A RESEARCH ON: AN EVALUATION OF IOT BASED REMOTE SENSING SYSTEM DESIGN AND DEVELOPMENT IN AGRICULTURAL SECTOR

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ABSTRACT

In recent years, sensors with improved methods such as artificial intelligence (AI) have played a crucial role in remote sensing and smart agriculture. The AI-enabled sensors function as smart sensors, and the introduction of the Internet of Things (IoT) has resulted in the availability of a variety of sensor-based equipment and gadgets that are quite beneficial in the area of agriculture. In this paper, we have conducted an in-depth analysis of the advancements in smart sensors and IoT, which are utilised in remote sensing and agriculture applications such as the evaluation of weather conditions and soil quality; crop monitoring; the use of robots for harvesting and weeding; and the employment of drones. Emphasis was placed on certain kinds of sensors and sensor technologies by giving a comprehensive analysis, evaluation, comparison, and suggestion for IoT improvements that would aid researchers, agriculturists, remote sensing scientists, and policymakers in their research and implementations.

Keyword : - *sensors; smart sensors; AI; IoT; remote sensing; agriculture applications*

1. INTRODUCTION

The most prevalent uses for sensors range from measuring bodily characteristics to autonomous driving. In addition, sensors play a crucial part in the performance of detection and vision-related activities in all current applications of science, engineering, and technology where computer vision predominates. Internet of Things (IoT) dealing with wireless networks and sensors deployed to detect data in real time and produce particular results of interest via adequate processing is an intriguing developing topic that incorporates smart sensors. Sensors and artificial intelligence (AI) are the most crucial components of IoT-based devices that make them smart and intelligent. In fact, due to the role of AI, the sensors act as intelligent sensors and find efficient use in a variety of applications, such as general environmental monitoring monitoring a number of environmental factors; weather forecasting satellite imaging and its use; remote sensing-based applications; monitoring of hazard events such as landslide detection; self-driving cars; healthcare; and so on. In hospitals and diagnostic centres, the use of smart gadgets for assessing and monitoring different health problems of afflicted patients, both remotely and physically, has expanded dramatically in recent years.

Practically no sector of science or study can function intelligently without sophisticated sensors. The widespread use and need of sensors, as well as the Internet of Things (IoT) in remote sensing, environmental and human health monitoring, make the applications intelligent. In the last decade, agricultural applications have also included the use of a variety of sensors for monitoring and managing environmental factors such as temperature, humidity, soil quality, pollution, air quality, water contamination, radiation, etc. This study also seeks to emphasize the usage of sensors and the Internet of Things for remote sensing and agricultural applications via a thorough discussion and assessment.

1.1 Agricultural IoT systems

The IOT technology based on the Internet and mobile communication network can meet the needs of many different fields with the development of science and technology. But because agriculture is influenced by many objective factors, the development of IOT technology in agriculture is slow. Agricultural field is one of the most urgent and

important development areas of the IOT technology. A large amount of sensor nodes will form a variety of monitoring networks in the agricultural field through the IOT technology, and with the help of various sensors to collect information, it helps farmers to find the troubles in time and determine the location of the troubles accurately. IOT for agriculture is an application system of IOT which runs through the production, processing, and circulation of agriculture.

IOT technology for agriculture is implemented in a hierarchical structure at the business level. It consists of four layers from low to high.

1. Sensor layer: It can be used to collect basic information of growth environment, logistics, and storage, such as monitoring information, trading information, storage information, and weather information.

2. Transport layer: It includes the two parts of wireless communication and wired communication. The backbone network is mainly wired communication, that is, through the Ethernet ring network to ensure the reliability of network transmission, data reliability, convenient and fast transmission and exchange.

3. Business layer: It is used to monitor environmental factors or growth factors and various types of information in quality traceability systems. It includes environmental data basic information, business management information, geographic information, and so on.

4. Application layer: It is divided into several application portals according to the roles, including supervisors, producers, suppliers, channel providers, consumers, and so on. 5. User layer: It includes all kinds of information security methods, data storage, access, and transmission security system, mainly through the security system and technology to ensure the safe access to information and malicious attack environment data security and data integrity.

2. LITERATURE REVIEW

2.1Mohamed EsmailKarar et.al (2020) Conducted study on, "A Pilot Study of Smart Agricultural Irrigation using Unmanned Aerial Vehicles and IoT-Based Cloud System" This article introduces a new mobile-based application of modern information and communication technology in agriculture based on Internet of Things (IoT), embedded systems and an unmanned aerial vehicle (UAV). The proposed agricultural monitoring system was designed and implemented using Arduino microcontroller boards, Wi-Fi modules, water pumps and electronic environmental sensors, namely temperature, humidity and soil moisture. The role of UAV in this study is to collect these environmental data from different regions of the farm.

2.2 Nikesh Gondchawar.et.al (2016) Conducted study on, "IoT based Smart Agriculture" Agriculture plays vital role in the development of agricultural country. In India about 70% of population depends upon farming and one third of the nation's capital comes from farming. Issues concerning agriculture have been always hindering the development of the country. The only solution to this problem is smart agriculture by modernizing the current traditional methods of agriculture. Hence the project aims at making agriculture smart using automation and IoT technologies. The highlighting features of this project includes smart GPS based remote controlled robot to perform tasks like weeding, spraying, moisture sensing, bird and animal scaring, keeping vigilance, etc. Secondly it includes smart irrigation with smart control and intelligent decision making based on accurate real time field data. The only solution to this problem is smart agriculture by modernizing the current traditional methods of agriculture.

2.3 Sharma Sachin, et.al (2019), Conducted study on, "Nuts and Bolts of ETL in Data Warehouse" Data transformation from text files to database files, relational database management systems, and distributed database management systems in recent past has emerged a vast field of data warehouse. Currently data analytics is the most appealing field for the data scientists and challenges are very big as data volume is very huge. Not only data volume is high but the speed at which data is growing annually is exponentially. Data analytics has become a tool to grow the business by forecasting, business intelligence and decision support systems. In a simplified way, data is organized in the form of database, collective databases make the data warehouse and the technologies like business intelligence, decision support system, and data analytics make use of data warehouse for their purpose.

2.4 Silvia LiberataUllo, et.al (2021) Conducted study on, "Advances in IoT and Smart Sensors for Remote Sensing and Agriculture Applications" Modern sensors find their wide usage in a variety of applications such as robotics,

navigation, automation, remote sensing, underwater imaging, etc. and in recent years the sensors with advanced techniques such as the artificial intelligence (AI) play a significant role in the field of remote sensing and smart agriculture. The AI enabled sensors work as smart sensors and additionally the advent of the Internet of Things (IoT) has resulted into very useful tools in the field of agriculture by making available different types of sensor-based equipment and devices. In this paper, we have focused on an extensive study of the advances in smart sensors and IoT, employed in remote sensing and agriculture applications such as the assessment of weather conditions and soil quality; the crop monitoring; the use of robots for harvesting and weeding; the employment of drones.

2.5Muhammad Shoaib Farooq, et.al (2020) Conducted study on, "Role of IoT Technology in Agriculture: A Systematic Literature Review" The growing demand for food in terms of quality and quantity has increased the need for industrialization and intensification in the agriculture field. Internet of Things (IoT) is a highly promising technology that is offering many innovative solutions to modernize the agriculture sector. Research institutions and scientific groups are continuously working to deliver solutions and products using IoT to address different domains of agriculture. This paper presents a systematic literature review (SLR) by conducting a survey of IoT technologies and their current utilization in different application domains of the agriculture sector. The underlying SLR has been compiled by reviewing research articles published in well-reputed venues between 2006 and 2019. A total of 67 papers were carefully selected through a systematic process and classified accordingly. The primary objective of this systematic study is the collection of all relevant research on IoT agricultural applications, sensors/devices, communication protocols, and network types. Furthermore, it also discusses the main issues and challenges that are being investigated in the field of agriculture.

2.6 Rajendra P, et.al (2020) Conducted study on, "Applications of Remote Sensing in Precision Agriculture: A Review" Agriculture provides for the most basic needs of humankind: food and fiber. The introduction of new farming techniques in the past century (e.g., during the Green Revolution) has helped agriculture keep pace with growing demands for food and other agricultural products. However, further increases in food demand, a growing population, and rising income levels are likely to put additional strain on natural resources. With growing recognition of the negative impacts of agriculture on the environment, new techniques and approaches should be able tomeet future food demands whilemaintaining or reducing the environmental footprint of agriculture. Emerging technologies, such as geospatial technologies, Internet of Things (IoT), Big Data analysis, and artificial intelligence (AI), could be utilized to make informed management decisions aimed to increase crop production.

2.7 M. Weiss et.al (2017) Conducted study on, "Remote sensing for agricultural applications: a meta-review "Agriculture provides humanity with food, fibers, fuel, and raw materials that are paramount for human livelihood. Today, this role must be satisfied within a context of environmental sustainability and climate change, combined with an unprecedented and still-expanding human population size, while maintaining the viability of agricultural activities to ensure both subsistence and livelihoods. Remote sensing has the capacity to assist the adaptive evolution of agricultural practices in order to face this major challenge, by providing repetitive information on crop status throughout the season at different scales and for different actors. We start this review by making an overview of the current remote sensing techniques relevant for the agricultural context. We present the agronomical variables and plant traits that can be estimated by remote sensing, and we describe the empirical and deterministic approaches to retrieve them.

2.8Xiang Feng et.al (2019) Conducted study on, "Study of Wireless Communication Technologies on Internet of Things for Precision Agriculture" Precision agriculture is a suitable solution to these challenges such as shortage of food, deterioration of soil properties and water scarcity. The developments of modern information technologies and wireless communication technologies are the foundations for the realization of precision agriculture. This paper attempts to fnd suitable, feasible and practical wireless communication technologies for precision agriculture by analyzing the agricultural application scenarios and experimental tests. Three kinds of Wireless Sensor Networks (WSN) architecture, which is based on narrowband internet of things (NB-IoT), Long Range (LoRa) and ZigBee wireless communication technologies respectively, are presented for precision agriculture applications.

2.9 Anna Triantafyllou, et.al (2019) Conducted study on, "Precision Agriculture: A Remote Sensing Monitoring System Architecture" Smart Farming is a development that emphasizes on the use of modern technologies in the cyber-physical field management cycle. Technologies such as the Internet of Things (IoT) and Cloud Computing have accelerated the digital transformation of the conventional agricultural practices promising increased production rate and product quality. The adoption of smart farming though is hampered because of the lack of models providing guidance to practitioners regarding the necessary components that constitute IoT-based monitoring systems. To

guide the process of designing and implementing Smart farming monitoring systems, in this paper we propose a generic reference architecture model, taking also into consideration a very important non-functional requirement, the energy consumption restriction.

2.10 George Adamides (2020) Conducted study on, "A Review of Climate-Smart Agriculture Applications in Cyprus" Climate-smart agriculture is an approach for developing agricultural strategies to modernize agricultural systems using digital techniques, aiming for sustainable agriculture and ensuring food security under climate change. This article provides a systematic literature review of smart agriculture technologies towards climate-smart agriculture in Cyprus, including robotics, Internet of Things, and remote sensing. The paper starts with a review of climate-smart agriculture, presenting its importance in terms of optimizing agricultural production processes in order to address the interlinked challenges of food security and climate change.

3. METHODOLOGY

The research technique used for this work is a comprehensive literature review. This project seeks to explore and assess current Internet of Things (IoT)-based agricultural monitoring apps, sensors/devices, and communication protocols. We used the technique suggested by in order to make our study neutral in terms of information selection and representations of findings.

Fig 1: Flowchart of methodology process

3.1 Problem Statement

To provide efficient decision support system using wireless sensor network which handle different activities of farm and gives useful information related to farm. Information related to Soil moisture, Temperature and Humidity content. Due to the weather condition, water level increasing Farmers get lot of distractions which is not good for Agriculture. Water level is managed by farmers in both Automatic/Manual using that mobile application. It will make more comfortable to farmers. Performing agriculture is very much time consuming.

3.2 Objectives of the study

- To focused state-of-the-art research work has been identified in the field of IoT agriculture.
- To Proposed a taxonomy that further highlights the adopted IoT agriculture methods and approaches.
- To Identify the research gaps in terms of challenges and open issues.

3.3 Hypothesis of the study

H1. Farmer's attitude towards IoT-A will positively affect the adoption intention.

H2a. Farmer's 'reason for' adoption of IoT-A influences the attitude toward IoT.

H2b. Farmer's 'reason against' IoT-A adoption influences the attitude toward IoT-A adoption.

H3a. Farmer's 'reason for' IoT-A adoption influences the adoption intention of IoT-A.

H3b. Farmer's 'reason against' IoT-A adoption influences the adoption intention of IoT-A.

H4a. The value of farmer will (positively/negatively) affect the 'reason for' IoT-A adoption.

H4b. The value of farmer will (positively/negatively) affect the 'reason against' IoT-A adoption

H5. Farmers' values will (positively/negatively) affect their attitude toward IoT-A adoption.

3.4 Scope of the study

- It increases productivity, reduces manual work, reduces time and makes farming efficient.
- By using IoT crop monitoring can be easily done to observe the growth of the crop.
- Soil management such as pH level and Moisture content etc can be identified easily so that farmers can sow seeds according to the soil level.

4. IMPLEMENTATION

The Internet of Things (IoT) IOT is made up of the words Internet and Things. Things in IOT refer to various IOT devices with unique identities and the ability to perform remote sensing, actuation, and live monitoring of specific types of data. IoT devices can also exchange data in real time with other connected devices and applications, either directly or indirectly, or collect data from other devices and process it before sending it to various servers. The internet is also defined as a global communication network that connects trillions of computers around the world to enable information sharing. An ideal IOT device has multiple interfaces for connecting to other devices, which can be wired or wireless. Any IoT device is made up of the following components:

- I/O interface for Sensors.
- Interface for connecting to Internet.
- Interface for Memory and Storage.
- Interface for Audio/Video.

4.1 Smart Sensors for Remote Sensing Applications

As discussed in the previous section, the remote sensing applications become interesting and powerful if the smart sensors are used for smart sensing and detection of real time data and their analysis. an application scenario in which the active and passive sensors. are used in remote sensing applications, which can range from those including navigation, surveillance, communication forecasting biological research, earth resource monitoring, up to atmospheric condition monitoring Weather monitoring, navigation, communication, forecasting assistance are major application areas of remote sensing employing different types of sensors. The sensors used in such applications behave smartly due to artificial intelligence (AI) techniques embedded in the sensors, also based on IoT for the specific purposes.

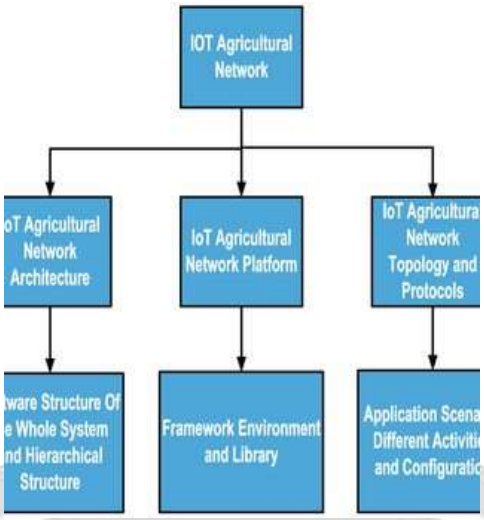

Fig 2: General Hierarchy of Possible Applications, Services and Sensors for Smart Agriculture

(Source: Research Gate)

4.2 Proposed system

The automated system was developed and deployed in this work using a low power microcontroller. To address the shortcomings of the existing system, such as its high cost, difficulty in maintenance, and wired connection, we propose a new system with a wireless connection between the server and the nodes. We present a new embedded web server design that makes use of Raspberry Pi technology and the internet of things. The automated irrigation system is comprised of a distributed sensor network comprised of soil moisture sensors, temperature sensors, humidity sensors, water level sensors, and colour sensors. The water level sensor detects excess water in the field, and the motor automatically pumps it to the surrounding area.

4.3 Block diagram

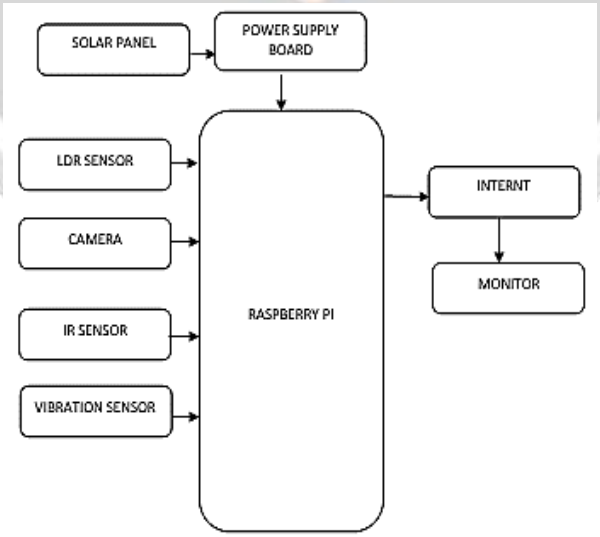

Fig 3: Block Diagram

(Source: Research Gate)

4.4 Software requirements

- The arduino ide

When working with the InduinoR3 Board, choose Arduino UNO from the Tools Boards List and the appropriate Com Port.

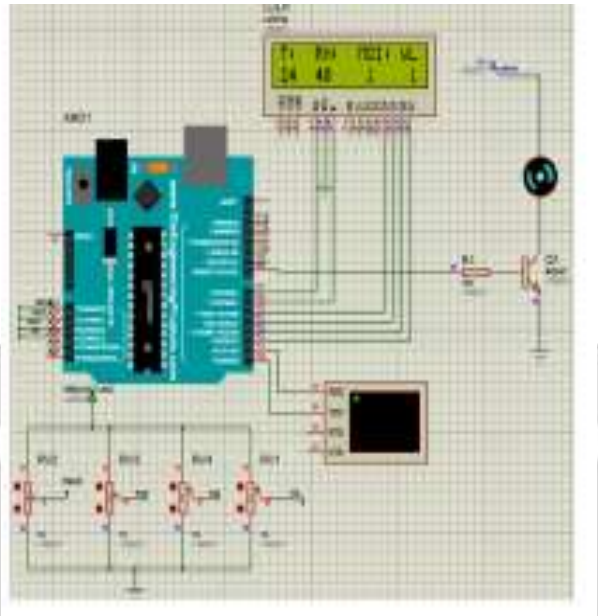

Fig 4: schematic diagram

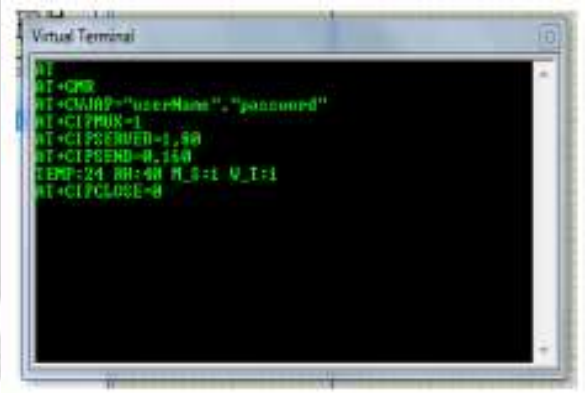

Fig 5: Simulation Output

Following the completion of the experiment on the hardware, the following results were extracted as an output.

Hardware output

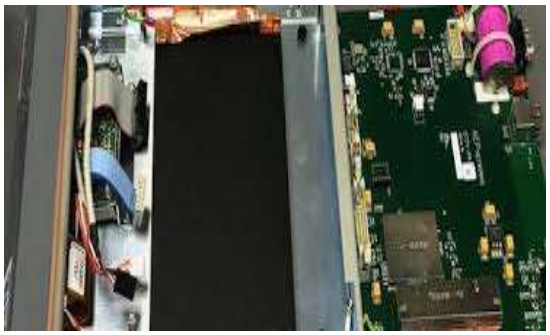

Fig 5: Hardware Module

(Source: APNIC Blog)

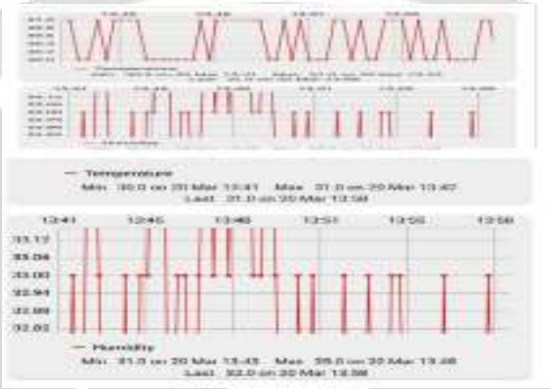

Fig 6: Output Chart

Fig 7: Software Output

(Source: Arduino)

Conclusion

This study evaluates current research and studies on the Internet of Things (IoT) and sensors used for Remote Sensing applications and in agriculture. The literature and a critical analysis of work in numerous fields of smart sensors and IoT in terms of their application, characteristics, and limitations have been given after extensive

investigation. In addition to the review-based recommendations and debate, an impact analysis of the research conducted in recent years in the area of study has been developed. An IoT framework and a robust collection of sensors are required for successful Remote Sensing applications and their execution. Despite the fact that there are several sensors for a variety of applications, sensors for remote sensing that result in distinctive and robust remote sensing-based agricultural monitoring and control are very limited. Statistical analysis and performance evaluation of IoT and sensors for the enumerated applications may be attempted in a future study. Furthermore, statistics and their application in various publications are seldom used in research. Future research will be necessary on robustness, sensor selection, climatic conditions, and the design of suitable IoT and smart sensors.

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