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An Agricultural Perspective in Internet of Things

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Abstract— Internet of Things (IoT) is a pioneer to the field of wireless communication. IoT is that network in which things are interconnected wirelessly via smart sensors. Smart sensors are equipped with various sensing and monitoring parameters depending on the scenarios where they are actually deployed. IoT is such an upcoming thing in which there is no need of human interference. IoT has wide range of applications like in agriculture, automotive industries, transportation, hospitals etc. This paper has focussed on agricultural application based on wireless technology to generate an effective value such as enhancement of agriculture productivity, standard increment of agriculture products in the entire procedure of agriculture production. Conclusively, We get better quality of agricultural products.

Keywords— IoT, decision support, agriculture, monitoring, statistics

I. INTRODUCTION

The internet of things (IoT) is the network of physical objects that contain embedded technology which has capabilities of sensing, monitoring and communicate with their internal states or the external environment. IoT is that network in which things are interconnected wirelessly through smart sensors. IoT is such an upcoming thing in which there is no need of human interference. Some of the applications of IoT have already being implemented in various fields like in agriculture, automotive industries, transportation, hospitals etc.

IoT is now considered as the future part of the internet [2]. However, in recent years, IoT technologies are developing in many fields and currently development of IoT is occurred in the objects which are integrated with sensors in the cloud computing. There are many issues that involves during the development of IoT such as manufacture, standards, protocols, communication sensors and interface. In 1999, the concept of IoT was firstly proposed by Kevin Ashton and he gave the definition of IoT as uniquely recognizable connected objects that are able to exchange information and signal using the radio-frequency identification (RFID) technology.

With the advent of IoT, the technology is expanding its purview not just in terms hardware but also software level. The internet has played a vital role in providing the connections. IoT enables the physical devices like vehicles, buildings, electronic devices, sensors, actuators to communicate (hear, see, think, perform) and coordinate decisions through technology and data flow. IoT [9] transforms the simple objects to smart objects. With communication the prime focus between devices the flow of data securely in the main concern [3]. Almost anything can be connected to internet: cars, watches, spectacles, meters at home, and manufacturing machines. But the pitfalls prevail and covering them through the best known foundations of world class security using hardware and software level protection is the concern [10].As connectivity of devices is increasing so is the threat to malware, hacking and other types of attacks with smart gadgets like TV, media PC's, fridge's. A fridge was reportedly involved in sending spam emails as web attack compromised smart gadgets in the year 2014. With artificial intelligence giving this feature, Internet of things is the internetworking of these features by integrating physical devices (wireless SOC, Prototyping boards and platforms) and making them communicate (RFID, NFC, ANT, BLUETOOTH , ZIGBEE, Z-WAVE, IEEE 802.15.4, WIFI). The terms coined as smart home, smart car, and smart healthcare, smart city fall under the domain of IoT.

II. IOT IN AGRICULTURE

IoT based agricultural converging technology is a technology to generate an effective value such as enhancement of agriculture productivity, standard increment of agriculture products in the entire procedure of agriculture production. Furthermore, applying accurate agriculture, which may be an another way for the future of agricultural production through the converging technology that permits the prediction of real-time management, standard maintenance, requirement and production during the whole life cycle of agricultural products.

Techniques of harvest prediction have become progressively elaborate. To withdraw information from the previous data and to direct forecasting values of economic variables, extremely strained statistical methods in agriculture are now being used. To a greater extent, these improvements in the science of harvest prediction have been made attainable by development in IT technology. But only, statistical methods do not give the ideal future situation [4]. Therefore, it is mandatory to examine the relationship of the statistical data with the crop monitoring environment regarding harvest. The data on the statistical norms of crop can be obtained from the IoT based decision support system. To enhance the agricultural prediction supporting data system, so that there is possibility of future real-time prediction of agriculture, is the main purpose of this study as fig.1. To the end, it will be necessary to control the IoT based devices and collect the data on them with more accurately**.**

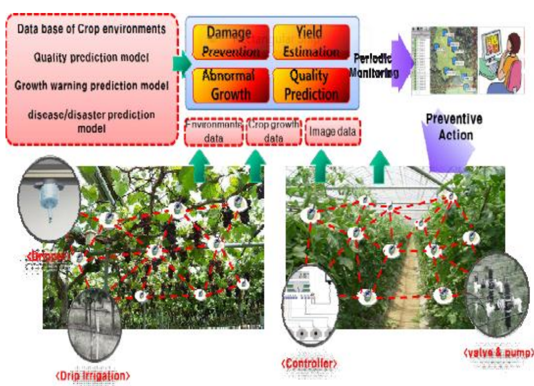

Figure1.IoT-based agricultural production system [5].

There are mainly three parts that are included in the IoT-based agricultural production system: relational analysis, statistical analysis and IoT services. The whole system is designed to develop an agricultural decision support system that is to forecast the growth of the crop by examining periodically using IoT-base sensor technology.

A. Relational Analysis

In this part, the relation analysis which is a prior necessary method for this agriculture support system ,used the text mining method to study the interconnection of the agriculture associated text and location norms, replacement and selection of crops [7]. Using carrot, this model was specialized in agriculture system for data mining methods. The agriculture production system is to more logically achieve a process deciding a choice for seeding by organising a variety of data on crops figure. 2. It is not difficult to make decision on the choice of crops such as sowing, planted area, farming intention, shipment time, planting time and place decision of that chosen crop before seeding.

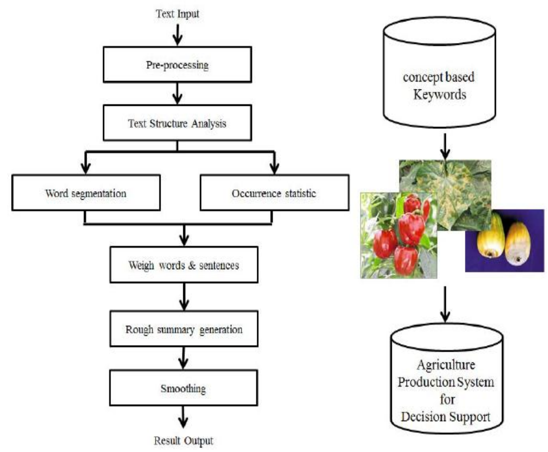

Figure2. Relation Analysis and Conceptual Approach [6]

For this, the agriculture-associated terms have been split into, for each classification to recognize the link for each subject such as growth details, disease, insect harm and growth related weather states for certain crops [6]. The decision making of a farming strategy in the prevailing viewing system such as planted area, farming intention and seeding was processed by reflective subjective such as expert advices or excepted values of initial crops. Moreover, the income could be predicted, if the agriculture production system via relation study was used, through the analysis model before the seeding for the selected crops and objective data and it could be built as an integrated database that could be useful in forecasting system and in the real-time agricultural product determining using IoT services.

B. IoT Services

With a purpose to make the whole agricultural prediction system, an IoT based crop environment information system was introduced. The main aim of the system is to make a valid data gathering system within the minimum time period, site on IoT devices [8]. This system functions around the clock and the real-time examined equipments. The IoT services have evinced to be extremely useful component for the agricultural decision system that validate the growth management to make decision support based on data obtained from the survey of the examining camera for better forecasting. Data obtained from the camera can be joined with environment information from IoT devices. To save crops and properties during disasters, environment information approachability and its timely delivery are very invaluable and IoT technology system is building favourable contribution in agriculture. Some of the most notable advancement in disaster reduction is being made in mitigation, making use of statistical information and IoT sensing information in union with relative analysis as input to evaluate predictive model and prior warning systems.

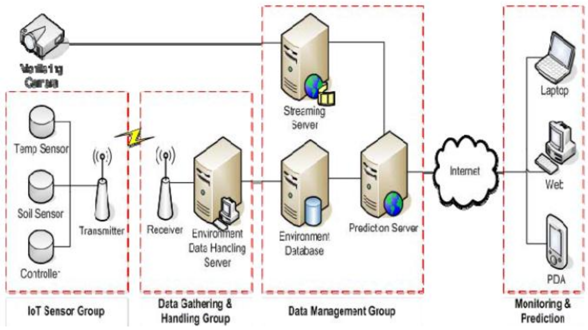

Figure3. IoT Service for agriculture [5]

III. CHANGING FARMING TRENDS IN IOT

A leading grain research organization is an Australian government grain research and development corporation. GRDC works with CSIRO and they conduct many experimental trials across Australia to understand and research about grain varieties. Basically, the challenges they face is heterogeneous records which are produced by different trials. The system which helps in collection of this data has many limitations. Many trials produces heterogeneous data which is present in CSV format which is not easy to discover and interpret. To address the challenges, we present phenonet Open IoT, a semantically enabled IoT middleware platform used for digital agriculture:

- Provides automatic symbol experiment data using the phenonet ontology.
- It also discovers resources.
- With the help of phenonet a user can share crop trial information which makes data more compatible.
- User can compose and visualise services using sensors.

a. Description

The phenonet invention doesn't uses conventional methods rather they uses stack-of-the-art sensor network technology to collect data of crop variety trails and it also provides high performance real-time online data analysis platform which allows scientists to envisage, process and retrieve data real-time and long-term crop performance data[9].

Advantages of phenonet experiments:

1. Efficient administration of water resources.
2. Efficient administrator of usage of fertilizers.

Here in a phenonet experiment the effect of sheep grazing on crop is shown by water usage and root activity etc. Here in this experiment Gypsum soil moisture sensors are used at different depths and canopy temperature sensors like how much extracted from the soil by the roots throughout the crop growing season. Then this data is used to examine crop activity. In figure a trial is conducted on a piece of land which is basically an intersection of columns and rows or blocks. Every block has a same variety of crops different fertilizers are applied at the same time.

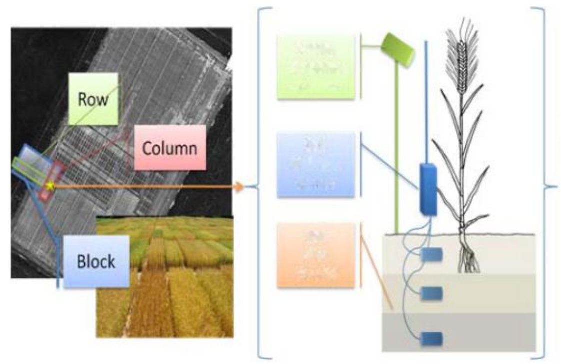

Figure 4. Description of phenonet Experimental Trial [5]

b. OPENIOT: open source Platform for IoT:

OPENIoT platform is open-source IoT platforms provide applications like on-demand large scale sensing. Basically the architecture of the OPENIoT platform is divided into the following:

1. **Sensor Middleware:** Sensor Middleware is a extended global sensor networks which perform three activities: collects, filters and combines data from any sensors. OPENIoT uses GSN platform.
2. **Cloud Semantic Data store:** It enables storage of data from relevant sensor. OPENIoT technology, domain specific ontology etc on cloud.
3. **Schedule and Service Delivery and Utility Manager:** SDUM basically processes the requests for on-demand deployment of services.
4. **User Interface Do-It-Yourself Tools:** It enables on-the-fly composition and viewing of generic service requests.

c. Architecture of PHENONET-OPENIoT:

The architecture of phenonet-openIoT is shown in fig. 5. The phenonet-openIoT platform wants to make IoT applications easy to use and that's why they promote zero-programming effort. The phenonet platform allows scientists to retrieve data, perform operation on it and represent it in the most efficient form. The work flow of the phenonet-openIoT system is shown as follows:

1. An X-GSN node tells about the available sensors to LSM directory. The phenonet addition implemented on the semantic note for the incoming data streams and are linked with the correlating domain like experiment type, field etc. The data which is collected from the sensors are published in SSN compliant RDF format based on each X-GSN local configuration.
2. Now user request for the available sensors which satisfy the specific attribute for example experiment

type by using the phenonet-openIoT UI (user interface). The response which we get from LSM directory service is send by the extension of openIoT platform to link sensor information with domain specific request as specified by request.

3. After framing the request user can use user interface to visualise data which is related to previously registered applications.

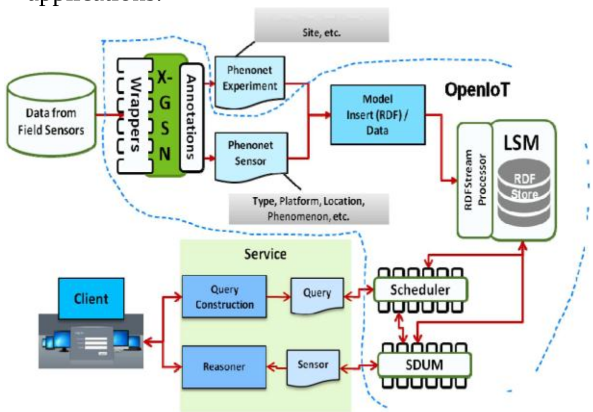

Figure5 Phenonet openIoT arctitecture [4]

IV. Conclusion

This paper sketched an agricultural production system for the agriculture production using IoT technology and implemented it as GUI visualization software. This system has made on the long-standing needs of the farmers to guard their land remains productive in the future. It also ensures the society's concern and expectations for the safe food and protective environment. Moreover, the quality of agricultural products can be improved because the view the whole cycle from seeding to selling using IoT-based agriculture production system. IoT in agriculture helping farmers to store important data. Large landowners and farmers should understand the potential of IoT market in agriculture and farming by increasing smart technologies to increase the production. Agriculture contributes a large part in economy. So if we use smart technologies in agriculture our economy will automatically rise.

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