IoT Structure based Supervisor and Enquired the Greenhouse Parameters

Abduljaleel Al-Hasnawi[1*], Laith Ali Abdul-Rahaim[2], Hassan Muwafaq Gheni[3] and Zahraa Emad Fadel[4]

[1*]Directorate of Scholarships and Cultural Relations, Ministry of Higher Education and Scientific Research, Baghdad, Iraq. jaleelaldaly17@gmail.com, https://orcid.org/0000-0002-5420-7934

[2]Electrical Engineering Department, University of Babylon, Hilla, Iraq. drlaithanzy@uobabylon.edu.iq, https://orcid.org/0000-0001-8064-4401

[3]Electrical Engineering Department, University of Babylon, Hilla, Iraq. hasan.gheni.engh444@student.uobabylon.edu.iq, https://orcid.org/0000-0003-0971-0829

[4] Electrical Techniques Engineering Department, Technical College Al-Musaib, Al-Furat Al-Awsat University, Hilla, Iraq. mokhaladali5@gmail.com, https://orcid.org/0000-0003-3658-3079

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Abstract

The world on the beginning of a new period of regeneration and developing with the increase of Internet and also Internet of Thing (IoT) in the market commercial application. where a new revolution can be made by characterizing its important. The rapprochement of the universal system and the power of sophisticated calculating, sensing with low cost and add create of communication supported by the Internet. In this paper, the green house system is consisting of two sections they are the software and hardware sections. Hardware has three types of sensors for natural environment measuring and gateway (router). Software consists of monitoring and controlling sub system, and IoT cloud, vb.Net software is used to write the programs codes for the proposed system. The environmental parameters of the greenhouse are continuously recorded by various sensors, and the collected data is displayed on a customized website. The system software has the ability to monitor and control the green house environment variables like humidity, temperature and water level on the greenhouse. Thus, the greenhouse can be monitored and controlling from anywhere and at any time. The fundamental aims of this paper have been achieved with the help of all systems parts. The green house environment has been displayed using the IoT cloud and the control is done over the internet connection. The system is implemented in practices. The system result gives an accurate indication that the system is reliable and work completely.

Index Terms: Sensors WSN, ZigBee, ASP.NET, IOT.

1 Introduction

Facility of farming is an agrarian industry that have a good intensification degree, and also substantial class of new farming. Now a days, the technology of Internet of Thing technique has an important effect

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*Corresponding author: Directorate of Scholarships and Cultural Relations, Ministry of Higher Education and Scientific Research, Baghdad, Iraq.

on the development of farming. The drawbacks of using of large number of humans and environment of farmland can be reduced by using wireless sensor networks WSN. The good information gathering and to control the environment of the product can be done using automation equipment. With the use of automation parts, the field information can be controlled remotely (Dan et al., 2016). Food or cash crops depending on the fact that developing the plants can generate a strong plants field. In the present agriculture one of essential problems is that the information about improving innovations is little and parameters of agriculture learning are minimum (Vatari et al., 2016, Pallavi et al., 2017, Danita et al., 2018). The old people avoid employ a specific expansion for specific crops growing in the past agribusiness, but they used a uniform miracle for the whole plants. Under normal natural cases the changing in the technology can develop plants. As well, the developing of particular plants with particular conditions can help to obtain high output and low compost (Dedeepya et al., 2018; Satpute et al., 2018; Bhagwat et al., 2018). The greenhouse is a house like structure covered with a transparent material, which can keep up controlled environment conditions, for the healthy plant growth. In these days, the agriculture can advance by using green house. The developing of the plants has resulted on less cost innovations and high account for the agriculturists to rear reproduction (Lee et al., 2019, Abdul-Rahaim and Ali 2015; Mahfuz et al., 2020). There are specific classes of plants need to be monitoring around the year this can be done using the greenhouse fields in order to obtain high quality and quantity. the monitoring and controlling of most of the greenhouse in the present are manual. therefore, it is time consuming and heavy action (Hu et al., 2021; Saxena and Khare 2021). Greenhouses are buildings that provide plants with controlled climate conditions to protect them from harsh external conditions. Greenhouse technology gives farmers the freedom to choose any type of crop at any time of the year. This very important issue has particular implications for the food security of countries' economies and populations (Nili et al., 2022; Lu et al., 2021; Han et al., 2021). Greenhouse systems can be divided into two more or less interacting main parts: indoor climate and soil watering conditions.

The process of photosynthesis is the cornerstone of climate regulation inside the greenhouse. Photosynthesis is the process by which plants make food. Plants absorb CO_2 and H_2O from the environment and use light energy to convert them into glucose molecules and store them as glycogen (Chen et al., 2021; Hamzah and Abdul-Rahaim 2022; Abdul Kareem et al., 2022; Maraveas and Bartzanas 2021; Zhang et al., 2021). The process operates using enzymes, which are temperature dependent. At high temperatures around 50ºC, enzymes denature, while at low temperatures they lose their activity (Karle et al., 2021). Obviously, the photosynthesis process is affected by environmental parameters such as light, temperature, humidity and carbon dioxide levels. Therefore, a greenhouse is ideal for cultivation as it provides an enclosed environment where climatic variables can be controlled for optimal photosynthesis rates (Shatti et al., 2021).

Irrigation is another important part of the greenhouse system. The water we provide ensures that plants will survive under certain conditions. Most Iraqi farmers are known to use manual systems for watering their crops. This system is expensive and inefficient (Lu et al., 2021). Traditionally, one of the common methods for measuring greenhouse parameters has been to install individual sensor devices at fixed points in the greenhouse. This is because greenhouse installations require a lot of wires and cables to distribute sensor and actuator equipment. As a result, the system becomes complex, expensive and unsafe, and adding new sensors or actuators as the greenhouse expands is very limited. In addition to the internal factors, greenhouse industry is some type of business. The target of the commercial purpose greenhouses, like in any other business, is to increase profit and reduce costs (Abdul Kareem et al., 2022). According to all reasons and drawbacks which we mentioned above, the idea of greenhouse automatic monitoring and controlling system based on wireless technology is sprung, in such a way to maintain the optimum climate conditions, keep high photosynthesis rate, maximize the growth of plants far from diseases and reduce waste resources, cost and time. The main methods to control the greenhouse climate are to change indoor temperature and humidity conditions through ventilation and heating, shading and artificial light to change internal radiation, and to inject CO_2 to affect photosynthesis (Saxena and Khare 2021).

2 Literature Review

Dan, et al., 2016, this paper is deals with the controlling of the greenhouse environments such as light, humidity, and temperature and monitoring these conditions to get optimum plants conditions. An accurate farming greenhouse depend on IoT was designed by using platform monitoring and management system for data collection. **Vatari et al., 2017**, in this work the use of input sensors such as soil control, co_2 control, temperature, humidity to sense the greenhouse environment and to form and IoT system for monitoring of green house. this system can up load the data to the cloud. the data can download from the cloud and applied to each output devices. the input devices sense the required data from the environment and send to the cloud through the internet connection. The user can monitor and control the received data using a control algorithm in order to control the changes of the conditions. **Pallavi et al., 2017**, This paper deals with sensing the farming conditions remotely and also the control of greenhouse system. there are a number of parameters are sensed such as light, soil moisture, CO_2, and temperature. the controlling of greenhouse is done by controlling windows/doors during the round year season. **Danita et al., 2018,** in this article there are a number of sensor devices are used such as Moisture, Temperature and Humidity sensor. the information obtained from these sensors inside greenhouse are directly controlled using Raspberry PI3. the controlling is done by control the windows the fan for cooling purpose and irrigation system. The data are uploaded and stored in the database of cloud, and the data are displayed to the user using webpage view. This control system can achieve a good growth status and efficient output.

Dedeepya et al., 2018, This paper deals with monitoring of greenhouse parameter such as soil moisture, temperature, and humidity by using appropriate devices with Raspberry pi. this paper can alert the farmer through the internet by using a mobile application. the sensed data are sent to the MySQL database of Raspberry pi where these data are processed and give the accurate situations. **Rupali Satpute et al., 2018,** The proposed system uses the concept of IOT (Internet of Things) and is more efficient. The environmental parameters of the greenhouse are continuously recorded by various sensors, and the collected data is displayed on a customized website. Therefore, the greenhouse can be monitored anytime and anywhere. Data from individual sensors can be plotted over time for better monitoring and analysis. **Bhagwat et al., 2018**, In this work the sunlight and other environment such as soil moisture, humidity, and temperature readings of green hose are controlled. the collection of data is done in easy and simple way, also these values are controlled in order to optimize the output of the greenhouse crops and get efficient yield with low cost. **Lee et al., 2019,** In this work, ICBM management system are used to manage the environment of greenhouse. ICBM paradigm system are used to collect and control the data obtained from greenhouse environment. this work uses a low power consumer system by controlling the topology of sensor network and also control the inside parameter of the greenhouse. In our paper, the greenhouse monitoring system uses different types of input sensors to collect the different condition of the green house. there are various variables to monitor such as temperature, humidity, water levels. The information collected by the sensors is passed to the microcontroller for processing. The microcontroller is also connected to the Wi-Fi module that connects the system to the internet. After processing, the data is sent over the Internet and displayed on a customized web page. Three types of sensors are used to measure the environment (humidity, temperature, water level) and send the data to a cloud database. System control is downloaded from the cloud to the actuator in response to changes (Megías et al., 2022).

3 Aim of Proposed Project

The aim in this work to implement a real time monitor and control of three unit such as temperature, humidity, and water level processes and control the actuator in the green house. Also, the implemented system has the ability to compute and process the data with internet based on IoT architectures.

The major goals of this paper are:

1. To achieve the modest technique for monitoring and controlling greenhouse environment.
2. Recognize the kinds of sensors and algorithms for process of each sensor.
3. designing and implementing of three unit that control the field environment such as (temperature, humidity, and level).
4. Development of graphical user interface (GUI) based on Visual Basic for monitoring and controlling the environment.
5. Implement the system with IoT cloud and investigate uploading and downloading the data via internet networks

4 The IoT Cloud Architecture for Proposed System

The Internet of Things (IoT) is base for the homes, industries, physical devices and etc... that are supported with electronic systems to obtain the network connectivity and collect and transmit information with internet network as shown in Figure 1 below.

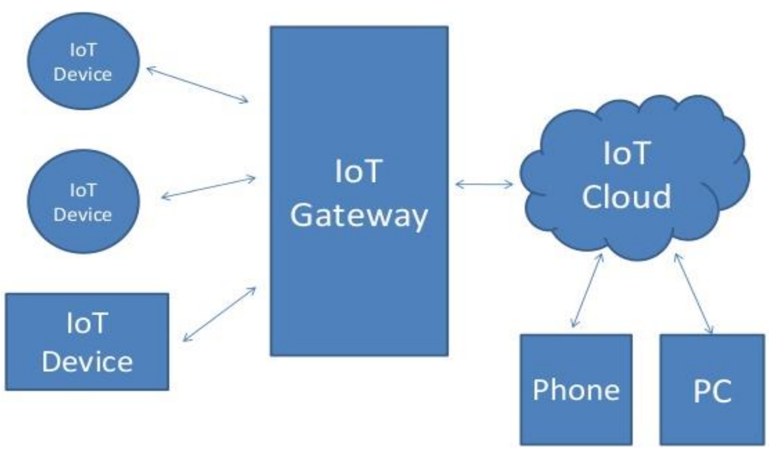

Figure 1: Cloud Architecture for IoT

There are four main stage of cloud architecture for IoT. The first stage consists mainly from sensor that gathering the data from natural environment. that gathered data is important for calculation such as temperature sensors. The actuators that transform the system response to an action such as turn the fan on.

The second stage it is combined stage between the sensor and actuator. the second stage may be physical device to process the data and forwarded to the next stage. The third stage after the data converted to digital forms and becomes ready. In some cases, the data need more processing before forward it to the IT units where more analysis is done. Stage four which is the last one, the data are received from stage three to the based system of cloud. In this stage more analysis is done and store of the data is also taken place. The other sensor data can be combined with main sensor in this stage Figure 2.

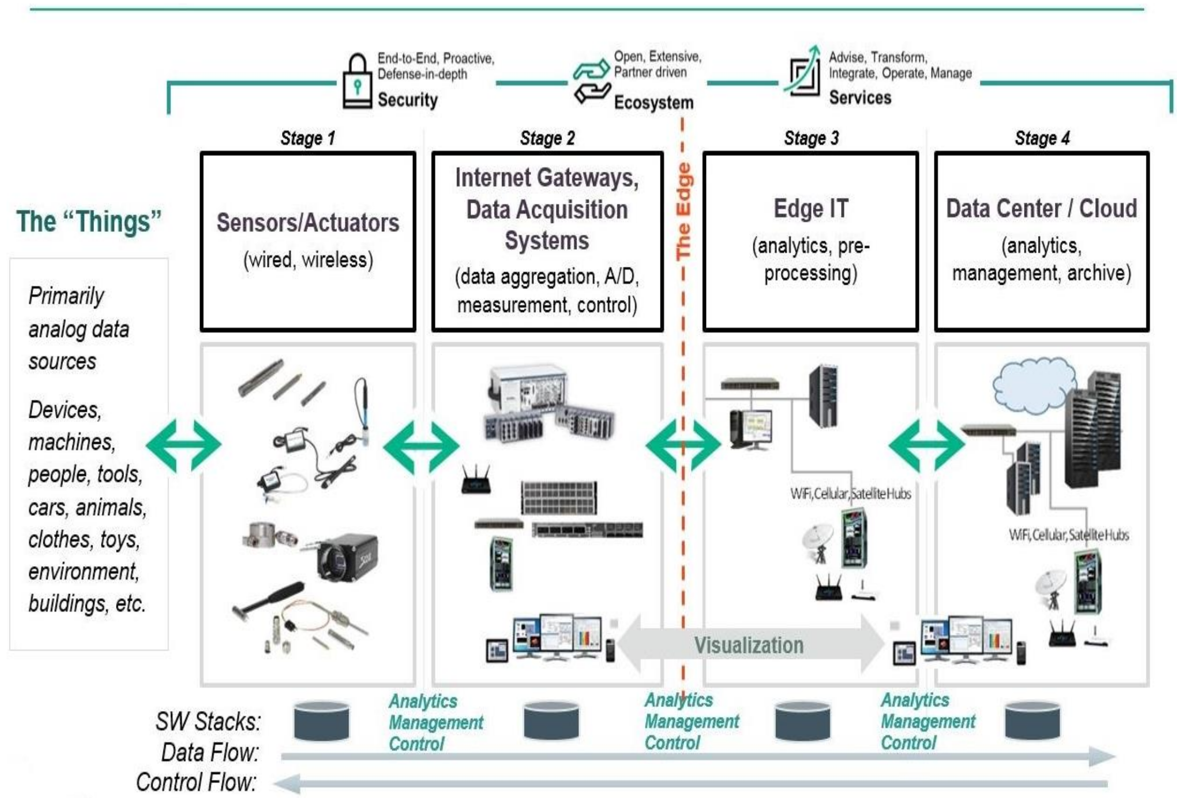

Figure 2: Four Stage of Cloud Architecture for IoT

5 Proposed System Structure Design and Operation

the intelligent system is an integrated system for collecting and monitoring the environment variable of any. this system has the ability to operate around the clock for the specific kinds of plats. This system can increase the production over the year seasons and reduce the human interact to get efficient crops. In this work, there are three parameters are obtained the sensors and comparing these values with threshold values that stored in the cloud. These threshold values are stored in the cloud database and can be accessed in any time and from any place. This paper deals with controlling and monitoring the environment inside the green house. We have a special type of plants that need a special environment for growing, and using the system can give us the appropriate environment conditions for best production during the different seasons of the years. The implemented system expressed in Figure. 3 which is consisted of sensor types they are humidity and temperature sensors and water levels with Arduino board. Ultrasonic sensor (HC-SR04) is used to measure the water level inside the tank and Gas sensor to measure the amount of Gas, humidity (DHT11) sensor is used to measure the greenhouse humidity.

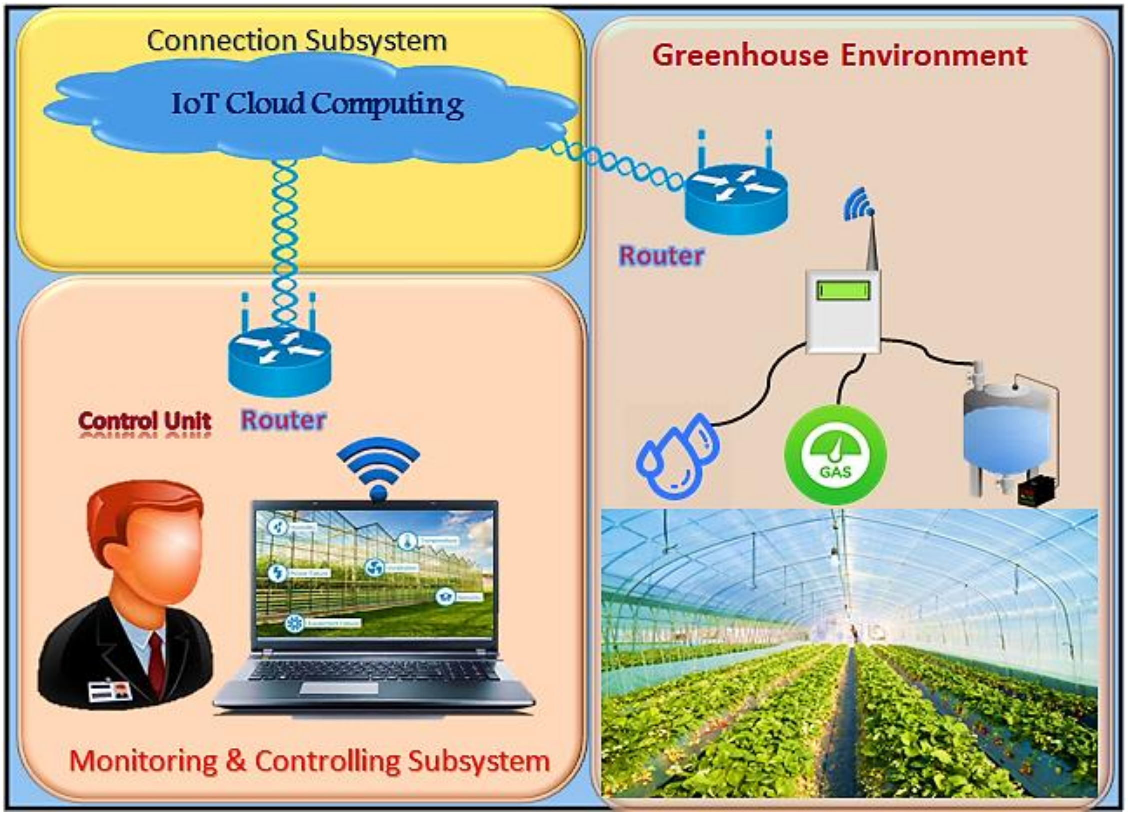

Figure 3: General block Diagram of proposed system

The measured data values are forwarded to the Arduino board to process these data. according to the threshold value the water pump can be turned on or off also depending on the water level inside the tank. The temperature and humidity sensor measure the temperature and humidity inside the greenhouse and comparing these readings with reference values in order to decide wither turn on or off the fan or cooling system.

The Arduino board is a low-cost board is used to manage the sensors situations for the mentioned sensors. WIFI local networks can be obtained by using Yun board where the sensor data are uploaded to the cloud database. The uploaded data are processed inside the cloud to get the action from this process and for monitoring and controlling. These data have important impact for the people that invest and develop the greenhouse environment.

6 System Requirement

The basic element used to build the proposed system will be arrangement as:

6.1. Arduino Yun

Arduino Yun is considered a powerful device that support WIFI where it combing both the Linux power and the easy Arduino usage. The Yun is combined from Arduino Leonardo and the WIFI chip. The Arduino direct use the Linux on PCB on the Leonardo also with WIFI and Ethernet connection in Figure 4.

Figure 4: Arduino Yun

6.2. DHT11 Temperature and Humidity Sensor

DHT11 sensor is capable of measuring both Temperature and Humidity of the environment with digital or analog output read of the data. It has a microcontroller with eight-bit performance. It has a high stability and wide range of reading with excellent performance. It consists of NTC for temperature reading and resistive device with good response in Figure 5.

Figure 5: DHT11 Temperature and Humidity Sensor

6.3. Ultrasonic Sensor

The noncontact sonar is used with HC-SR04 sensor to detect and measure the distance between the object and the sensor. This sensor consists of ultrasonic transmitters, and receiver and circuit for controlling. it emits a high frequency signal and waiting to received its echo. the processing is done with the received signal echo signal and by calculating the difference in time the distance can be measured in Figure 6.

Figure 6: HC-SR04 Ultrasonic Sensor

6.4. Gas Sensor

Gas sensor is one of well-known and best gas sensing elements in the family of gas detection tools. Its operation state that when the gas reach with the sensor internal material which is basically a resistance will cause this resistance to change. The change of resistance changes the voltage in the network of voltage divider, so the voltage can measure to detect the gas type and gases amount. In this paper the use of MG811 sensor is to determine the number of gases. The basic shape of the gas sensor is shown in Figure 7.

Figure 7: Arduino Gas Sensor

6.5. Gateway Router

The router gateway allows the connection between the greenhouse environment and the control field system, wireless connection. It also gives us the ability to forward the sensors data the cloud of IoT through its connection with the internet. the router type used in this system to provide WLAN network is TLWR940N as shown below.

Figure 8: TLWR940N router

7 The Overall Connected System

The proposed system is configured as shown in Figure 8. Its express the presence of monitoring system in form of three sensors which are ultrasonic, humidity, and gas sensors. It is also consisted of actuator system which is represented by three LED with different colors for each actuator in Figure 9.

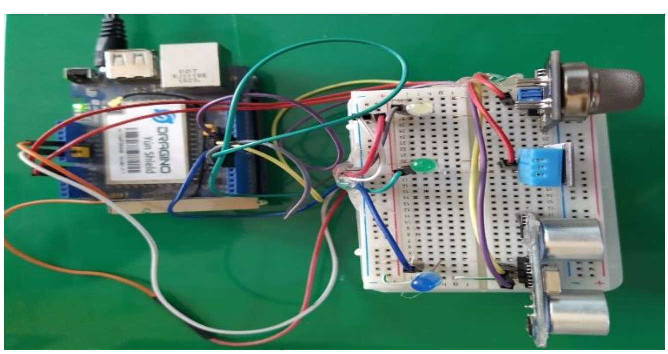

Figure 9: The overall connected system

8 The Proposed System Results

In this section we are going to show the practical system results for different cases of the greenhouse environment variables. The result expresses the proposed system is efficient and reliable due to easy implemented and real time features under slow speeds of internet connection. The different results are described in the following cases:

Case 1: Local monitoring and controlling of the paper is shown in Figure 10 and Figure 11 which describes the local control of case the water pump is on and the water valve is off and fan is on.

Figure 10: Local GUI controller

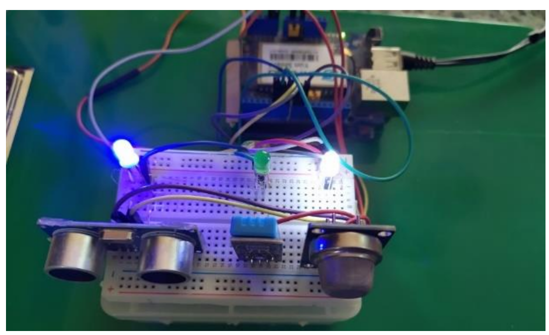

Figure 11: System with local controller

Case 2: Online monitoring and controlling of the paper is shown in Figure 12 and Figure 13 which describes the online control of case the water pump is off and the water valve is on and fan is off.

Figure 12: Online GUI controller

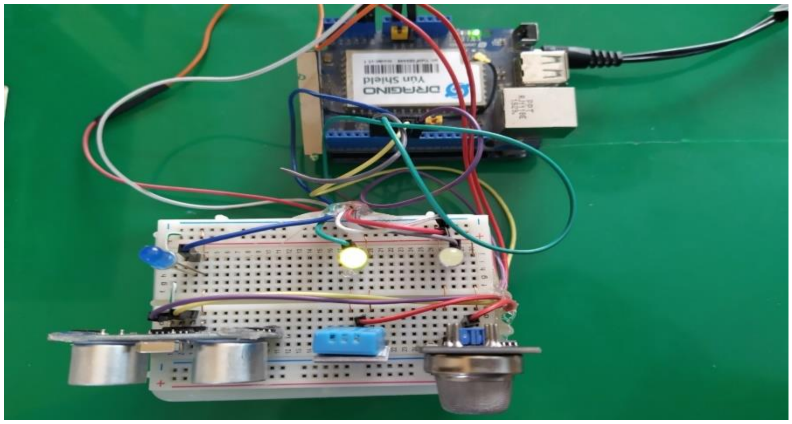

Figure 13: System with online controller

Case 3: Online and local monitoring and controlling of the paper is shown in Figure 14, Figure 15 and Figure 16 which describes the online and local control of case the water pump is on and the water valve is off and fan is off.

Figure 14: Local GUI monitoring

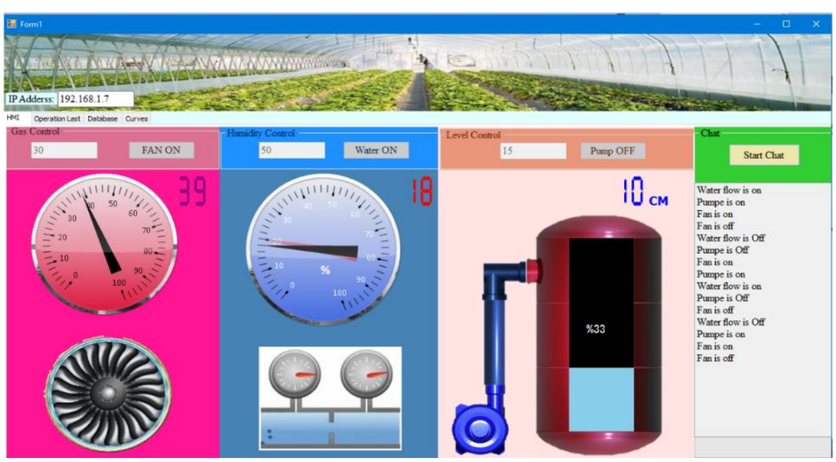

Figure 15: Online GUI monitoring and controlling

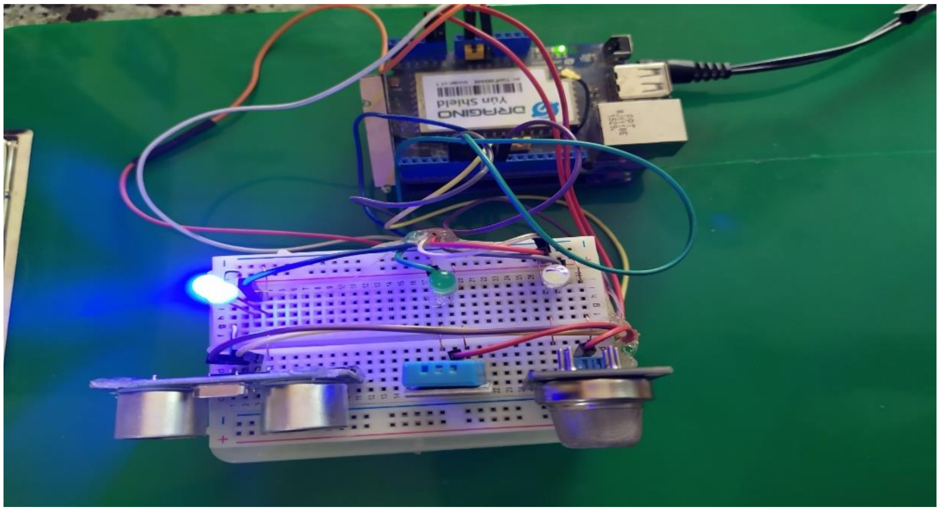

Figure 16: System with online control

The deigned proposed system has been tested practically under the supervision of expert greenhouse manager. The results obtained are very good and satisfactory.

1. The system effectively provides the GHO with actual measurements (temperature, relative humidity, soil moisture, CO_2 levels, and irrigation water levels) without errors or unexpected delays.
2. When comparing the fitted equations provided by the EC-5 manufacturing with our actual fitting results for the same soil type (mineral soil), we can estimate that they are almost in agreement at the points shown in Figure 17.
3. DHT11 digital output sensor has good accuracy and resolution. It is an efficient method of measuring relative humidity and temperature without the complexity of these types of measurements.
4. If we compare MG811 sensor response to change CO_2 level which presents in the datasheet with our practical fitting result. The comparison shows both the two curves have the same slop and output voltage approximately as shown in Figure 18.

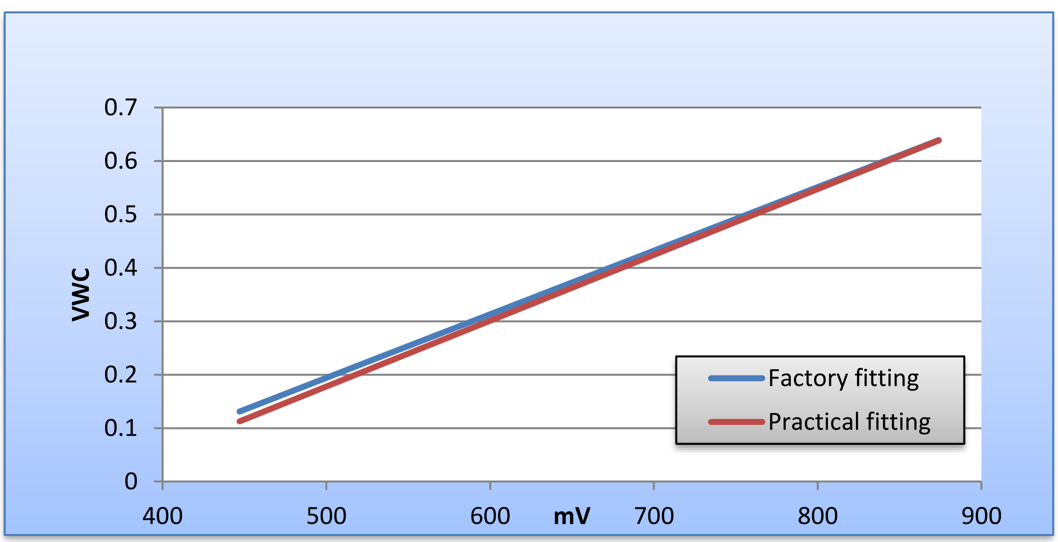

Figure 17: Comparison between EC-5 sensor factory fitting and our practical fitting result

1. Five. Regarding the control panel, two points are made:
    - The designed system exhibits high stability in controlling the actuators.
    - The ON/OFF actuator control method can effectively adjust the greenhouse climate parameters.
2. Six. If we talk about diagnostic subsystems, the designed system will be tested under different operating conditions to detect all types of errors (network topology changes or node states). The designed system works efficiently.

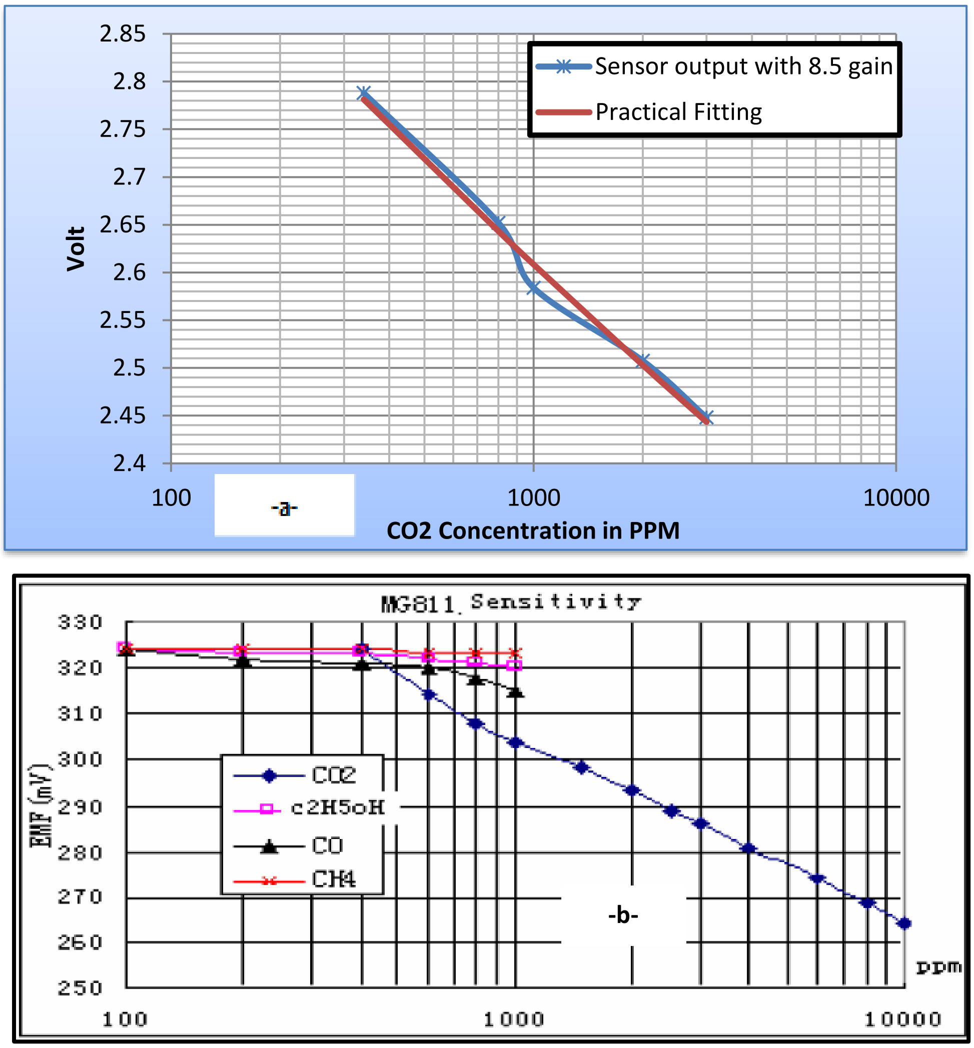

Figure 18: MG811 sensor response (a) Our practical result, (b) Datasheet response

9 Conclusion

The IoT technology is beneficial to agricultural development. Therefore, it is able to collect information from the environment and by using automation components on site, the greenhouse can be controlled remotely. The implemented system has a simple design and can achieve real-time monitoring based on the use of cloud technology. Furthermore, the system can reach all destinations regardless of whether an internet connection is available or not. This is intended to be achieved by the proposed system. The quality and productivity of plants in a greenhouse depends largely on the quality of management.

Therefore, continuous monitoring and adjustment of climate conditions will maximize crop yields. Controlling humidity in greenhouses can reduce disease on the planet. If carbon dioxide levels remained high during the day, Earth's growth rate would accelerate. Sensor selection is an important and critical process. Multi-sensor node options increase system reliability compared to other greenhouse automation systems. Influenced by future developments of open-source software and hardware support systems. The proposed design is supported by a fault diagnosis subsystem. The system can adapt to any changes in the network topology, while greenhouse management can simultaneously monitor the number of active sensor nodes in the network, the status of CO_2 sensors and tank nodes. In an emergency, manual control must be used.

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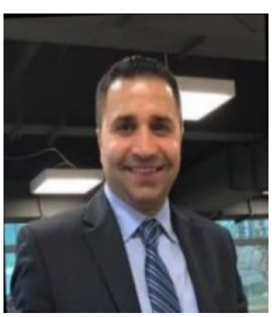
Authors Biography



Abduljaleel Al-Hasnawi was born in Babylon 1978, Iraq. He has Bachelor in (Mathematics) in 2001, Higher Diploma in Informatics (Informatics Institute for Postgraduate Studies), 2002, Master (Informatics Institute for Postgraduate Studies), 2006, from Iraqi Commission for Computers and Informatics Baghdad, Ph.D. (Department of Computer Science), 2018. The current research interests are social networking, IoT, and recommendation systems. Simpy (Python-based discrete event simulation) as well as Riverbed modular are interested me as evaluation tools. I am currently working on academic event recommendation and a novel approach for social networking.

Laith Ali Abdul-Rahaim (Member IEEE) was born in Babylon-1972, Iraq. He received the B.Sc. degree in Electronics and Communications Department from the University of Baghdad (1995)-Iraq, M.Sc. and Ph.D. degrees in Electronics and Communication Engineering from the University of Technology-Iraq in 2001 and 2007 respectively. Since 2003, he has been with the University of Babylon-Iraq, His current position is Dean of faculty of engineering at university of Babylon. His research interests include MC-CDMA, OFDM, MIMO-OFDM, CDMA, Space Time Coding, Modulation Technique, Image processing, Communication Design, Information Science, Computer Security and Reliability Computer Communications (Networks) Communication Engineering, Electronic Engineering, Instrumentation Engineering.

Hassan Muwafaq Gheni Received his Bachelor (B.Sc.) of Electrical and Electronic Engineering from Department of Electrical Engineering, Babylon University-Iraq Hilla in June 2016. In February 2018, he entered the master’s program at the Faculty of Electrical and Electronic Engineer, Universiti Tun Hussein Malaysia. He is a lecturer at Al-Mustaqbal University College/ Department of Computer Techniques Engineering His research interest is optical communication, IoT, wireless sensor network, Communications, V2V system, artificial intelligent.

Zahraa Emad Fadel was born in Babylon-1994, Iraq. She received the B.Sc. degree in Electrical Engineering Department from the University of Babylon (2018)-Iraq, M.Sc. degrees in Electronics and Communication Engineering from the University of Babylon-Iraq in 2022. She has with Al-Furat Al-Awsat Technical University, Technical College of Al-Mussaib, Department of Electrical Engineering Technologies Her research interests include MC-CDMA, OFDM, MIMO-OFDM, CDMA, Space Time Coding, Modulation Technique, Image processing and IOT.