SMART GREENHOUSE PLATFORM: AN INFRASTRUCTURE FOR AGRICULTURAL APPLICATION AS CLOUD COMPUTING SERVICE

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ABSTRACT

Smart greenhouse platform: an infrastructure for agricultural application as cloud computing service

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In today's world some technology companies are using sophisticated IT systems to integrate urban services and infrastructures. The smart city is made up of different parts that make the Internet of Things one of the most important infrastructural necessities for optimizing process automation functions. With the increase in world population and the need for food supply on one hand and the lack of water, energy and agricultural land on the other hand, traditional agriculture no longer meets the food needs of the world population, so smart agriculture has received more attention in recent years. The Internet of Things (IoT) is a novel technique which is able to provide many solutions for agricultural modernization. The agricultural process is affected using wireless sensor network and is anticipated to utilized from the IoT. The problem that we are trying to solve is to minimize the energy consumption in smart green houses. Each sensor should communicate with each other and their own headers with efficient energy consumption. The main contribution of this thesis is to study the IoT applications in a smart city, Investigate the use of IoT in smart greenhouses, explore the infrastructure required to use the Internet of Things and

provide solutions for efficiency in smart greenhouse performance by improving IoT energy consumption.

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Chapter 1

Introduction

1.1 Overview

The tremendous growth of information and communication technologies (ICTs) brings a new gift to humanity every day. Smart transportation, smart building and recently smart city are some of the prominent examples in this field [1].

The smart city phrase is not a novel idea. In fact, the word may be traced back to the Boller (1998) Smart Growth Movement, which emerged in the late 1990s. Which dictated new policies for urban planners [2]. Portland and Oregon are a comprehensive example of smart growth. Smart City was acquired in late 2005 by some technology companies, such as Cisco and IBM, using sophisticated IT systems to integrate urban services and infrastructure such as construction, transportation, electronics, water distribution, and social security. And was used [3].

Due to the growing popularity and acceptance of smart cities by users, citizens and various governments, there are many cities around the world that are looking to become a smart city and are looking to develop related infrastructure.

The Internet of Things and smart cities are two interrelated words that are heard a lot these days; Because today, companies active in the field of science and technology, in cooperation with telecommunication operators, want to realize the dream of a smart city where all its objects and devices are equipped with the Internet and things can be done very quickly [3-5].

Technology giants and major operators such as Nokia, Huawei, Verizon and Cisco have focused on managing smart cities and have begun to compete closely with each other, with IDC estimating that by 2021 the pioneers will be around 135 billion Dollars will be spent on building smart cities around the world. The process of smartening the world's cities has accelerated in the last one or two years, so that it can be said that many large and important cities in developed countries have already gone half way [6]. In addition, we are facing the phenomenon of intelligence in the military field; In this regard, for the first time in the US invasion of Afghanistan, we saw remote command and control on the battlefield. So progress in this area is such that we are witnessing the formation of robotic wars, and it is necessary to look at this issue. The smart city is made up of different parts that make the Internet of Things one of the most important infrastructures for optimizing process automation functions. In the smart city, we have the optimal use of available resources and automated processes make it easier and increase the quality of life of people.

The smart city and its definitions are closely related to, and not limited to, the concepts of the Internet of Things. With the growing spread of the Internet and its applications in the

Web and applications, with the entry of the Internet into the world of objects, it will be a huge and effective transformation.

With the help of the IoT, in addition to objects, all services can be integrated and connected with the function of several objects, and this will be the beginning of smart cities.

Protocols, infrastructures, sensors and actuators, platforms, data analysis and processing servers and applications, and a set of the most important components of the smart city; Together, these components can manage large cities and speed things up. Smart parking lots, waste management, security, air quality sensors, smart stores, smart irrigation and green space maintenance, smart and smart buildings in hospitals and healthcare in general are parts of a smart city.

1.2 Problem Statement

The concept of "smart cities" has expanded in recent years as a new form of sustainable development and represents an urban model that addresses all alternative approaches to improving the quality and performance of urban services in order to better interact between citizens and government. Modern urban space deals with data, and this has created many challenges and opportunities in this field. New information sources provide opportunities for new programs to increase the modality of the dailylife of persons [7].

Urban data exploration requires a lot of interdisciplinary effort and attracts the interest of research communities in various fields including data mining and learning, energy and environmental sciences, social sciences, optimization, urban planning and transportation.

The smart city can be considered as the invention of new urban areas and changes that lead to the control of physical infrastructure, information and communication technology, information resources and social infrastructure for economic recovery, cohesion, better city management and infrastructure management [8-11].

The concept of the salient features of the smart city is the centrality of the people or the well-being of the citizens. Also, in the smart cities, there are concerns about changes in the lives and jobs of the citizens. Conceptually, the smart city is an interaction between new technologies, new organizations, and new policies that build smart cities as an integrated social and technical system. The concept of smart city has different meanings from the point of view of people than from the point of view of technology. It is clear that when countries take the initial steps to become a smart city, they offer different points of view about the smart city. Although the discussion of the smart city has become popular in the world, its meaning is still important. The smart city is still in a phase without a global consensus. In other words, a common concept for the smart city has not yet been proposed, and it is difficult to provide a universal standard concept.

However, most concepts have overshadowed the common features, features and components that can define the vision of a smart city. Examples include improving the quality of life for a particular segment of the city that uses information technology, hardware, software, networking, and data from different areas of the city and services. It can also include various components of the city including natural resources, infrastructure, electricity, transportation, education, government health and public safety [12-16].

Simultaneous development will facilitate service evaluation and conduct various research experiments, thus facilitating the creation of a smart city environment. Similarly, the Outsmart project focuses on water, electricity, and the environment in cities and addresses the role of the Internet of Things in waste and water management, public lighting, transportation, and environmental monitoring [3,4].

One of the areas of smart city that has received more attention in recent years is smart agriculture and smart greenhouses using IoT technology. Innovative ideas and technological advances help the agricultural industry to increase production and optimize resource allocation. In the late nineteenth and twentieth centuries, we saw a number of mechanical innovations such as tractors and machines.

Today, the Internet of Things (IoT) is used to produce more agricultural products with lower costs and efficient use of resources. IoT can play a role from launching an intelligent and comprehensive solution in agriculture to producing a specific sensor for the market In the next few years, we will see the increasing use of such technologies and other technologies in the field of smart agriculture.

1.3 Objectives

Main goals of study:

1. Study of IoT applications in smart city and smart agriculture.
2. Investigating the use of IoT in smart greenhouses.
3. Investigating the infrastructure required to use the Internet of Things in smart greenhouses.

4. Providing solutions to improve the performance of smart greenhouses based on the Internet of Things.

1.4 Research questions

The most important questions of this research are as follows:

1. What are the applications of the IoT in the smart agriculture?
2. What infrastructure is needed to use the Internet of Things in smart greenhouses?
3. What solutions can be provided to improve the performance of IoT-based smart greenhouses?

1.5 Research structure

In the continuation of this research, in chapter 2, the research literature is discussed, in the chapter, the proposed method is introduced, in chapter 4, the performance of the proposed method is evaluated, and finally in chapter 5, a general summary of the research is made.

Chapter 2

Background and Related Work

2.1 Introduction

Today, with the increase in world population and the need for food supply on the one hand and the lack of water, energy and arable land on the other hand, traditional agriculture no longer meets the food needs of the world population, so smart agriculture has received more attention. The Internet of Things (IoT) is a novel technique. This technique is able to provide many solutions for agricultural modernization. Scientific groups and research institutes are competing to provide more IoT products to agricultural business stakeholders, and ultimately, IoT will play a key role as a core technology. Cloud computing, meanwhile, provide sample resources and solutions for collecting, storing, and analyzing large volumes of data generated by IoT devices. The agricultural is affected using wireless sensor network and is anticipated to utilized from the IoT. In this chapter, we will review recent IoT technologies, their current influence in agriculture, its potential for future farmers, and the challenges facing IoT development.

2.2 Introduction to the Internet of Things

The IoT is a modern technique in which any creature (human, animal, or object) is able to send data through communication networks, whether the Internet or an intranet [17-21]. By considering the many competencies of interactions in IoT system, this concept has been utilized in industry (especially in a variety of manufacturing plants), energy and gas [22-25].

In IoT system, physical things will be linked to the Internet subsequently and will be linked to other things [26, 27]. The Internet of Things is a computing concept used to describe the future in which physical objects connect to the Internet one after the other and interact with other objects [28,29]. The Internet of Things is closely related to the concept of "radio frequency identification" (RFID) as a communication method, but it also includes sensor technologies, wireless technologies, rapid response codes (QR), and so on. The Internet of Things is of particular importance because objects, when they can present themselves digitally, will eventually become a phenomenon far beyond the totality of reality. In such cases, the connection of objects is no longer limited to us, but they also relate to the surrounding objects, the data of a database, and so on. When objects are interconnected, we can speak of an "intelligent environment."

2.3 Smart Agriculture

In the last half century, due to the unbridled development and expansion of metropolises, suburban lands have gradually been transformed from agricultural use into skyscrapers and residential blocks. The economic dimension is also one of the important reasons for the swallowing of these lands around the cities, which automatically leads to the loss of vegetation and gardens around the cities, as well as global warming and pollution, as well as lack of access to fresh and healthy food sources [30].

Due to these reasons and consequently the food security of the citizens should be provided from the sphere of influence with a relatively greater distance. It will be very difficult to provide food for this population without adopting new strategies for producing and distributing food in urban environments.

Most cities in developed or developing countries today also face problems such as municipal waste, water and sewage, air and river water quality, and the creation of suitable job opportunities for citizens. In this regard, the idea of urban agriculture can be presented as a suitable and new solution to deal with this problem in the future of cities [31].

Urban agriculture includes the production of food products including legumes, cereals, vegetables, mushrooms, fruits, etc., as well as the breeding of local and indigenous animals (chickens and roosters, goats and sheep, cattle and fish). In general, it can be said that plants and animal products that are relatively perishable and can be damaged during transportation over a relatively long distance are more important in urban agriculture.

Production of non-food products such as dips and medicinal plants, ornamental plants, tree products, etc. can be recognized as section of agriculture. Urban agriculture is possible in urban areas (houses, protected parks, schoolyards and urban rooftops).

In the economic dimension, it can reduce a large part of the citizens' purchasing and transportation costs by producing food in the houses of the citizens, and also create employment opportunities for the unemployed citizens and cause economic prosperity [31].

From the social dimension, urban agriculture can be a good solution to eliminate poverty and create joyful spaces in the city to create happiness and mental health of citizens. In the environmental dimension of urban agriculture due to the reuse of municipal waste and sewage to reduce urban pollution and also by expanding urban green space to reduce air pollution in cities. person prefer to sip and smell new vegetables and fruitage. The benefits of urban agriculture are enormous and can be applied to almost any climate around the world. Whether you live in a developing country or in a developed country, encouraging residents to produce healthy food is a program that can bring long-term benefits such as providing food, income and employment, improving the quality of the environment. Reduce pollution and improve urban green space for smart cities of the future [32].

In intelligent agriculture and animal husbandry, many of the tasks that are performed today by (or with the intervention of) a human agent will be performed automatically. For example, tracking animals and monitoring their health status using connected gadgets, soil fertility status is monitored by sensors, agricultural machines at the right time and automatically harvest crops and irrigate farms intelligently and It is done according to the needs of the soil. Many technologies are used to achieve the above, such as robotics, image processing, big data and artificial intelligence. Smartening the agricultural and livestock industry has many benefits, including irrigation management, loss reduction, immediate and accurate information on the state of the environment, helping to increase the accuracy and precision of decisions and monitoring of agricultural and livestock products from production to supply. Receiving analytical reports at any time and place is another feature of smart agriculture and animal husbandry.

It is clear that urban intelligence as a revolution will take over all cities in the world, and solutions based on new technologies will be used to manage cities. These solutions are planned for the purpose of a better and easier life for citizens. In recent years, the urban agricultural industry has seen an increase in demand for nutrient production, which is why investment in Agri Food Tech reached more than $ 10 billion in 2017. However, urban agriculture may be eliminated from smart cities despite its current capabilities.

With the introduction of IoT technology to the world, it can be said that many professions have been affected by it. Of course, both positively and negatively! The positive side was for those who quickly adapted to the technology and tried to use it to improve their business. Of course, this synchronization also had some problems for them, but in the end it caused them a huge benefit. The downside is for those who did not have enough justification to use this technology and therefore could not take advantage of it. In this case, it can be said that they lost the arena to their rivals! But in this section, we want to examine the impact of IoT technology on agriculture and the emergence of smart agriculture.

Traditional versus modern agriculture: You must know that agriculture is one of the most difficult jobs in the world because to be productive, you need to have enough patience and accuracy over time. Over time, this has prevented the younger generation from entering the profession, and the average age of farmers has increased. Over time, devices were invented that made it much easier for the farmer to do things. For example, devices such as milking machines, unmanned tractors, etc. are among the things that greatly improved agriculture. But this is not the end of the story, because there are still cases that the farmer has to spend a lot of money and time to consider. So it's time to find better and newer ways to solve the problem.

The difference between modern agriculture and smart agriculture: In the previous section, we stated that intelligent agriculture was created using new devices. But other than that, aren't these devices the same as smart devices!? In the case of modern agriculture, we only provided the device with tools that made it easier to do a series of tasks. But did these devices have sensors?! Were these devices capable of collecting data and sending it to servers for analysis!? Yes, the answer is no. So here we can recognize the disagreement between these kind of agriculture. In intelligent agriculture, the goal is to use devices that are composed of different sensors. Using these sensors, these devices are able to collect a series of data and send them to the server for analysis. After analysis, the necessary command for proper operation will be sent. Therefore, using this smart technology, the farmer only needs to know how to use these devices.

Smart agriculture: In intelligent agriculture, various sensors are used to have the best efficiency, which can be mentioned as an example:

Soil Intelligent Sensor: Using these sensors, factors such as humidity, soil temperature and can be measured.

Smart air sensor: These sensors are used to measure temperature, forecast weather conditions and etc,.

Intelligent water sensor: As you know, the pH of water has a direct impact on plant health.

Using the above 3 items, it is easy to create an intelligent farming system that has unique benefits. Of course, to complete this system, additional sensors can be used, these are the basic sensors of this system. After this data is collected by the mentioned sensors, it is sent to the cloud, where using the processor devices, the appropriate command is announced. Note, however, that this data can be updated in 5 to 15 minutes, thus keeping up with external conditions.

Chapter 3

Proposed Method

3.1 Introduction

In order to achieve optimal production of products and higher efficiency, we need scientific knowledge of agricultural lands. Therefore, in order to identify and solve the existing problems in the agricultural sector and optimal production, combining information and using appropriate management methods is an effective and acceptable solution.

In this regard, in order to create sustainable, low-input and high-yield agriculture, a new approach has been introduced called precision agriculture or location-appropriate management. This study aims to investigate the impact of the Internet of Things on increasing the quality of agricultural greenhouse products. Accordingly, in this research, the library method has been used to collect information and use the best scientific books and educational articles in the field of Internet of Things in the field of intelligent agriculture.

The results of studies in this field indicated that product quality, production efficiency, resource management and cost savings are just some of the benefits of using the Internet of Things in agriculture. The use of this technology will transform agriculture and food production in the near future. In this regard, IoT applications in the field of agriculture have been very effective and efficient. Therefore, it is suggested that introductory and advanced trainings to empower the employees of information and communication technology companies active in the field of IoT, using various capabilities such as face-to-face and virtual training and culture building, so that IoT users can benefit from Be informed of intelligent detoxification.

In recent decades, many fruitage related to a particular season have been sold in the market, but these fruitage have ripe in traditional agriculture greenhouses, and renovation these productions, need to lot of changes. Modifying agricultural products in small greenhouses is relatively easy and can be implemented. The IoT concept uses network in agriculture productions. These machines link using wireless devices. The system is generated with web technique and is integrated in the form of a network to long-distance eexamine the data generated by the network. This study presents an IoT-based model using sensor networks. This system includes sensor networks and a software control system. The sensor network includes the main control center and many sensors that do not use zigzag protocols. The firmware communicates with a hardware network using a basic interface and then connects to a web system using a higher interface. The above web system provides the user with an interface for reviewing and managing hardware features; Managers can monitor the condition of agricultural greenhouses and issue instructions through the system to remotely manage temperature, humidity and irrigation in greenhouses.

The main aim of this thesis are:

1. Review of the current development of new technologies applicable in the field of agriculture and a summary of the strengths of IoT applications in the country and abroad; Also provide new methods in the management of agricultural greenhouses.

2. Examining the requirements of the IoT-based model also examines user expectances of this model.

3. Use software engineering to ensure the performance of system modules , establish requirements with high coherence and low communication between modules, as well as accurate design and implementation of each module.

Some examples of IoT applications in agriculture:

1. Soil check using the Cropx system: Cropx productions and its models that evaluate soil humidity, temperature and electrical conduction. This model warns farmers how much they need irrigation.

2. Wireless-based system checking using TempuTech: TempuTech helps farmers protect their crops. The use of these sensors to deal with hazards is of particular value. Using GE equipment, TempuTech provides a way to connect to wireless sensors and help farmers collect data from silo and grain elevators.

3. CLAAS smart equipment: CLAAS is most important producer of engineering tools is agriculture. Farmers can start CLAAS equipment on autopilot and use it to improve crop flow, minimize losses, and automate the equipment process.

4. Precision Hawk information management platform: Precision Hawk has developed a standalone UAV that collects high quality data through a set of sensors used to map and image farmland. Before sending the drains into the air, farmers determine what part of the field to inspect and adjust its accuracy or height.

3.2 Subject research and development background

Currently, the management of homemade greenhouses generally utilizes a customary method of hand worked management, based on the expertise of periodic and manual adjustment of light, temperature, moisture. This system not only increases management expense, but also poses a set of difficulty such as low generation, performance, damages of equipment and pollution.

Over time, the overall structure and process of a greenhouse has not changed, and a greenhouse has always maintained its products with the passage of cold and hot seasons, wind and rain, and has regulated the constant temperature required by plants.

The development of the Internet of Things has also made it possible in the field of smart greenhouse equipment with the help of IoT map; So that in a smart greenhouse, all factors of temperature, humidity, air conditioning, the amount of different gases and plant requirements and dozens of other items are examined at the same time and its control is applied and even remotely. It is possible. Among the advantages, it should be noted that in order to control our greenhouse in traditional ways, we must be present on site and examine and analyze all the factors one by one. At present, the cost of running a smart greenhouse is very reasonable and justifiable.

Smart greenhouses are equipped with modern sensors and communication technologies that automatically record the information about the environment and crops, all the time and without interruption. The collected data is sent to the IoT platform, where analytics algorithms turn it into practical intelligence to report abnormalities.

Accordingly, HVAC (heating, ventilation and air conditioning) and lighting operations, in addition to irrigation and spraying activities, can be regulated and carried out during a specific schedule and time.

Continuous data monitoring can help manufacturers anticipate some issues including; Crop diseases and pests help.

By receiving a wide range of product information from smart greenhouses, manufacturers can improve resource efficiency and the use of chemicals in addition to reducing human operations.

IoT-based smart greenhouse has four major advantages:

1. Maintaining ideal microclimate conditions: IoT sensors allow farmers to collect a variety of data from their farms. They provide real-time information on the most important climatic factors, including; Provide temperature, humidity, light position and carbon dioxide in the greenhouse. To provide this information, all HVAC and lighting settings must be sent to the platform immediately in order to maintain the best conditions for plant growth while consuming energy. In parallel, accelerometer and motion sensors help identify data from all parts of the farm.

2. Improving irrigation and fertilizing methods: In addition to environmental parameters, smart greenhouses help farmers maintain their crops in the best condition. This feature in the smart greenhouse ensures that irrigation and fertilization activities are performed exactly equal to the actual needs of the cultivated plants, in order to save water consumption. for example; From the information received regarding the volume of water, you can find out whether the crops are under water pressure or not. It is also worth noting that measuring soil salinity can provide useful information about fertilizer crop requirements. According to stored data, sprinkler and sprayer systems can be turned on automatically when plants need them.

3. Controlling pests and preventing the spread of disease: Throughout history, pest control of crops has been one of the challenges of agriculture and every outbreak of disease on farms has serious consequences. Agrochemical treatments can help, but most farmers do not know the best time to use them. Pesticide programs often involve environmental concerns, safety, and additional costs, while failure to use the proposed solutions can lead to the spread of harmful diseases. With the help of a machine learning platform, by storing data on greenhouse environment, external climate and soil characteristics, you can get valuable information about the dangers of pests and fungi. Using this information, farmers can ensure the health of crops when needed by applying treatment methods with minimal use of chemicals.

4. Prevent theft and improve security: Greenhouses with valuable agricultural products are one of the vulnerable targets of thieves. Because the implementation of traditional surveillance networks using CCTV is expensive, many manufacturers do not have an efficient security system. In this regard, IoT sensors in smart greenhouses provide a cost-effective infrastructure for monitoring farm conditions and tracking suspicious activity. With the help of an automated alert system, IoT sensors immediately notify manufacturers that a security issue has occurred.

At present, many companies already produce the hardware equipment needed by the Internet of Things, such as sensors with communication module and control equipment with the ability to self-network. Therefore, the main problem using the Internet of Things is the design and realization of the overall system.

3.3 How to build a smart greenhouse

In a greenhouse, by creating a controlled space and away from outdoor weather conditions, it is possible to create an environment with the desired temperature, humidity, light and suitable for any plant. But controlling the condition of greenhouses is so important that intelligent agriculture has come to the aid of smart greenhouses by using IoT equipment to control everything with the least effort. A smart greenhouse is a greenhouse whose entire parameters are managed under a comprehensive system. In smart greenhouses, temperature, humidity, light, oxygen, carbon dioxide, pH and other parameters are measured by special sensors and by processing the information, the result is applied to the actuators based on the appropriate scenario to create optimal conditions.

By transferring information and greenhouse parameters to the cloud, in addition to storing data, they can be analyzed and the results applied for better performance. Data processing on the cloud (cloud computing) is much more accurate, cheaper, more powerful and more flexible. For example, local processing of the parameters of a greenhouse by artificial intelligence is expensive and not economical, but by transferring information to the cloud, this can be done easily and at a much lower cost. Also, this processing with the latest achievements and up-to-date software, without change Hardware available.

Intelligent components under a comprehensive system, create an intelligent set. In a smart greenhouse also intelligent irrigation, intelligent fertilization, intelligent light control, intelligent humidity control, etc. as intelligent elements with a single intelligent management make up the greenhouse. Change in pattern Each of these components is created by considering other elements and the effect of this change on these elements, and the optimal state is always implemented by understanding all the conditions.

Another advantage of using IoT in agriculture is storing information and also sharing it. There is also this issue in using IoT in smart greenhouse. In addition to the possibility of archiving data in the cloud, it also has the ability to share records for periodic comparisons. When the data is at the local, regional, national and even global levels, this information can be used for macro-level decisions and the possibility of damage can be quickly identified so that it can be prevented.

One of the main features provided by the Internet of Things is the possibility of having a dashboard to display information simultaneously (Real-time) as well as access to previous data on which the ability to display the output of the analysis is possible and can be used with the dashboard tool. Apply the necessary controls and decisions from the results. There are several key factors to consider to have a smart greenhouse:

- Battery-based low-consumption sensors to record various points of climate, agricultural and security data
- Reliable and cost-effective wireless connection for remote connection
- Disease Diagnosis, a machine learning platform for identifying sensor data and displaying it in user interfaces to make informed decisions about agricultural activities. You can also integrate this platform directly into greenhouse gas control systems to perform automated actions on HVAC systems, lighting, sprinklers and sprayers.

Greenhouse complexes in commercial areas of large geographical areas require long-distance wireless communications with strong penetration. In addition to reliable data transfer, this solution allows you to reduce the interface wire as you approach the power source. Most importantly, the connection must be very efficient so that the sensors can work together efficiently for years with minimal maintenance. Given the market value, it is predicted that more than 1 billion US dollars by 2024, smart greenhouses will undoubtedly become one of the most popular agricultural trends. A smart greenhouse brings together traditional farming systems and new Internet of Things technologies to visualize and fully automate farming.

The smart greenhouse can end all the agricultural problems that have been discussed throughout history and bring about the protection of crops as well as the efficient harvesting of crops.

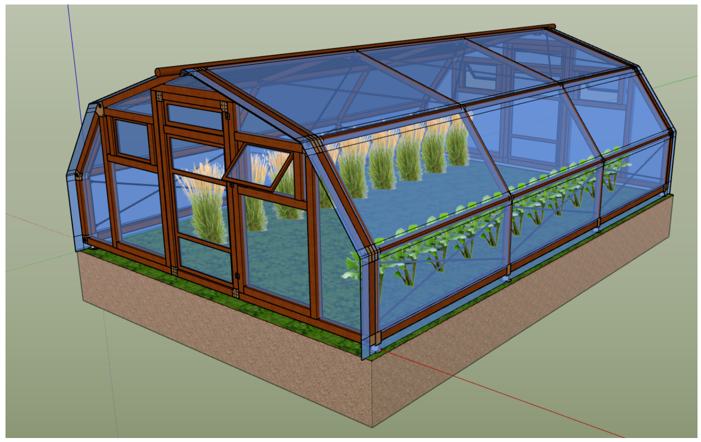


Figure 1: Green house

as you can see in figure 1 in order to having a smart green house, first we need to have simple greenhouse. Then we can add IoT technologies and devices so it can be connected to cloud computing systems.

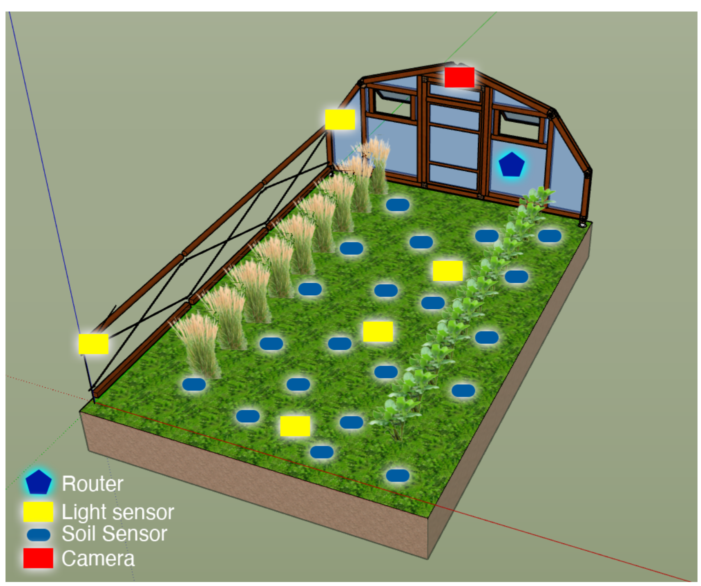


Figure 2: Green house

in figure 2 you can see that we have 4 types of devices that we wanted to have in our methodology and they are consist of Router, Light sensor, soil sensor and camera. soil and light sensor will send their data to the cloud via router available in the smart green house. camera will send its data to the surveillance system which is also available in the cloud via the router.

3.4 Overall System Design

The main components of the proposed model are examined from the aspects of network and equipment. The overall structure of the proposed greenhouse model should have access to both a wireless network and an Internet cable network. The proposed model is also reviewed and controlled by hardware and software equipment.

Designing of system construction The construction of the proposed model, including the Zigbee wireless construction network, serial port transducer, server, is examined. The details of each section is as bellows:

1) Zigbee Wireless connection subsection: In the proposed model, the hardware executes the final commands. In this method, wired communication and its combination with wireless communication will be used.

2) Series of network interface conversion settings: The proposed model usually uses the Zigbee protocol to establish a connection between the equipment and the base station. In this model, the data is very simple and limited and it will not be possible to send complex data. In addition to the data, the devices used are usually simple in this model to simplify and improve performance and reduce the computational complexity. This simplifies data management and network communication.

3) Server: Since the system control interface is web-based, a personal computer can be considered as a web server. This web server must send data from the desired nodes to the destination. Database server, web server, middleware on the computer, the computer is connected to the router via a network cable, and the network port transducer is linked to the router with a cable, the router interface can connect several network cameras immediately. One end of the transducer is linked to the basic machine, the serial port, and the other end to the Zigbee network. After completing the structure in the host system, the middleware program should be run and then checked through the establishment and implementation of the web server, server network and middleware connection. If the system is installed correctly, these settings can be used for future submissions. The general components of the proposed model are shown in Figure 3.

as its shown in figure 3 we have 2 green houses that both are identical. each one of them are consists of soil sensors that are named here as sensor which we have three of them and also we have irrigation control which also we have three of them. each green house need lighting control devices that its included in these green houses too and at last we have camera to monitor the progress. all these devices will send their data to the their primary device and it will send them to the sink which is located on middle of the field.

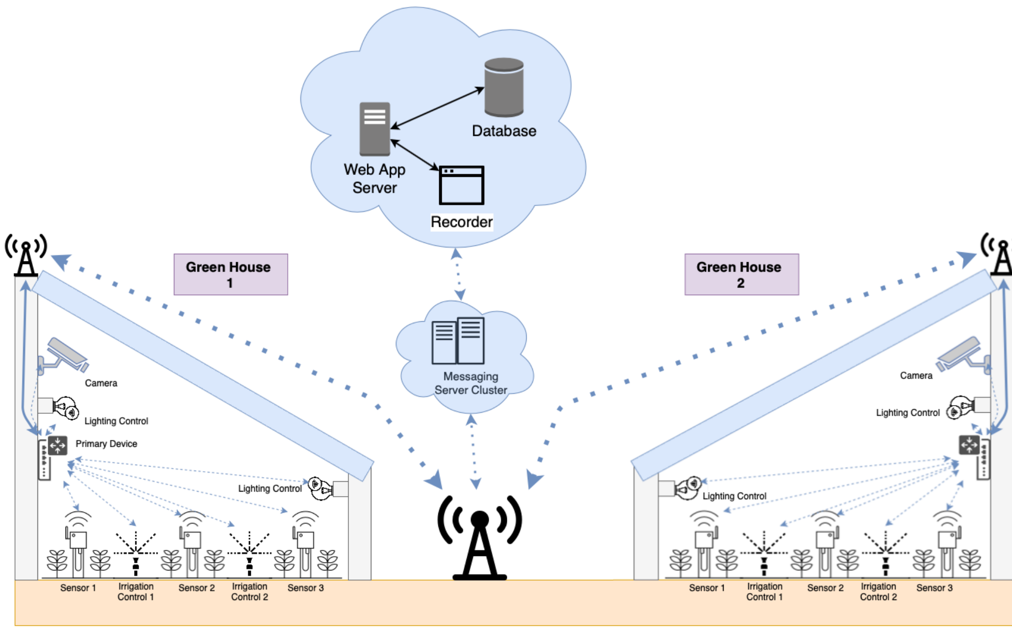


Figure 3: System architecture diagram

3.5 Functional module Design

The proposed model can be considered as several subsets. The components of the proposed model subsystems can be defined as follows:

1) User handling subsystem

The user handling subsystem is autonomous of the all system; the system should certify a successful connectivity Web database model in the execution.

2) Hardware node handling subsystem:

This subsystem is generally defined using the host system issued a command, the basic tool for the sensor and control machine's current status is collected and sent to the host device, and the Web Program to show to the user.

3) System control subsystem:

The basic handling subsystem is the handle center of the all system. This subsystem is generally responsible for indicating the current state of the original model, such as the temperature, moisture, light, etc.

4) Network settings subsystem:

This subsystem is uncomplicated, the Web server show the related page, then input by the user Web server and middleware IP and port, using this subsystem in the performance is uncomplicated but can set up the right IP address so that the normal work of the all model, therefore, this subsystem must be humanized plan as much as feasible, to operate the user whether to set the network correctly.

5) Monitor module:

A webcam can be installed in each greenhouse unit to manage the greenhouse. In general, the monitor and control network is directly linked to the basic system path, which can be autonomous of the hardware model.

6) Weather module:

Climate forecasting is crucial to improving agricultural performance, and many techniques for predicting climate change are now being developed. The proposed model uses the meteorological observatory background to forecast the weather through the server due to software engineering guidance's, each subsystem must be autonomous of each other, the performance of each subsystem to get a unit, cannot enlarge and fill the subsystem. Of course, entirely autonomous of the subsystem in the various subsystems still do not need to communicate, then you can make the design of the external interface subsystem more compact, changing this subsystem will not change other linked subsystems. The proposed

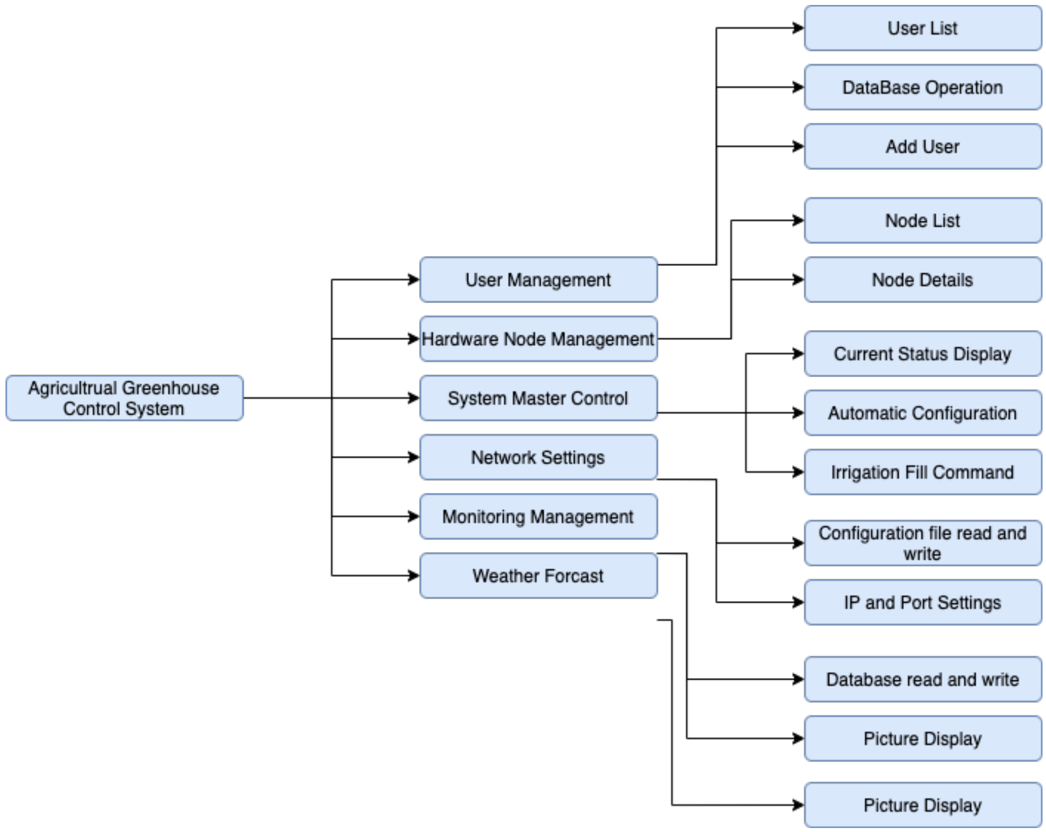


Figure 4: System block diagram

model diagram is shown in Figure 4.

Chapter 4

Experimental Results

4.1 Introduction

In this section, we use the proposed method to provide the Smart greenhouse platform in the smart city using the Internet of Things and cloud computing. First, we describe the desired scenario for the smart city greenhouse. In this scenario, it is assumed that the headers node are determined based on the proposed method and the sync is fixed. Clustering is done centrally in Sink. In fact, at predetermined time intervals, all live nodes send their position and identification number to Sink, and Sink, if the number of live nodes has changed from the previous round, the proposed algorithm for Executes routing. The proposed method obtains the new location of the headers in 2D space, and Sink announces the new position of the headers. It also notifies all nodes of the header identification number associated with them.

4.2 Simulation environment

The objective function in the proposed method is to minimize the sum of the internal distances of the nodes from their headers. In this scenario, the closer the nodes are to their head, the less energy they use to send packets to them. In this scenario, it is assumed that the position of the sink in each round is determined based on the position of the headers. In fact, its position is equal to the center of gravity of the headboards so that they can give information to the sink with less radio range and consume less energy. Sink is a node with high computing power that can perform complex optimization algorithms. The intra-cluster communication between the nodes in a cluster and the cluster head of that cluster is done one-step.

It can be said that the energy consumption of the second power is the distance between two nodes. Therefore, when sending information, the distance between the sender and receiver will have a great impact on energy consumption. Since all information is sent to the Sink after being collected from the environment, the location of the Sink as well as the way the information is delivered to it is very important. The experiments were performed using MATLAB software. For simulation, this software is used and it is assumed that the proposed method is executed in the sink using MATLAB. In fact, a sink can be a laptop that, after receiving network information, executes the proposed algorithm and applies the information obtained from MATLAB to the network. The two-dimensional network environment and its dimensions are 50×50, 100×100 and 200×200. The number of nodes and threads can vary and the sink will be unique. The initial energy of each node is 1500 joules and the energy of the sink and the threads is considered very high. The radius of view of each node is 50 meters and the radius of view of CHs is 150. The number of packets sent is irregular, but each node must eventually send one packet every 10 seconds. Each round is assumed to be 10 seconds.

4.3 Experimental results

Table 1 shows the obtained results to improve data transition in the smart greenhouse using the Internet of Things and cloud computing and using the proposed method in the mode of the Internet of Things with a size of 50 × 50 with the initial 100 nodes:

Table 1: Node death time in 50*50 network size with 100 network distance

Network Size (m)	Nodes	First Node Died(round)	Half of Node Died(round)	Last Node Died(round)
50x50	100	47	2027	3315

Figures 5, 6 and 3-4 show the results of node clustering in the smart greenhouse based on the Internet of Things, the number of nodes remaining, respectively, in the network with 100 nodes and size 50 x 50.

Following figures are for other experiments that we have done with network size of 50x50 , 100x100 and 200x200 with number nodes of 100 and 200.

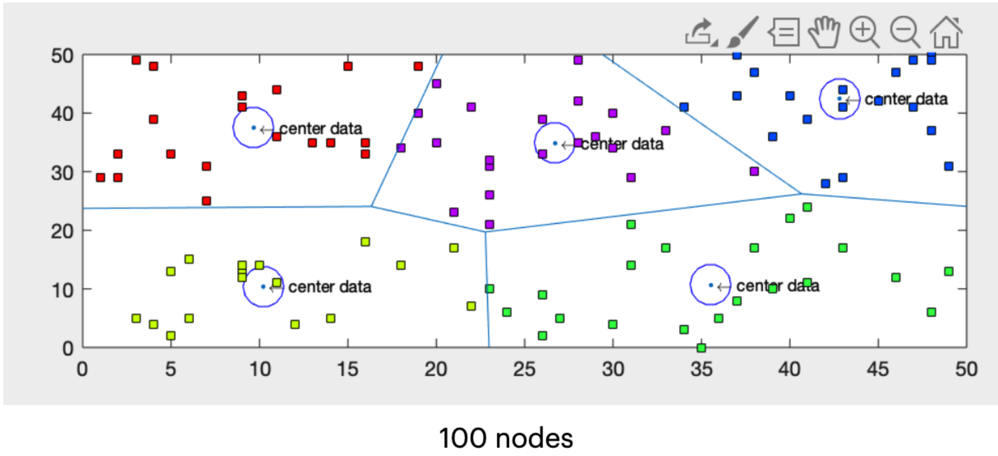


Figure 5: Sensor network clustering in 50*50 network with 100 nodes

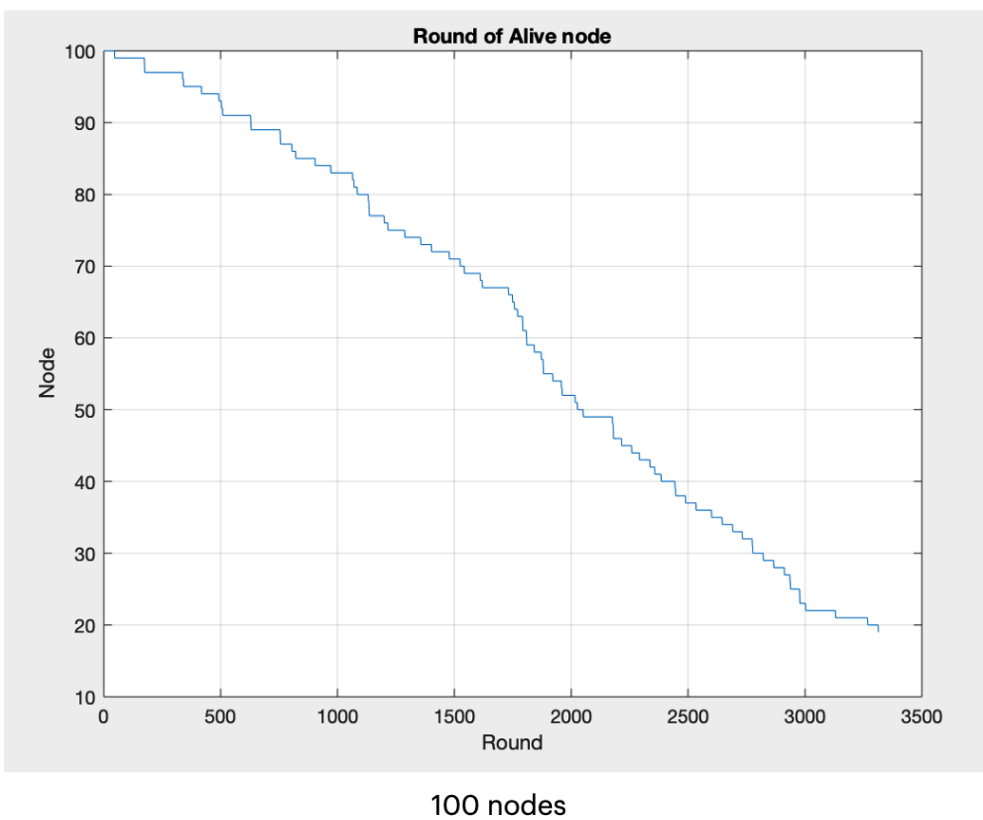


Figure 6: Rate of death time for sensors in 50*50 network with 100 nodes

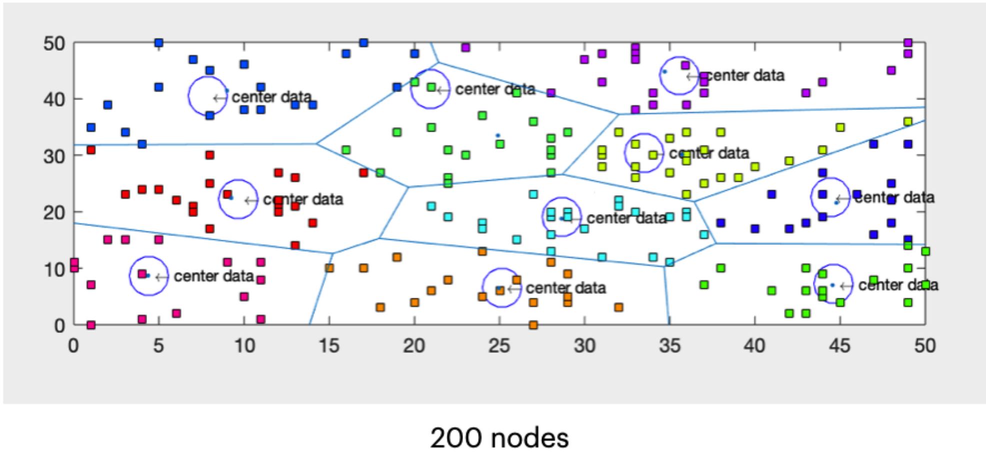


Figure 7: Sensor network clustering in 50*50 network with 200 nodes

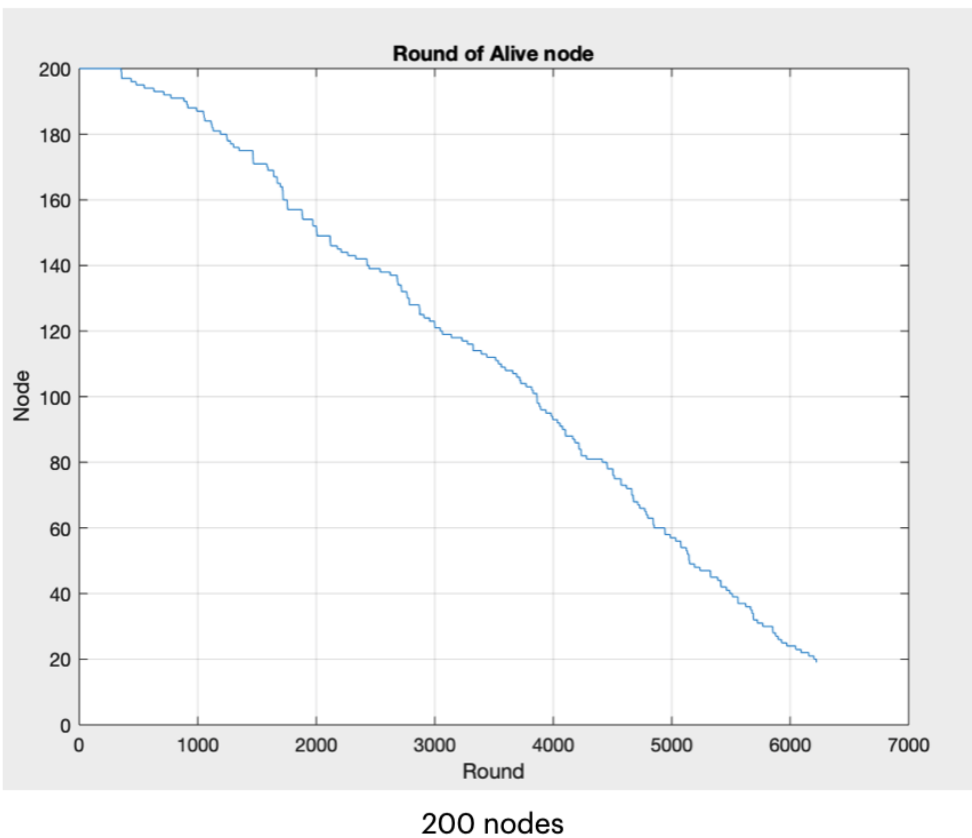


Figure 8: Rate of death time for sensors in 50*50 network with 200 nodes

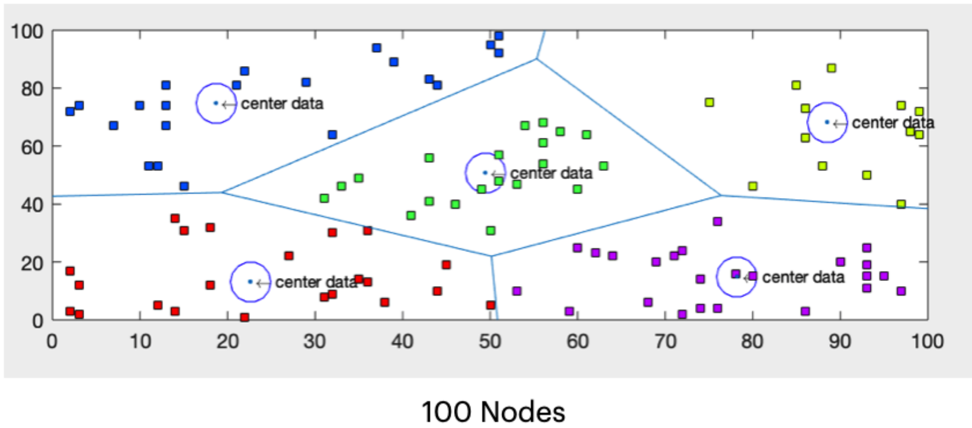


Figure 9: Sensor network clustering in 100*100 network with 100 nodes

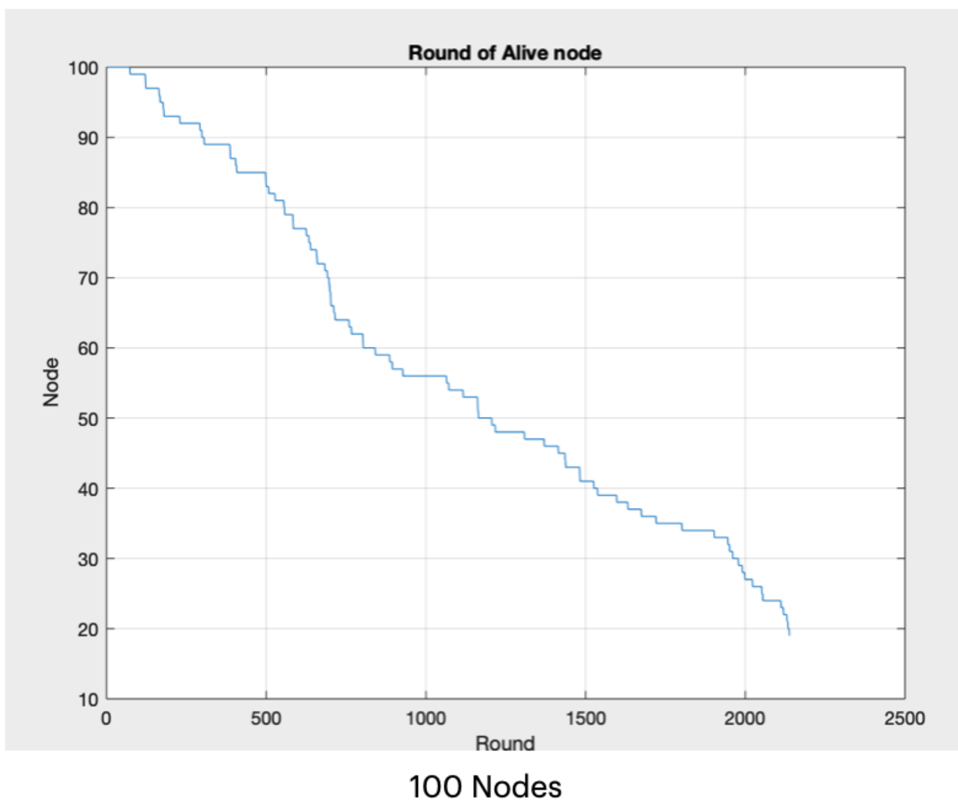


Figure 10: Rate of death time for sensors in 100*100 network with 100 nodes

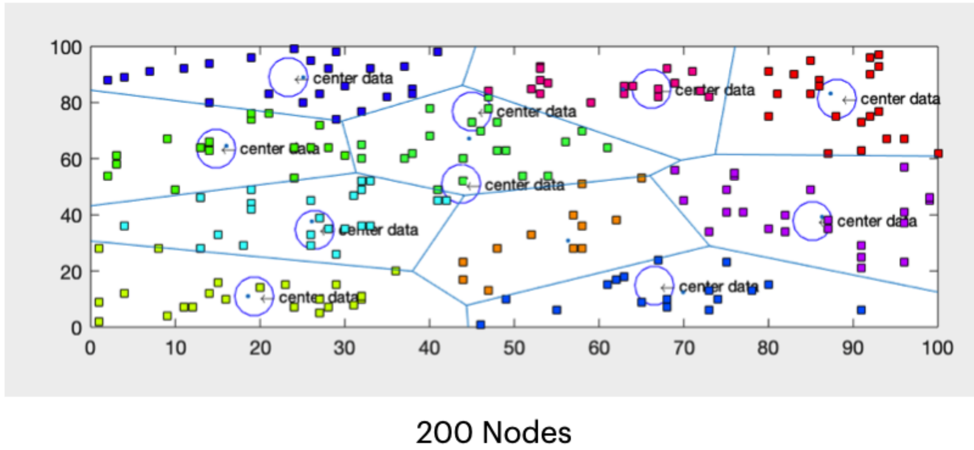


Figure 11: Sensor network clustering in 100*100 network with 200 nodes

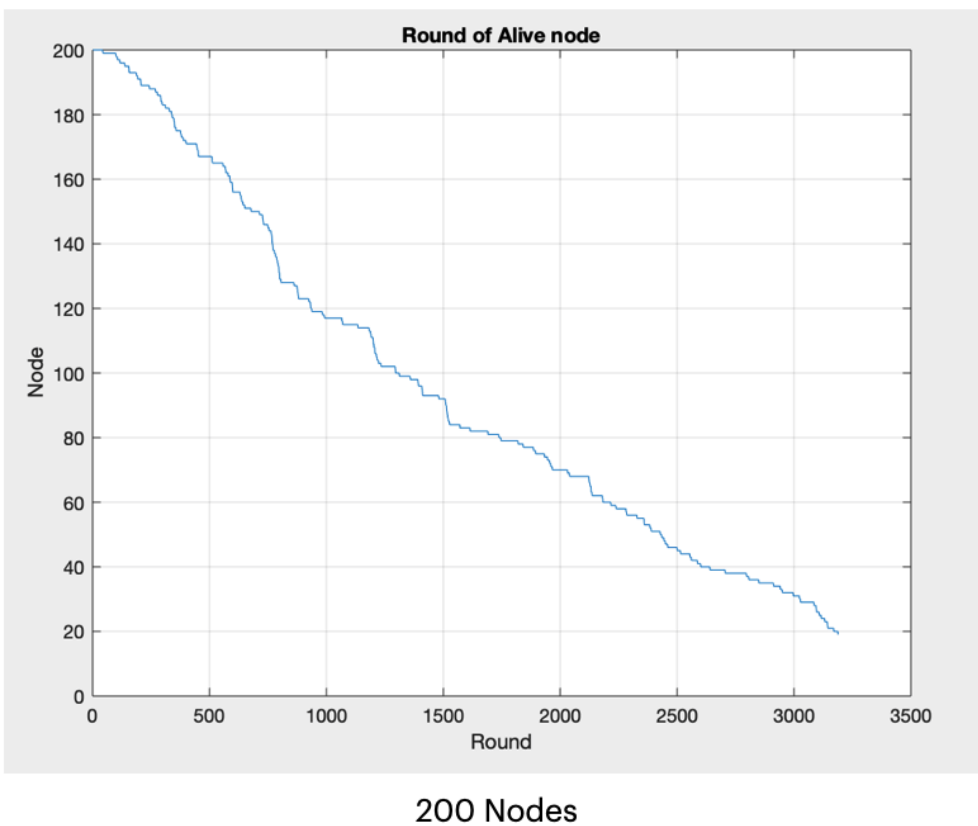


Figure 12: Rate of death time for sensors in 100*100 network with 200 nodes

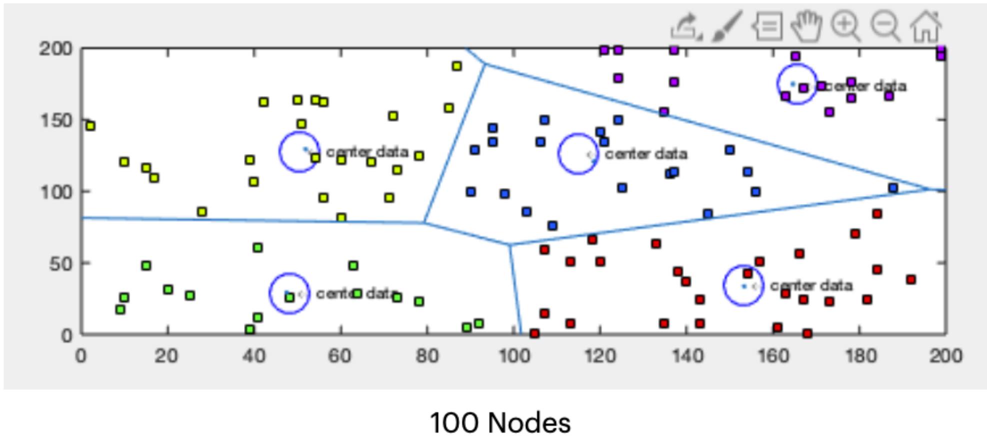


Figure 13: Sensor network clustering in 200*200 network with 100 nodes

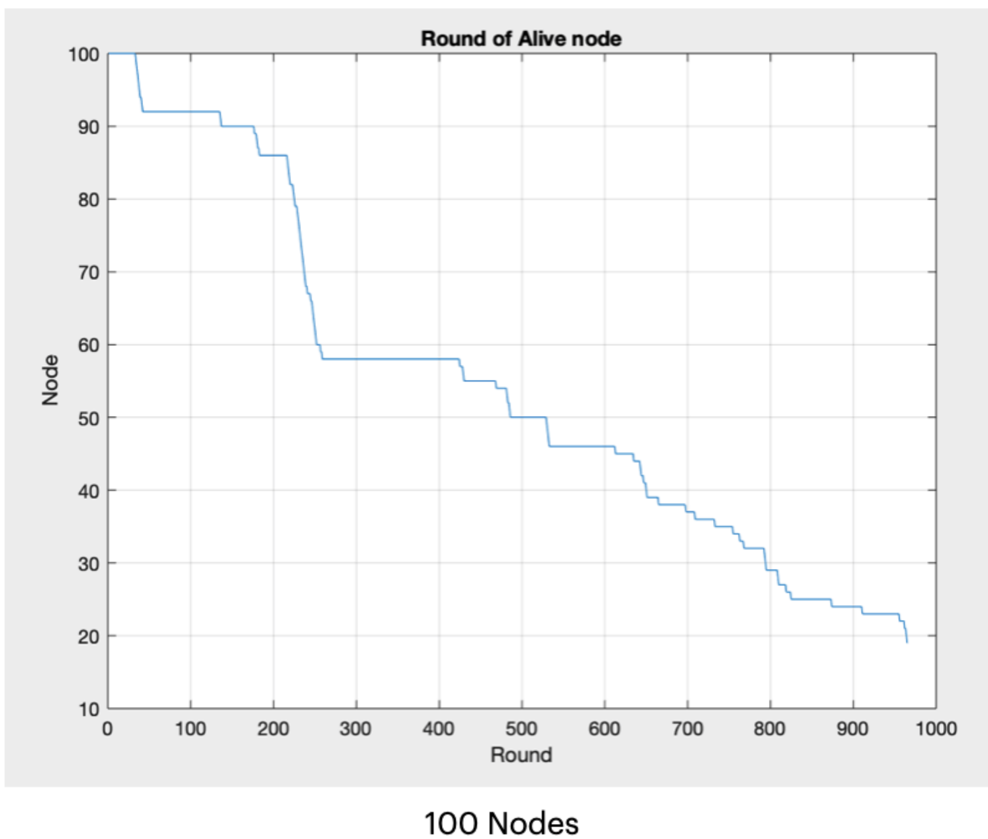
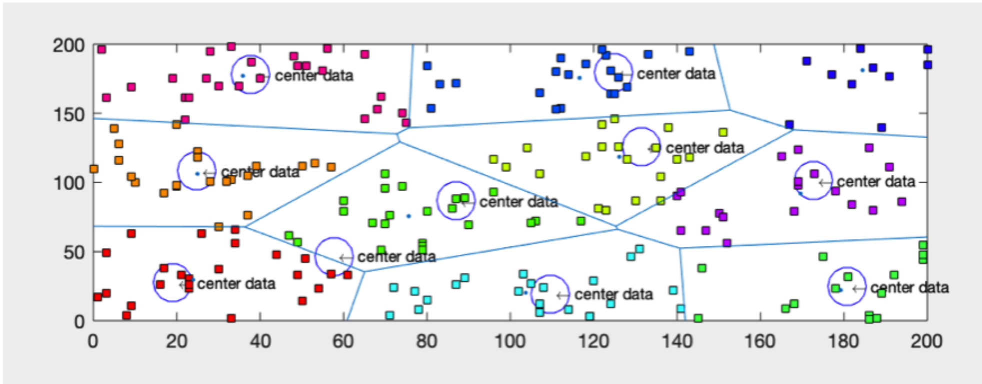
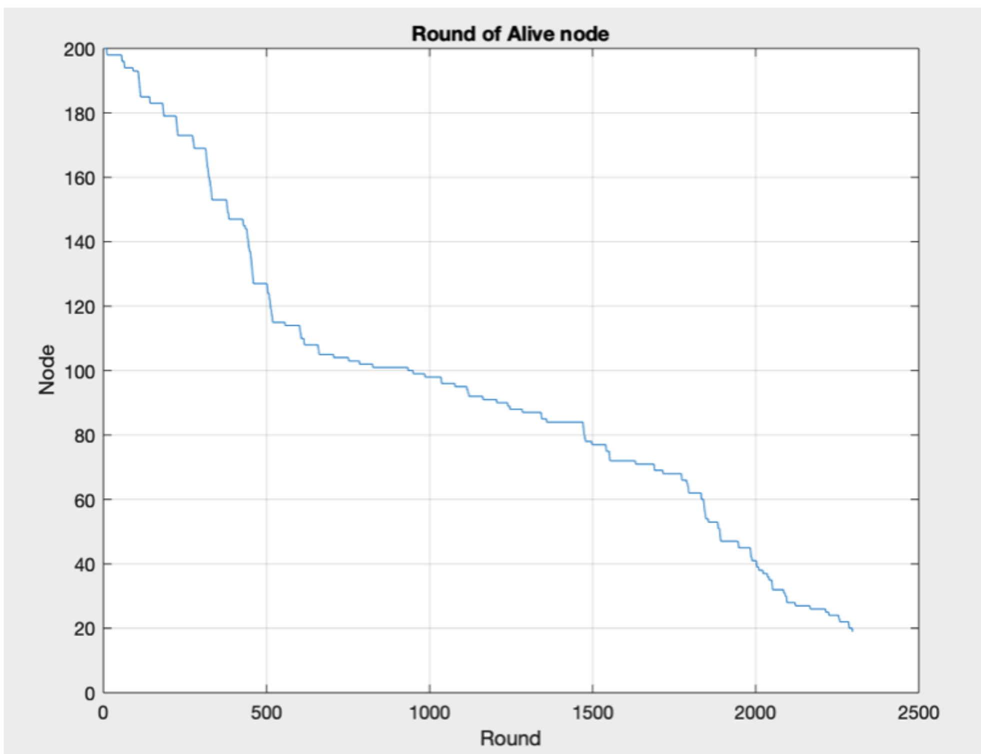


Figure 14: Rate of death time for sensors in 200*200 network with 100 nodes



200 Nodes

Figure 15: Sensor network clustering in 200*200 network with 200 nodes



200 Nodes

Figure 16: Rate of death time for sensors in 200*200 network with 200 nodes

4.4 Results

Our hypothesis was that if nodes are closer together they will need less energy to consume to send data to the cloud. in the table 2 we are showing the results of running the simulation for the various conditions that we mentioned in last figures.

Table 2: Result of Node death time in different network size with 100 and 200 nodes

Network Size (m)	Nodes	First Node Died(round)	Half of Node Died(round)	Last Node Died(round)
50x50	100	47	2027	3315
50x50	200	354	3862	6223
100x100	100	74	1165	2139
100x100	200	44	1296	3189
200x200	100	34	486	996
200x200	200	10	934	2298

as its shown in table 2 when ever the density of the nodes are increasing the nodes will last longer and it is shown that they are using less energy to transmit the data. in simulation with network size of 50x50 with number of nodes of 200 which they have more density in the filed, the nodes will last longer. each number for the First Node Died (FND) , Half of Node Died (HND) and Last Node Died (LND) are measured by rounds which each one of them are count as 10 seconds. As it shown in 50x50 field with 200 nodes available the last node died in round 6223 which is 17.2 hours to die. but for the field of 200x200 and 100 nodes it just took 996 round which is 2.7 hours to died. which is proof the hypothesis that we had.

Chapter 5

Conclusion

5.1 Overview

Today, the world's metropolises are all moving towards intelligence. A smart city is also a city where technology is integrated into the daily lives of its citizens and the level of well-being is enhanced by technological facilities. In this regard, the demand for technology facilities based on the Internet of Things is increasing. These include wearable gadgets, IoT-based services, smart cars, smart homes, and even one-of-a-kind smart gadgets.

One of the most advantageous applications of these facilities is their use for intelligent management of natural resources such as water, soil and plants. Smart greenhouses are among the facilities that have been created for this purpose. Intelligent greenhouses have been created in line with a need and demand. In general, all of us in our homes or those around us have encountered the question that they have bought or received a plant, do not know the conditions for its use, or that they do not have time to care for it, or are worried about taking care of their plant while traveling.

In addition, another problem that exists especially in today's crowded and crowded lives is the lack of sufficient light inside all parts of the building or places of interest; Therefore, it is not possible to keep the plant in these places. All these problems have led to various solutions such as the use of smart pots that irrigate the pot at the time specified by the user; However, in this model of pots, the problem of light is not solved or any type of plant can not be kept in the building because in addition to a special water regime, they also need a special light regime or moisture regime, which is sometimes different from the existing conditions of the building. Also, some users, for various reasons, such as interest in using organic plants, face the problem of lack of space and time to grow plants in their buildings, or places such as restaurants and hypermarkets that are interested in using fresh plant products but The reason for the distance from shopping malls or the long distance between the land and the store are not able to meet this need. All these problems and needs have led to the creation of a solution called smart home greenhouse, which while solving the problem of lack of space, lack of light, lack of awareness of environmental needs of the plant, the need to use organic and fresh products, can be a variety of decorative and edible plants and did not worry about meeting its water and environmental needs. In general, by using smart apartment greenhouses as a decorative element in interior design, exceptional changes can be made and the interior space can be deepened. In fact, natural elements are among the effective factors in absorbing harmful ambient sounds and transmitting a sense of freshness and life. For example, the use of these greenhouses in large environments such as building lobbies visually divides the space into smaller sections that eliminate the unpleasant feeling of being in these spaces.

All intelligent equipment in smart greenhouse systems can be connected to wireless internet. But they can connect to each other through the Internet of Things, collecting and transmitting environmental information to each other. The Internet of Things enables smart devices to work in sync with each other. For example, imagine that the temperature inside the greenhouse is higher than the allowable limit. Under these conditions, the intelligent thermostat detects the unfavorable temperature situation and turns on the ventilation system, the intelligent shade system prevents excessive sunlight into the greenhouse, and the intelligent irrigation system according to the amount of evaporation done at this temperature.

Either starts watering or stops it. All this is done at once so that the greenhouse atmosphere returns to normal as soon as possible and the plants are not harmed in the slightest. In ordinary greenhouses, there is a possibility of human error, but in smart greenhouses, most of the work is done by sensors and machine systems, and the error rate is very close to zero. With greenhouse intelligence, most work is done automatically and requires less of your presence and intervention. Therefore, you can develop your own greenhouse or increase the number of greenhouses in different places. The term IoT refers to the fact that various objects, machines and equipment can be connected to each other via the Internet and their actions are organized and controlled by a computer.

In this modern technology, the equipment does not require human control and is controlled by a central computer. By using the Internet of Things in agriculture, the efficiency of greenhouses and agricultural lands can be increased and the amount of damaged crops and waste can be reduced. All sensors, software, machines, and cameras monitor environmental conditions, and the central computer decides when and how much to irrigate, when to aerate, and what type of fertilizer to use.

In this dissertation, a new model for IoT-based smart greenhouse was presented. The main components of the proposed model are examined from the aspects of network and equipment. The overall structure of the proposed greenhouse model should have access to both a wireless network and an Internet cable network. The proposed model is also reviewed and controlled by hardware and software equipment.

5.2 Contribution

Our contribution is the methodology that we proposed to have green house infrastructure to collect data and send the data to the server in the cloud. with study of the different sensors and architecture of the implement and deploying the in the farm Fields that they can work together. also we propose a a hypothesis about the distance and density of the number of nodes that they can consume their energy in order to transmit data more efficiently and we proved it in the simulation mention in the simualtion section.

5.3 Future Works

Though, management has some exploration of smart IOT-based greenhouse, there are still many shortcomings to be considered, the elimination of these shortcomings is useful to precise propagation model:

1. The greenhouse for empirical model of smaller, limited number of sensors, Zigbee networks simpler, which must be modified in the region of large greenhouse, which will gain the complexity of the model, which is the follow-up to eliminate issues.

2. Smart greenhouse management models can now do temperature and humidity automatic control, but still need human intervention such as fertilizing, weeding, automation still needs to be modified.

3. Systematic security mechanisms need to be further corroborated, in a small region when utilizing the model security problems may not be outstanding, if the model is being widely increased, you must investigate to improve security structures.

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