Raspberry pi based real time monitoring of Agriculture & Irrigation Using IOT

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Abstract – Precision Agriculture is a technology used in farm management that uses information technology to ensure that the crops and soil receive exactly what they need for optimum health and productivity. Now a days smart technology deployed for modern farms grow together with the concept of Precision Agriculture(PA). The concept of Internet Of Things (IOT) helps us to join all these elements. Environment real time monitoring is an important factor in smart farming. Graphical User Interface based software will be provided to control the hardware system and the system will be entirely isolated environment, equipped with sensors like temperature sensor, humidity sensor etc. So to overcome problems in monitoring we go for smart agriculture techniques using IoT. In the context of Smart Security and Monitoring System for Agriculture, we address the challenge of integrating Internet of Things with Raspberry pi and sensors to improve the efficiency of the agriculture. The use of sensor network which collects the data from different types of sensors and then send it to main server using Raspberry pi and all these parameters can be monitored using LCD display. Using IoT all the details are stored in the cloud and can be monitored. Data is processed in a smart cloud service. The developed multimedia platform can be controlled remotely by a mobile phone. It uses LoRa WAN network protocol which provides a long distance communication with very low energy consumption. This proposal is towards the increasing need of availability and facilities of a farmer.

Keywords – Precision Agriculture , Internet of Things(IOT) , LoRa WAN

I. INTRODUCTION

In the Internet of Things (I.o.Ts) pattern, all things which are everywhere will be on the network in one form or another. At present, many kinds of electronic device such as Radio Frequency Identification (RFID) and sensor network technology will growth to meet this new task, in which information and communication system are unnoticeably embedded in the environments around us. Internet of Things (IoT) is the network of physical things embedded with electronic circuits, sensors, software and network connection which enables these things to exchange data from one another. The Internet of Things allows objects to be sensed and controlled remotely across existing network infrastructure, creating opportunities for more direct integration between the physical world and computer-based systems, and resulting in improved efficiency, accuracy and economic benefit. In near future, IoT is expected to provide many more services like advanced connectivity of physical objects over a wide network and also many applications. It is obvious to think that in using these services provided by this technology, it is possible to control and monitor systems from a distance using the GSM network. Mobile internet are integrated-applications as useful as home automation, industrial applications for handling and remote monitoring of complex systems but also in security systems, and protect property and people, management, infrastructure monitoring etc. Applications in agriculture include soil and plant monitoring, greenhouse environment monitoring and control systems, monitoring of food supply chain, monitoring of animals, etc.Generally farmers visit their agriculture fields periodically to check soil moisture level and based on requirement water is pumped by motors to irrigate respective fields. Farmer need to wait for certain period before switching off motor so that water is allowed to flow in sufficient quantity in respective fields. Traditionally farmers will present in their fields to do irrigation process. But nowadays farmers need to manage their agricultural activity along with other occupations. Automation in irrigation system makes farmer work much easier. Sensor based automated irrigation system provides promising solution to farmers where presence of farmer in field is not compulsory. The highlighting features of this paper include Arduino ,Raspberry pi and LoRa WAN technology.

Precision Agriculture

Precision Farming is the Information Technology based farm management system to identify, manage and analyze variability within the field for optimum profitability, sustainability and protection of the land source. Precision agriculture is about collecting timely geospatial information on soil-plant-animal requirements and prescribing and applying site-specific treatments to increase agricultural production and protect the environment. The goal is not to obtain the same yield everywhere, but rather to manage and distribute inputs on a site specific basis to maximize long term cost or benefit. Applying the same input across the entire field may no longer be the best choice. In this mode of farming new information technologies can be used to make better decisions about many aspects of cop production. Precision Farming involves looking at the increased efficiencies that can be realized by understanding and dealing with the natural variability found within a field. Precision Farming is helping many farmers worldwide to maximize the effectiveness of the crop inputs. This technique is strictly based on the

Global Positioning System (GPS), which was initially developed by U.S. defence scientists for the exclusive use of the U.S. Defence Department. The unique character of GPS is precision in time and space.

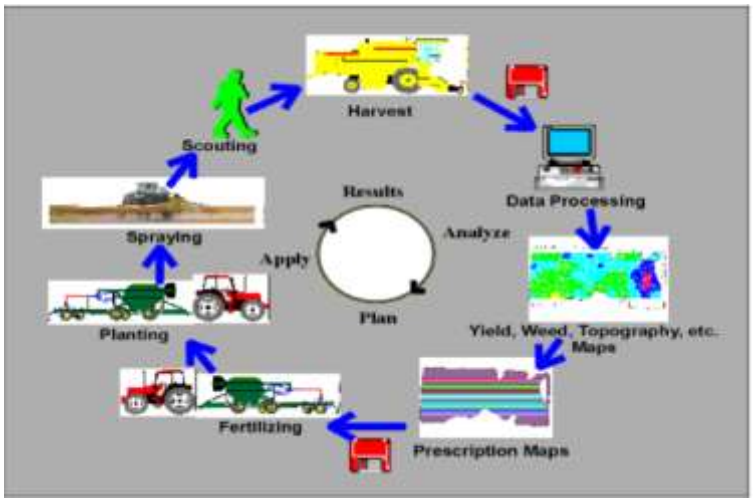

Figure 1 Precision Farming cycle

The Smart Farming System

Smart farming reduces the ecological footprint of farming. Minimized or site-specific application of inputs, such as fertilizers and pesticides, in precision agriculture systems will mitigate leaching problems as well as the emission of greenhouse gases. Smart farming can make agriculture more profitable for the farmer. Decreasing resource inputs will save the farmer money and labour, and increased reliability of spatially explicit data will reduce risks. Optimal, site-specific weather forecasts, yield projections, and probability maps for diseases and disasters based on a dense network of weather and climate data will allow cultivation of crops in an optimal way. Site-specific information also enables new insurance and business opportunities for the entire value chain, from technology and input suppliers to farmers, processors, and the retail sector in developing and developed societies alike. Smart farming also has the potential to boost consumer acceptance. In principle, optimizing management also permits increased product quality (e.g., higher amounts of antioxidants and other secondary metabolites. The adoption of smart farming solutions is not rapid. The reasons for this are primarily cost – only large farms can afford the investment, and the industry is by nature conservative. That said, government agencies are stimulating adoption of new technologies through subsidies and projects. The figure below show the different types of technologies involved in smart farming.

Figure 2 Technologies involved in Smart farming

What makes precision agriculture special is the IT system at the one end of the supply chain, the decision support system at the back office. Smart farming can provide a concerted path out of locked-in technologies and practices characterized by strong polarization and market segmentation. It offers a path toward sustainable agriculture by diversification of technologies, crop and livestock production systems, and networks across all actors of the agri-food sector. There is no single policy approach that can achieve this vision, which supports and facilitates the appropriate use of ICT technology. Rather, the idea is to identify the dominant mechanisms that constrain or threaten a sustainable use of the technology and to select the most appropriate actions in developed and developing countries. Data is the fundamental building block of smart farming, whether the data comes from a soil sample or a satellite correction signal. For example, data points collected can highlight both spatial and temporal variability within a field. Many factors can contribute to this variability; under-standing the effect each factor has can only be measured and managed using statistical analysis of the data .

The cost of smart farming is still high for any but the largest farms. Farm offices now collect vast quantities of information from crop yields, soil mapping, fertilizer applications, weather data, machinery, and animal health; these are all factors that influence farming such as soils, nutrition and weather. The complexity of smart farming is also reflected into the ecosystem of players. They can be classified in the following way: Technology providers – these include providers of wireless connectivity, sensors, M2M solutions, decision support systems at geomapping applications. The end users of precision farming solutions include not only the growers but also farm managers, users of back office IT systems. Everyday farming applications are starting to move into the cloud, with the aim of delivering benefits in terms of data access, synchronization, storage and even cost to the farmer. The rising use of smart phones and tablets on farms means that apps can be used to cache data offline until it can be synchronized; data need no longer be tied to a single computer in a single location.

II. LITERATURE SURVEY

Environmental monitoring applications can be broadly categorized into indoor and outdoor monitoring . Indoor monitoring applications typically include buildings and greenhouses monitoring. These applications involve sensing temperature, light, humidity, and air quality. Outdoor monitoring applications include chemical hazardous detection, habitat monitoring, traffic monitoring, earthquake detection, volcano eruption, flooding detection and weather forecasting. Sensor nodes also have found their applicability in agriculture. Soil moisture and temperature monitoring is one of the most important application of WSNs in agriculture.

Tanmay Baranwal et al.(2016)[1] , proposed a wise agricultural model which are designed, tested and analyzed an 'Internet of Things' based device which is capable of analyzing the sensed information and then transmitting it to the user. This device can be controlled and monitored from remote location and it can be implemented in agricultural fields, grain stores and cold stores for security purpose. In this it is oriented to accentuate the methods to solve such problems like identification of rodents, threats to crops and delivering real time notification based on information analysis and processing without human intervention. The issue is that Failure of any particular part or device is not informed and has to be tested manually.

Joaquín Gutiérrez et al. (2014) [2], The paper aims at optimizing usage of water in agricultural crops. An algorithm was developed with threshold values of temperature and soil moisture that was programmed into a microcontroller-based gateway to control water quantity. The system was powered by photovoltaic panels and had a duplex communication link based on a cellular-Internet interface that allowed for data inspection and irrigation scheduling to be programmed through a web page. The issue is that the investment in electric power supply would be expensive.

Rajeev R,Ketu et al.(2015)[3], As mentioned here the concepts of Wireless sensor networks and Ethernet protocols are made of use. Its mainly concerns its application towards Irrigational activities such as soil moisture monitoring and water pressure monitoring along with protection against trespassing with motion detections and concervation of energy. Here Remote access being provided to the user in knowing the deployed sensor status.One of the disadvantages is the technique is inconvenient in smart boarder security, Industrial automation and very low cost home automation devices.

G.MeenaKumari et al. (2014) [4], The approach proposes technological development in Wireless Sensor Networks made it possible to use in monitoring and control of greenhouse parameter in precision agriculture. ZigBee protocols based on IEEE 802.15.4 for wireless system are used. Partial Root Zone Drying Process is implemented to save water. Also Controller Area Network (CAN) and Hybrid networks are used. It uses traditional communication system is used. In the Field bus concept, the data transfer is mainly controlled by hybrid system(wired and wireless) to automate the system performance and throughput. The atmospheric conditions are monitored and controlled online by using Ethernet IEEE 802.3. The future research can be focused on Optical communication System with wavelength routing networks and can also be implemented using advanced ARM Controllers and core processors and also in energy saving, data fusion and other directions.

Krešimir Grgić et al.(2016)[5], it reviews a web-based Internet of things solution aimed for monitoring, tracking and analyzing data in agriculture area is proposed. Real time data is achieved using broker-based publishing/subscribing Message Queue Telemetry Transport protocol which is briefly described. Using this protocol limitations resulting from constrained networks in rural areas are avoided. Collected data from sensors is shown and stored in web part of the information system. This type of implementation is developed by the manufacturers need for monitoring and tracking data. One major issue is that it is not much energy saving and here data fusion is present.

Zheng, L et al. (2011)[6], This approach proposes a smart mobile farming service system is developed based on WSN (Wireless Sensors Network), GPS and GIS technologies. It can monitor and control the WSN via the Zigbee coordinator, collect the farming information from the WSN nodes, acquire GPS information of each sampling site and exchange data with the host PC via GPRS. The host PC can supervise several farming PDA terminals, exchange data with the farming PDAs, visualize the farming information and offer irrigation decision support according to real-time field information and the farmland irrigation model. One of the issue includes here a NovAtel OEM1 board was selected as the GPS OEM module and a corresponding extending circuit was developed to control this module. The module occupied two serial ports, one was used to set up the serial port and to input the needed instruction. Another was used to apply for the differential information.

Hwang et al. (2010)[7], Here an agricultural environment monitoring server system is introduced which is used for monitoring information concerning an outdoors agricultural production environment.It utilizing Wireless Sensor Network (WSN) technology. This could even monitor the environmental information on the outdoors remotely, and it could be expected that the use of such a system could contribute to increasing crop yields and improving quality in the agricultural field by supporting the decision making of crop producers through analysis of the collected information. It collects environmental and soil information on the outdoors.WSN-based environmental and soil sensors, collects image information through CCTVs, and collects location

information using GPS modules used for collecting information.The issue is that the system required a CCTV to monitor a real-time video and GSM module to transfer information and high technologies is needed .

III.LITERATURE SURVEY SUMMARY

S.NO	PAPER	TECHNIQUES	RESULTS	ISSUES
1	Development of IOT based smart security and monitoring devices for agriculture	Iot, Sensors, Linux based Raspbian OS, Raspberry pi 2	system is designed for identification of rodents in grain stores.	Failure of any particular part or device is not informed and has to be tested manually
2	Automated Irrigation system using a WSN and GPRS module	WSUs and a WIU, based on microcontroller, ZigBee, and GPRS technologies	Feasible and cost effective for optimizing water resources for agricultural production.	The investment in electric power supply is expensive
3	Implementation of IoT in Monitoring and Control of Agricultural Activities.	Zigbee and Ethernet protocol	Remote access being provided to the user in knowing the deployed sensor status.	The technique is inconvenient in smart boarder security, Industrial automation and very low cost home automation devices.
4	A web based IoT solution for Monitoring data using MQTT Protocol.	Bus concept, ZigBee protocols based on IEEE 802.15.4, Hybrid network.	Monitoring and control of greenhouse parameter in precision agriculture.	Not energy saving and data fusion,directions are left for future research
5	Real - Time Automation and Monitoring System for Modernized Agriculture	Sensors and Message Queing Telemtry Transport Protocol	IoT solution for realizing real-time web-based solution aimed for monitoring and tracking temperature and moisture values in the agricultural drying process.	Not energy saving and data fusion is present.
6	Development Of a Smart Mobile Farming Service System	It is based on WSN , GPS and GIS technologies,Zigbee technology, customized farming PDAs and a host PC	A smart mobile farming service system is developed. The embedded GIS system is used on the PDA, both the farming information from the WSN and the GPS information of each sampling site were recorded by the smart mobile terminal and the embedded GIS system checked the data.	A NovAtel OEM1 board was selected as the GPS OEM module and a corresponding extending circuit was developed to control this module. The module occupied two serial ports, one was used to set up the serial port and to input the needed instruction. Another was used to apply for the differential information.
7	Study on an Agricultural Environment Monitoring Server System using Wireless Sensor Networks	Wireless Sensor Network (WSN) technology,Use of CCTV and GPS modules.	It collects environmental and soil information on the outdoors through WSN based environmental and soil sensors, collects image information through CCTVs, and collects location information using GPS modules.	The system required a CCTV to monitor a real-time video and GSM module to transfer information and high technologies is needed

IV. CONCLUSION AND FUTURE WORK

Through sensor networks agriculture can be connected to the IoT which will be further usefull us to create connections among agronomists,farmers etc. By using this latest IoT concept farmers can get the information and notification of various mechanisms performed in the farm. By using various sensors. Also agricultural products quality can be improved because farmers observe whole cycle from seeding to selling using this IoT based agricultural production system. With the use of IOT and the application

on the users mobile or computer, constant monitoring of a particular sapling is possible.The main aim is the complete monitoring of farm. Not only the monitoring, the application would have complete database of the ,ideal requirement of the sapling, which helps the user to provide necessary measures for the appropriate care of the vegetation. Irrigation controllers consist of a mesh network that operates at the 868MHz ISM Frequency Band as LoRa WAN or Sigfox. This system can access the plant health by a simple application through the phone. The advantages of the proposed work are more efficient and accurate information is fetched, reduced man power and Electrical Energy was saved. The visual alert in the farmers own language helps in weather forecasting and theft protection which is another advantage. Further, the aim is to develop and actual implement this product on multiple agricultural land.

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