Use of IoT for Smart Greenhouse

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ABSTRACT

To maintain an adequate flow of food supplies it is required to maintain sustainable agriculture for the benefit of the future of the world. The world population is growing rapidly whereas the usable land area is gradually declining along with the rapid changes in climate as a side impact of these rapid changes happening in the world. Particularly, to the world context the same concerns are hindering in the Sri Lankan domain as well. For all these prevailing issues, the greenhouse is a sustainable solution that is also viable to counter the future food supply-related crises. The greenhouse can successfully combat the harsh conditions in the natural environment and is vital to cultivate throughout the year irrespective of the seasonal differences. Anyway, there are many limitations and challenges faced by farmers as well as the researchers in manually maintaining them. Certainly, the Internet of things as an evolving technology can contribute to this greenhouse-based agriculture and farming with the intervention of automation. This paper aims to analyze and understand the vital and viable mechanisms to use within the Sri Lankan domain by reviewing the recently available IoT- based applications in the world context to develop the most viable application.

Keywords: Internet of things, Agriculture, smart agriculture, smart farming, control systems, automation, greenhouse, remote monitoring, wireless communication, business

1. INTRODUCTION

Agricultural land area throughout the world is declining annually due to the increasing population, industrialization, climate change and the spread of environmental pollution. So, a drastic shift is required to make in order to prevent the ecological supply of foods by advancing the agricultural mechanisms. Greenhouse farming is seen as one of the better alternative approaches for food security and count as a sustainable socio- ecological approach. If we pay attention to the worldwide context currently, most of the things are controlled or operated through the automation, but in Sri Lanka this kind of mechanisms are not yet being used in fields like agriculture due to various reasons like cost issues. In Sri Lanka, agriculture prevailed from ancient civilizations. So, most of the people have only adopt the manual mechanisms of cultivating and they are not used to adopt technological stuff into to a field like agriculture. Greenhouses are very important in farming and agriculture sector. Under optimum environmental conditions, plants are used to cultivate within them. This is something made up of full transparent materials including walls and roof. As the world is developing and implementing new technology people world agriculture and farming have adopt sophisticated technologies these aspects of agriculture as well.

2. OVERVIEW OF IOT BASED SMART GREENHOUSE

2.1. Internet of Things (IoT) and Wireless Sensor Networks (WSN)

The Internet of Things can be defined as connecting daily objects, such as Smartphones, Internet TVs, sensors, and internet actuators. The smart greenhouse is a revolution in agriculture, creating a self-regulating, microclimate suitable for plant growth through the use of sensors, actuators, and monitoring and control systems that optimize growth conditions and automate the growing process.

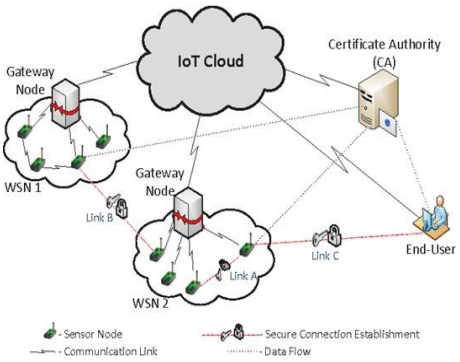


Figure 1.WSN Of IoT (Pawani Porambage, 2014)

In addition, with physical and internal security this smart greenhouse is securely built. In the operational, technological and consumer markets, IoT provides a transformation model. Trust and protection are required when changing the pattern in order to deal with different kinds of threats, problems, malfunctions and disastrous social effects. He is the producer of IoT securing products and the companies that use devices. In the event that the risk is organized, and all security issues are resolved in IoT, a complete collection of safety data is needed. Several IoT security needs including encryption, digital certificates and other safe communications have been suggested in this project.

Wireless sensor network (WSN) technologies figure 1. have grown rapidly over the years. Using outstanding instruments called sensor nodes, environmental phenomena are monitored in a wide range. A number of sensors, processors and RF modules are supplied with battery operated WSN Bluetooth and Wi-Fi networking. A connection allows the communication of sensor nodes.

Wirelessly and forward their communication gateway to the database station or coordinator. The contact between sensor nodes depends on the different sensors being combined. WSNs were used for a range of purposes, including military, agriculture, sports, medical and industrial applications. Agriculture can be regarded as one of the most beneficial WSN facilities in raising the yields of food crops and reducing the pressure on farmers. Agricultural WSN is used to improve as cost- returns.

2.2. IoT and Cloud Services for Smart Greenhouses

By offering third-party network connectivity, IoT provides public cloud services to the IoT region conveniently. IoT data or computer components that operate with IoT products will also be helped by integration. When considering scalability requirement, IoT devices required a high storage capacity to store and share the respective information. IoT should provide clients with more space that can expand according to the customer requirements. Greater performance scale should be there to process the information or data collected through different fields. Performance Increased. Cloud IoT provides the communication needed to share system information Internet Cloud Computing infrastructures help IoT to provide more information. Consumers do not need to purchase more or less storage. (McKenna, 2021) By increasing the amount of data produced by Internet Cloud Computing and paying for its storage, they can easily scale up the storage. In basic terms, cloud computing means getting access to data and services, which can be ordered and accessed on demand, from a centralized pool of computing resources. Cloud implementations are commonly defined as public, private or hybrid in three separate model models.

Private cloud services are a secure cloud which is accessible only to a specific organization. A private cloud framework provides additional

protection for any entity, including business, that needs to store and process private data or perform delicate tasks.

The Public Cloud Platform is like a private cloud, except the main distinction is that resources can be exchanged with other organizations, used to process and store the data, and the data can be transmitted over a public network like the Internet. Third-party providers offer Internet cloud services and are typically paid for the appropriate CPU, storage or bandwidth.

The Hybrid Cloud is a cloud-based computing facility utilizing a mix of private, in-build cloud and third-party public cloud resources. Instead of a typically packaged public cloud platform through the hybrid cloud model IT policymakers can handle both private and private elements.

2.3. IoT for Smart Greenhouse

Agriculture must also be an important objective; in smart agriculture, IOT plays a key role. Simply, smart greenhouse can be called as a self-regulating, climate created for growth of plants with the use of different types of actuators, sensors this monitoring and controlling of environmental conditions yields to growth optimization and automation of plants. In the IOT-based intelligent greenhouse farming system, sensors can be used to monitor required parameters like light intensity, humidity condition, prevailing temperature, condition of soil moisture.etc. and the irrigation system are installed to crop field monitoring. Farmers can check their field conditions from any corner of the world whenever they have time. In comparison with conventional approaches, IOT – based smart greenhouse farming is very efficient. Greenhouse agriculture is a method which improves vegetables, fruit, crops, etc.

3. MAJOR RESEARCH IN IOT BASED SMART GREENHOUSE

In particular, IoT-based smart greenhouse was proposed by Ravi Kishore Kodali, Vishal Jain and Sumit Karagwal to increase current farming practices through the use of modern technologies for improved yield[Kodali, V. J. (2016)]. This study offers the model of a smart greenhouse, which allows farmers automatically perform their business in a farm without much manual inspection. A closed structural greenhouse protects the plants of wind, hailstorm, UV radiation and insect and pest assaults from the harsh weather. Automatic dry irrigation, which works according to the threshold of soil humidity, in line with the need that plants get an ideal amount of water, irrigates the farm field. The Greenhouse monitoring and management of Android's Mobile Application has been suggested by Aji Hanggoro, Rizki Reynaldo, Mahesa Adhitya Putra. The monitoring and control of Green House is a whole system intended for inside a greenhouse to monitor and regulate humidity[Hanggoro, R. R. (2017)]. This program utilizes a mobile Android phone, which is connected by Wi-Fi to a central server that links a microcontroller and a moisture sensor through serial connection. The result demonstrates that the condition is in the data sheet and system of the sensor are in reality adequate. The achieved test result concludes that the system is working properly. Yung Sheng Chang, Yi Hsiung Chen, Sheng Kai Zhou suggested a clever lighting system for greenhouses based on narrowband- IoT connectivity, the promotion and popularity of communications technologies and the Internet. [Chang, Y. H. (2018)]. IoT applies in our daily lives to several applications, including medical attention, intelligent home, Greenhouse, smart cities and environmental monitoring. Three short range communication technologies – Bluetooth, Wi-Fi and ZigBee – are extensively employed in IoT, together with small drive ranges, average power consumption and weakness of the interference. Therefore, the low power wide area network (LPWAN) for cellular networks is proposed in the context of extensive coverage, reduced consumption and huge devices with reliable communication for IoT equipment. Have designed a greenhouse environment control and monitoring system consisting of the local and central stations by Ibrahim and Munaf [Al-D(2012)]. Local stations are utilized for the measurement of parameters and controlling of actuators, and a PIC microcontroller is installed at each local station that receives the data and delivers to the central station and receives the control signal needed for actuator operation. IEEE Global Humanitarian Technology Conference (GHTC) [2017] "For precision agriculture in Brazil utilizing remote monitoring systems." by Filev Maia Rodrigo . Have discussed an IoT device which is used to monitor

various agricultural parameters[Maia R. (2017)]. A sensor network is used to measure soil temperature, humidity, humidity and so on. In São Paulo, Brazil, the test was conducted. Different judgments on crop life and its sustainability have been supported by reference climatic data.

4. ADVANTAGES OF IOT BASED SMART GREENHOUSES

System Measurability and Straightforward Extension. - It is even more advantageous to have a wireless network in. Because of new or changed requirements, network expansion is important. The extension of the cable is tired.

Reduced Installation Costs - Since no cable is important, the installation prices are reduced considerably, first and foremost. Wired cable solutions must be cabled everywhere, because cables are highly expensive, wherever they are.

Mobility is there. The relevant circuits can be carried out anywhere anytime.

Due to the automation, there is a reduction in use of human labor as well. Embedded cost servers can be used in order to reduce the costs as well this would cutdown the unnecessary costs over purchasing very costly real web server.

Since the internet-based communication platforms are very scalable and flexible in using as per the requirements the everything like sensors and actuators are feasible to connect to a global scale network.

5. CURRENT ISSUES OF IOT BASED SMART GREENHOUSES

Controlling Issues – since most of the systems have been designed in order to monitor just one parameter at a time in order to monitor few parameters simultaneously few systems like that would be required. As most of the armers of developing countries they are not used to advanced techniques and technologies in their fields.

Energy consumption is very high in intelligent greenhouse systems if people are not there. This can waste enormous amounts of energy, as it cannot stop right away.

Technical Issues - The smartness of the domestic automation systems based on IOT is also a big challenge. A safe auto-configuration approach should therefore be studied to implement the smart Greenhouse successfully. In order to improve this smart Greenhouse efficiently and effectively, more technical support is needed.

Other Issues – Cost that have to measure over the technical implementations may not be bearable for farmers of developing countries. Secured data transmission and storing is also a major requirement whereas technical threats can be arising.

6. FUTURE DIRECTIONS AND CONCLUSION

IOT is an integrated technology in modern society that can be used in many different areas of society. The architecture of smart greenhouse IOT systems is presented in this paper. The challenges and issues of IOT-based intelligent greenhouse are also clearly discussed in this study paper. This can be done through the use of the latest technologies and especially using the combination of IOTs. There are some serious problems. The IOT-based, intelligent Greenhouse automation can be improved with new technologies and methodologies. If they are all combined, and the customer base is clear about the intelligent greenhouse technology. Given below is a summary of future perspectives in empowering smart greenhouses with IoT.

- Integration of blockchain related technologies for the security purposes of data storing and transmission
- Research on soil condition monitoring, plant growth monitoring, plant quality monitoring, monitoring chemical composition of plants after fertilizing, and get use of prevailing local climate around the planation if applicable can be seen as some of major directions to create a solution on lower cost with reliability

- Coordinate industry giants in creating a protocol for data transmission which is unified that enables inter-operation standards and enhance the generalization of data annotation standards which facilitates visualizing and decisioning.

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