 4.0" and refers to expanded integration of IT and communications technology with agricultural production as shown in figure 2 where the past, present and future point of view are explained using smart, networked systems combining various different types of data from multiple sources promises to increase productivity and efficiency. Transparency has arises in supply chain management. Agriculture 4.0 has benefits to agriculture as well as the environment in which downstream economic activities reaches to end customer. The model for the future is fully automated and autonomous agriculture.
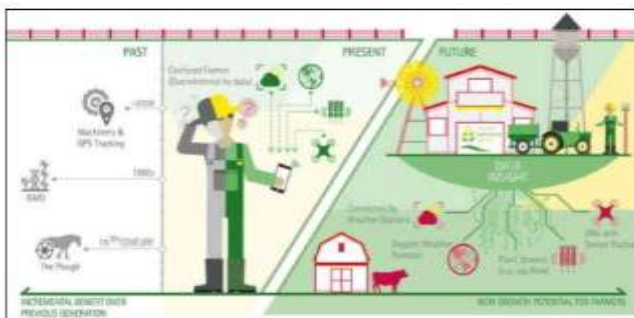

Fig. 2 The 4th Industrial Revolution in agriculture 4.0

Agriculture in India has highly dependent on the agricultural equipment and labour work. The portable instruments and gadgets used infield and outfield processes comprises of agricultural tools for different operations traditionally. The information gathered by digitalization of agricultural sector provides improved equipments for analysis of condition of farm. Every farmer has not contributed to digitalization in agricultural equipment which unaware of benefits to increase productivity in agriculture. However, the revolution of agriculture sectors using digitalization has familiarized due to development results after all, farmers were in the vanguard of electronic data capture for livestock farming.

1.1 Industry 4.0 In Agriculture Sector

Standard machines in agriculture is being changed over to mindful and self-learning machines needs Industry 4.0 to improve overall performance and maintenance management with the encompassing cooperation. The primary needs of Industry 4.0 in agriculture divisions focuses on the development of an open, smart manufacturing stage for continuous information observing, tracking the status and positions of product as well as to hold the guidelines to control farming processes.

2. OVERVIEW OF INDUSTRY 4.0

Industry 4.0 is a broad vision with clear settings and reference models, basically classified by the connecting of physical industrial resources and digital technologies in so called cyber physical systems. The fundamental procedures of Industry 4.0 which comprises of Big data, additive manufacturing, Automation, Intelligent robots, Internet of things, Cyber security, cloud computing is particularized in figure 3.

Fig. 3: Industry 4.0- Technologies [5]

The present industrial requirement of manufacturing development are intelligenitization of manufacturing

process and Digitalization. Productivity of industries has increases with quick improvement in manufacturing technologies and applications. With the use of Industry 4.0 in manufacturing process included integration of human for continuous improvement and focus on value adding activities and evading waste. This works illuminated the nine important pillars of industry 4.0, for example Big Data and Analytics, Autonomous Robots, Simulation, System Integration: Horizontal and Vertical System Integration, The Industrial Internet of Things (IOT), Cyber security and Cyber Physical Systems (CPS), The Cloud, Additive Manufacturing and Augmented Reality with its applications in different field.

Industry 4.0 is embracing the intelligent manufacturing where typical resources are changed into intelligent objects so that they are able to sense, act and behave within a smart environment through various pillars of Industry 4.0. The combination of embedded production system technologies with intelligent production processes in Industry 4.0 to overlay the new technological time that will basically remodel industry to business models with value chains and production value chains. Intelligent manufacturing used the key technologies, for example, the IoT, cyber-physical systems (CPSs), cloud computing, big data analytics (BDA) and information and communications technology (ICT). An application discernment, IoT-based manufacturing has been successfully utilized, with a large number of industrial cases being reported and maintained by professional training and instructive thoughts. Intelligent manufacturing and cloud manufacturing have still in the research results in a limited number of real life cases.

Development of Industry 4.0 is regularly including the digitization or full-scale automation. Industry 4.0 is a model moved to decentralize smart manufacturing and production from centralized system. Industry 4.0 refers to the automation of manufacturing and the production of a smart factory. The works audits the various viewpoints in industry 4.0 encompasses developments in previously split and disconnected fields such as artificial intelligence (AI) and robotics, nanotechnology, 3D printing, genomics and biotechnology. The effect of Industry 4.0 on different viewpoints like global value chains, education, health, environment, labour markets and many economic and social is to be expected.

The author specified the ongoing significant technology phenomenon and to explain industry 4.0. Foundation stage for Cyber- physical and informatics. Author presented both models RAMI (reference architecture model industry) 4.0

and parts models required for any industry 4.0 applications. The case studies for various industrial 4.0 applications are created through this model.

Continually expanding in demand of different products results in to adapt changes in incoming and outgoing logistics. Unavoidability of Information and communication technologies (ICT) advancement and Industry Internet of Things (IIoT) promoted new challenges in logistic domain, requires technological changes like high need for transparency, integrity control in the gracefully chains management. The advanced digitalization empowers man-machine communication in real time with the increase in internet use. The authors reduce this application to logistics 4.0 for following

1) Resource Planning
2) Warehouse Management Systems
3) Transportation Management Systems
4) Intelligent Transportation Systems
5) Information Security.

3. LITERATURE REVIEW

Industry 4.0 has based on integration of the business processes, manufacturing techniques. Industry 4.0 has involved in the organization's value chain such as suppliers and customers. Farming has an occupation which has playing the ultimate role for survive of this world. Industry 4.0 supplies maximum needs for the human being to live in this world. However in the advancement of the technologies with invention of Internet of Things, the Automation (Smarter technologies) has replacing the traditional methodologies which in cause resulting in wide range improvement of the fields. Agricultural digitalization will be occurred by introducing and developing new machines and new tools in the production system such as automated tractors, measurement tools and so on. Currently, agricultural industry facing number of difficulties which can be fathomed or minimize by using number of new technologies with Internet of Things in the farm.

4. DIGITAL TRANSFORMATION TECHNOLOGIES IN INDUSTRY 4.0 IN AGRICULTURE SECTORS

In worldwide food market, India has the leading contributor. In India Agriculture contributes to food grain production increases from 252.23 million tonnes to 271.98 million tonnes in 2016-17 from last year. Also, in horticulture areas comprises of Fruits and vegetables, floriculture, plantation crops and honey in 2015-16 was 283.4 283.4 million tonnes superior than food grains

leading the India move to one of the leaders in horticulture production in the world. In Agriculture sector where companies using new technology models to implement agriculture 4.0. This hi-tech organization uses new technologies in precision agriculture which is utilized to monitor the farm with measurement and analysis of suitability in crops in different atmosphere. This new strategy increases crops productivity with a higher environmental sustainability.

4.1 Internet of Thing Technology

The potential development of IoT industry is in Agricultural sectors. The Internet of Things (IoT) technology opens a worldwide the possibilities of deploying IoT devices in agriculture with capability of sensing data remotely. The farming data gathered by gadgets attached with sensors affects growth of crops is real time monitor as well as statistical survey shows further processing thorough IoT.

The utilization of IoT rationale and Cloud Computing, profundity of the framework by confirming every boundary in gracefully chain organize offers an improvement as far as prescion horticulture dependent on sensors in advertising situations, preparing and creation.

The fourth industrial unrests broadened their arm in agricultural field interconnected by all instruments through Internet of things (IoT). The agricultural information observed by IoT and this information is move to analysis software comes under revolution. IoT is a sensor-based innovation which is use to improve the exhibition of existing framework by assessing the gathered data from IoT through instruments and move has been made to improve it. This Hi-Tech innovation is worked by association which used the various sensors to gauge the information in regards to Atmosphere, soil structure, intensity of fertilizers and its impacts on the plants. When this boundary is checked is being moved to dynamic framework where it gives sign for atomization of procedure to be followed fundamental as indicated by gathered information distinctive agriculture applications. The cultivating strategies are additionally broke down by IoT by sensors and healing activity is being proposed to the rancher for development in the conventional procedure

4.2 Drone Investigation

Agriculture sectors are developed with agriculture 4.0 technologies which uses Drone investigation use to capture pictures of crops analyses by big data how the crops are yielding. With the help of drone farmers identified which

part of agriculture needed watering or fertilizers, weed removal area easily. Nowadays this drone used as remote fertilizer vehicles in farming so that specific area or individual plant covers without any problem.

4.3 Big Data Analytics

Various methods use to collect the data improve agricultural sector development. "Big Data" means processing massive amount of data collected from data and communications and technologies (ICT) leads to rapid decision-making data for improving productivity. Since all information is accessible from last decade in storage regarding crop cycle, yield problems, stresses each famer take preventive measures with new tools in agriculture 4.0 for various whether conditions. Recently under Industry 4.0, development of new technique of machine learning defined as Artificial Intelligence (AI) increases demands in various activities. This Artificial intelligence (AI) used the previously stored information for decision making and requirement of agricultural sectors with preparation of schedule of these activities.

5. THE FOURTH INDUSTRIAL REVOLUTION CHANGES IN AGRICULTURE

The idea of Agriculture 4.0 draws on the expression "Industry 4.0" and refers to the increased integration of IT and communications technology with agricultural production. Smart networked systems, combining different types of data from multiple sources, promise to increase productivity and efficiency. This revolution changes the tools used in agriculture sectors replaces leads to smart farming.

High normal time of agricultural tools arises the demand to integrate it into the digital world. As of now these tools with robust, universal and interoperable and not required with no special extra training. Because of lacking telecommunications infrastructure in rural areas they develop tools in agriculture 4.0 that work even where there is no mobile phone signal across parts of the development territories.

5.1. Agricultural Robots

Agriculture robots will work in different field like production, processing, distribution, and consumption. One of type of artificial robot has shown in figure 4. These robots recognize the service atmosphere and separately offer intelligent work. The fourth revolution results in utilization of robots in so many farming equipments for selection of

appropriate product and proper distribution of pest for insect control. This procedure additionally fixed with aerial vehicle used to control the health with regular monitoring of fruits, vegetables and animals in agriculture field. Robots extraordinarily planned under agriculture 4.0 are first is Open-field robots use in farming operations like water irrigation and cultivation of crops. The second robot is also known as facility robots used to monitor the yield of crops and controlling farming activities. The third robot named livestock robots deal with take care of animals used in agriculture sectors. This revolution in agriculture sector with the objective to improve productivity through automation, unmanned farming and the ecofriendly farming advancement.

Fig. 4: Agriculture robots examining plants

MARS (Mobile Agricultural Robot Swarms) has an agricultural robot developed for autonomous farming operations using a coordinated swarm of robots. These robots are equipped with fewer sensor technology results in low individual intelligence.

5.2 Accuracy farming

The smart farming innovation under prescion agriculture used to measure crop yield and healthiness. Likewise, these revolutions in agriculture sectors utilized for observing different types of crop, its growth during nurturing and post harvesting periods.

The agriculture 4.0 ideas build up the precision agriculture which is utilized for managing different activities in agriculture. The hi-tech organization implemented accuracy farming on large scale through a decision support system (DSS) in different fields of agriculture area. This assists with improving comes back from agriculture and increases demand of these technology.

The fourth revolution in agriculture is partitioned in three division as appeared in figure 5. The first division involving sensor-based innovation for collection of several parameter related to crops, land and whether conditions achievable for effective growth. Additionally, these strategies including the processing the data with development of decision-making ability in real-time application in field of agriculture.

The second division is invigorated based on first division investigation with respect to necessity by the agriculture crops regarding water content and fertilizers on suitable planning. Digitalized farming equipment is utilized to performed the action stated by system of decision making in the first division.

The third division comprises of control systems of different farm machineries is inputted by handling database gathered from computerized geographical information and farmers' input Absence of third decision making process, it is hard to carry out precision agriculture however the initial two divisions are very much evolved.
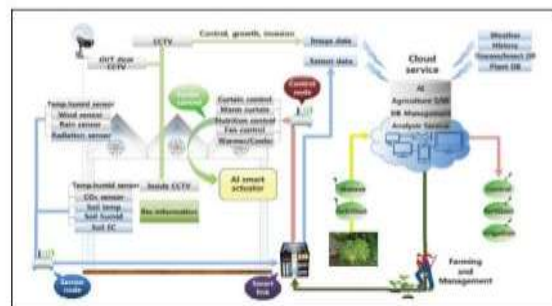

Fig. 5: Crop Production environment through biometrics and artificial intelligence [3]

5.3 Bluetooth "beacons" in agriculture:

The working procedure of beacons is shown in figure 6. Beacons" is a tool as transmitters that send their careful energy-saving Bluetooth protocol signals. When gadgets come within the transmitter range, information are gathered and handled. On the off chance that this introduced on hardware, tractors, combine harvesters, it is clearly identified as they allow a vehicle, device or a person. Each vehicle with various age, manufacturer or purpose, can be fitted with one of these beacons. Because of their low power utilization, batteries just should be replaced every four years. This device performs the task of machinery Identification and different focal points. Also, used for recording working hours, distinguishing workforce.
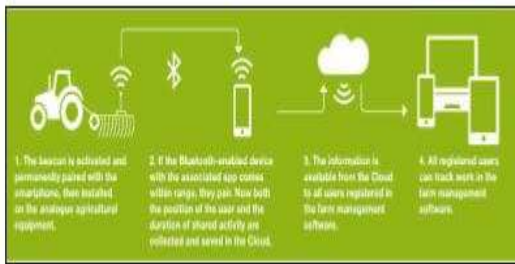
Fig.6: Bluetooth operated Beacon in agriculture.

5.4 Use of GPS in agriculture:

The figure 7 shows situating of Irrigation framework worked by GPS.

The "Worldwide Positioning System" (GPS) is a worldwide satellite system used for positioning and navigation. This system is initially developed for the military and now a day this system with agriculture 4.0 is use in different fields in agricultures. GPS have been utilized in agricultural equipment for both as fixed units or hand-held gadgets. The task performed by GPS system like Recording positions and developments, autonomous or assisted driving with applications, for example, Monitoring and backing on equal excursions, self-governing driving.

Fig.7: GPS operated Irrigation system.

5.5 Use of RFID in agriculture

Technology is used for detecting animals at automatic feeding machine in RFID (Radio Frequency Identification). This framework is furnished with transponder and it is associated with IT devices. This system comprises of automatic, contactless, identification and localizing of objects and animals. As of late these systems are utilized for tracking of Cereal crops in agriculture sectors. RFID is used for Identification, positioning of object in agriculture sectors and has applications like Identifying and limiting of domesticated animals, cereal batches and equipment in farm.

The figure 8 shows the changes in agricultural sectors caused due to fourth industrial revolution with digitalization:

Fig. 8: Digital transformation in agriculture [2]

6. BENEFITS OF SMART AGRICULTURE

- Give helpful, ongoing and quick data for the management decisions.
- Stored the farm records which can be utilized in sale and succession.
- Farming is currently getting more accurate, smart and scientific by using GPS systems, data analytics and remote sensors included in farming equipment and machinery. So farmers have ready to adapt new technologies in their farming to make it more precise
- The sensors or gadgets in the field allow continuous monitoring of the significant parameters and will provide real time data with up to date information related to plant parameters and status of the field at constantly.
- Save the time and cost.

7. CONCLUSIONS

The review of fundamental ideas and revolution stages of Industry 4.0 and smart farming devices and procedures has presented in this paper. Industry 4.0 is fundamentally focused on the automation with Internet of Things (IoT) in manufacturing technologies. Agriculture industry is play very important role in our life. Agriculture industry has been facing few difficulties. Automation with IoT (Internet of Things) assisting with decreasing these challenges by developing lots of changes in the fields, innovating new agricultural equipment, tools and techniques. Smart farming is mainly focus on connectivity between tools by automation, so that tools and equipment can work independently in the fields and provide real time information to the farmer. In view of smart farming, farming will be easy and farmers are getting lots of benefits and will increased profit.

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