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A Survey on Smart Agriculture

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Abstract - *Are plants intelligent? Do they solve problems and communicate with their surroundings—with other plants, insects, and higher animals? Or are they passive, unfeeling organisms without a trace of individual or social behavior? By combining Botany with Technology, we may get some answers. With the introduction of specialized sensors and a ubiquitous communication environment, plants, not only can give the world their needs but also take actions for themselves. The article presents many aspects of technologies involved in various domain of computation in agriculture.*

Key Words: Intelligent, Botany, Sensors, Technologies.

1. INTRODUCTION

'Human are most developed living organisms on Earth.' Or are they? Its plain to see that plant do not have eyes, ears, nose, and even brain but they do have nervous system. Plants have all five senses, just like us. And that's not all: they have fifteen others. Clearly, these developed according to plant, not human, nature, but that doesn't make them any less reliable. What if we compute these plants to produce best possible yield?

Agriculture is still major part of economy as it contributes to 30% of the Gross Development Product (GDP). Such a vital sector should be given adequate focus. With the world trending towards advanced and new technologies, agriculture should also take its advantage. Use of modern technologies reduce the chance of human error which can reduce problems like crop damage, soil erosion, leeching of nutrients, spreading of pesticides, unwanted vegetative growth.

According to researchers yield can be improved by eliminating issues which are holding it back. We can eradicate problems like crop damage if know all about weather, we can eradicate leeching of nutrients and spreading of pesticides by understanding plants' health correctly. And this can be done faster with technology.

2. LITERATURE SURVEY

Historically, agriculture has undergone a series of revolutions that have gained efficiency, yield and profitability Digitalization changes every part of the agri-food chain. It functions in real time, driven by data. Digital agriculture creates systems that are productive and adaptable to changes such as those caused by climate change. This leads to generate greater food security, profitability and sustainability. Digital agriculture has the potential to deliver economic benefits through increased agricultural productivity, cost efficiency and market opportunities, social and cultural benefits through increased communication and inclusivity and environmental benefits through optimized resource use as well as adaptation to climate change.

Urban areas have better developed 'digital ecosystems' compared with rural areas. Combined with global trends of urbanization and middle and rich classes settling in cities, there is potential for digitalization to exacerbate existing rural urban disparities and populations to fall behind in the process of a digital transformation.

3. CHALLENGES

There are some basic conditions which are essential so that we can use technologies at most and therefore for digital transformation of the agriculture and food sector.

3.1 IT infrastructure and network

Main challenge is that network in rural areas as compared to urban remains limited. Despite 5G becoming the most powerful connection globally, only around a third of rural populations receive coverage by 3G networks. Building huge infrastructure for agriculture is productive and efficient only when it is 100% useful.

3.2 Digital literacy

In addition, 'digital literacy' is critical for using digital technologies. Unlike in many developed countries, where students regularly use advanced technologies and digital skills in their education and day-to-day lives, ICT knowledge and skills lag behind. In many rural areas basic computer courses are not included in primary or secondary education due to a lack of interest from governments and the private sector to invest in building new digital skills rather than hiring already skilled labor.

3.3 Collecting Data

Unlike in other industries, data collection in agriculture lags behind. Many start-up companies are developing decision support tools, but they are still struggling with data collection, as farms lack the technological infrastructure for data collection. In recent years, data collection technologies are being developed –drones, soil, water and plant sensors, image recognition, and other technologies. These technologies can collect large amount of data that can be further analysed and used for better decision making.

4. PROPOSED SYSTEMS

4.1 Vanya – Detection of Needs of Plants

To promote healthy growth of plants their needs should be acquired. So in this project they have embedded sensors into soil depending on growth of its roots. Sensors used is soil moisture sensor which detect the moisture level present in soil at current time and temperature sensor. Then it recognizes the need of water and sends analog signal to Node MCU. This signal is sent and stored in cloud and processed for further execution. This signal further is sent to android application as notification which indicates the need of water to user. In application notification is sent and this text is further converted into speech.

When plant needs water then user receives a message which says *"I need water"* and when the need is satisfied it says *"I am full now"*. If user is available around plant then user nourish its plants by watering it manually. If not, then user needs to click a button which starts drip irrigation system. Drip irrigation system is attached to main supply of water in particular area to reduce risk of unavailability of water.

Fig. 01- Vanya Kit

4.2 Smart Plant Monitoring System

This project contains an automated system for monitoring the growth of plant can be done with appropriate taxonomies. This work combines Image Processing and IOT to monitor the plant and to collect the environmental factors such as humidity, insects, soil and temperature. In image processing, a recognition system capable of identifying plants by using the images of their leaves, stem has been developed and with the help of the image compare with previous plant images. Identify the problem in database and find it. Then choose the rectified natural pesticides and spread to the affected plants.

In this project they used natural pesticides instead of chemical pesticides. They used raspberry pi for control the whole system efficiently. The Servo Motor is used to rotate the camera left side and right side. Ultrasonic sensor is used to detect the obstacles nearby the rover. Pi camera is used to capture the image of the plant leaves and stems.

In image processing, a recognition system capable of identifying plants by using the images of their leaves, stem has been developed and with the help of the image compare with previous plant images. Identify the problem in database and find it. Then choose the rectified natural pesticides and spread to the affected plants. The different features that are extracted and compared are color, texture and shape of the leaf. Here they combined IOT and Image processing.

4.3 Machine Learning in Plant Disease Research:

Plants are constantly exposure to pathogens such as virus, bacteria and fungi. Plant diseases caused by pathogens lead significant crop yield loss globally. The purpose of this research is to present the application of machine learning in plant resistance genes discovery and plant diseases classification.

Over the past decades, continuous studies have been performed to reveal the interactions between plant immune respond and pathogens. Large amount of data has been generated from those researches due to the tremendous advances in genomics and proteomics. Previously, scientists typically applied large-scale genetic screening and genomic approaches to identify genes and proteins of interest (1,2). But now, the development of machine learning algorithms, which are a collection of analytic methods that automate model building process and iteratively learn from data to gain insights without explicitly programing, provides more powerful and efficient tools to not only identify genes/proteins involved in plant-pathogen interactions, but also classified plant diseases from images of infected leaves. They presented a review of studies that utilize machine learning regarding the plant-pathogen interactions and plant disease identifications.

They conclude, in the big data era, machine learning provides a powerful tool to analyses tremendous amount of data. Careful selection of pre-processing data methods and machine learning tools is critical to obtain highest accuracy of classification. Meanwhile, compared to traditional methods of identifying genes involved plant pathogen interactions, methods integrating machine learning approaches are relatively scarce in the literature. Thus more machine learning based tools are needed to predict important plant resistance genes, as well as make contribution to the agriculture. With aerial imaging platforms and sensor technology, collecting field data becomes easier and more precise, which is critical for improving machine learning accuracy. More sophisticated methods such as deep learning algorithms will be applied in detecting plant diseases and discovering plant resistance genes.

4.4 Smart Agriculture using Clustering and IOT

The purpose of the system is to develop centralize monitoring and control for the agriculture land. This can be managed and functioned from any location wirelessly using a mobile device. The application user can control basic operations of collection of environmental, soil, fertilization, and irrigation data.

System can integrate virtually any IoT device, including commercially available sensors, cameras, weather stations, etc. and can form a cluster of these devices which would make it flexible for a single user to cover a large area and store their data in the cloud for performance analysis and recommendations. End user can get all these details of the field on Smartphone by an application Smart Agro Services and can control the operations. The sensor network is designed to get information about the climatic conditions of the farm such as Soil Moisture, Temperature, Light, and Humidity. With the help of this, system will decide the operations on the field. A single farm can have multiple crops divided into fields. So each crop will have different parameters to be controlled. This, we need to have a cluster that will collect data separately. For these nodes are installed on various parts on the field depending upon the parameters. Each Node comprises of a microprocessor Raspberry Pi and a sensor connected to it. Sensors may be temperature and humidity sensor or soil moisture sensors. The soil moisture sensor being an analog sensor requires an ADC (Analog to Digital Converter). The data from sensor is in the analog form and need to be converted to digital form. Hence the raw data is supplied to ADC which in turns to digital. The digital data is in the form of voltage value and depending on voltage value the percentage of moisture in the soil is taken. The sensors are connected to Raspberry Pi. Raspberry Pi collects the data from the sensors of that node. There are multiple nodes that are placed around the field. Using the clustering technology, the farmer can make accurate decisions like in which part of the field soil moisture has reduced and where to divert the irrigation system. As well as when to switch on and off the motor pumps and other devices for the parameters to be maintained. Data from all these nodes is collected and transferred to a cloud. Here, we are using the cloud service as a storage database. The Data sent to the cloud is stored in the cloud database. Farmers can log in their respective accounts to view their history and the current data of each node. The data from the cloud is given to the mobile application. With the help of the mobile application the farmers get ease to control various devices and record the readings from the sensors.

5. ADVANATAGES

1. Monitor soil and plant parameters.
2. Automate Field management.
3. Collect Real-time Data
4. Get the best results from Labor and resources.

6. CONCLUSION

As said, with proper use of technology we might eliminate all problems which damages yield. There are tons and tons of methods which can be implemented in our fields and produce best results. Simply introducing technologies is not enough to generate results. Social, economic and policy systems will need to provide the basic conditions and enablers for digital transformation as well. Much work is needed in the area of digitalization in agriculture and rural areas.

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BIOGRAPHIES

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