International Journal for Innovative Engineering and Management Research
A Peer Revieved Open Access International Journal
www.ijiemr.org

IJIEMR Transactions, online available on 30h Nov 2018. Link
:http://www.ijiemr.org/downloads.php?vol=Volume-07&issue=ISSUE-12

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Volume 07, Issue 12, Pages: 724–730.

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A REAL-TIME CYBER-PHYSICAL SYSTEM FOR ENVIRONMENT MONITORING

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ABSTRACT:
This project explains the design and implementation of an electronic system based on cloud computing and Internet of Things (IOT) for sensing the climatic parameters in the greenhouse. Based on the characteristics of accurate perception, efficient transmission and intelligent synthesis of Internet of Things and cloud computing, the system can obtain real-time environmental information for crop growth and then be transmitted. The system can monitor a variety of environmental parameters in greenhouse effectively and meet the actual agricultural production requirements. Devices such as temperature sensor, light sensor, relative humidity sensor, current sensor and soil moisture sensor are integrated to demonstrate the proposed system. This research focuses on developing a system that can automatically measure monitor and control of changes of temperature, light, Humidity, current sensor and soil moisture sensor and moisture level in the greenhouse. With this the quantity and quality of production in greenhouses can be increased. The procedure used in our system provides the owner with the details online irrespective of their presence onsite. The main system collects environmental parameters inside greenhouse tunnel every 30 seconds. The parameters that are collected by a network of sensors are being logged and stored online using cloud computing and Internet of Things (IOT) together called as Cloud IOT.

Keywords- IOT, Internet of Things, lm35 sensor, moisture sensor, temperature sensor, humidity sensor, PH sensor, current sensor

1. INTRODUCTION

The greenhouse industry is the fastest growing sector worldwide. The greenhouse separates the crop from the environment, thus providing some way of shelter from the direct influence of the external weather conditions. This enables the production of crops which otherwise could not be produced at that specific location. The greenhouse enclosure enables the manipulation of the crop environment. This asset allows the farmer to improve the cultivation in a way the plants need. It leads to higher crop yield, prolonged production period, better quality, and less use of protective chemicals. The added value per unit area in greenhouse crops is much higher than that in open-field cultivation. In moderate climate zones, energy is needed, whereas in arid zones, the cooling and availability of water is of major concern. The use of materials and energy as well as crop yield and quality can be influenced by operating the adjustable components of greenhouse, such as heating and cooling inputs, window opening, drip irrigation, screening and CO2 dosage. Hence, it can be expected that the way these controls are operated influences the final economic result. To fully exploit the enhanced possibilities for crop and resource management in greenhouse, it is indispensable to know the control variables with a remote sensing system using the IOT. This is because it is almost difficult for human being to manipulate and be present every day near the system. Indeed, remote communication systems are a major component of the policy of modernization and technology transfer, due to the increasing development of mobile telecommunications. Internet of Things (IoT) is the network of physical things embedded with electronic circuits, sensors, software and network connection which enables these things to exchange data from one another. IoT is the fusion of the digital and physical world. In a world of IoT, millions of things or devices will be interconnected and uniquely identified on the Internet. The Internet of Things allows objects to be sensed and controlled remotely across existing network infrastructure, creating opportunities for more direct integration between the physical world and computer-based systems, and resulting in improved efficiency, accuracy and economic benefit. In near future, IoT is expected to provide many more services like advanced connectivity of physical objects over a wide network and also many applications. It is obvious to think that in using these services provided by this technology, it is possible to control and monitor systems from a distance using the GSM network. Mobile internet are integrated-applications as useful as home automation, industrial applications for handling and remote monitoring of complex systems but also in security systems, and protect property and people. Most physical variables relevant in a greenhouse can be measured by automatic sensors. This holds for temperature, light, soil moisture, and relative humidity. Precipitation can also be detected, although it is somewhat less common. All the mentioned physical variables are sampled and stored electronically at regular intervals when something is changing. Overall, the measurements provide quite a good input-output picture of the physical part of the greenhouse crop system. We propose a contribution to the development of greenhouse monitoring. This paper presents the design and development of an electronic system based on a microcontroller that integrates remote sensing functions rooted in the cloud computing using Internet of Things (IoT). The system allows the acquisition of different climatic parameters in an agricultural greenhouse and in addition, this electronic system achieves the remote monitoring of greenhouse solutions, by cloud computing solutions (Internet of Things). The most prominent improvement in technology based climate control is found in data logging which means recording the data monitored from the greenhouse. Greenhouse cultivation represents a very important role in modern agriculture. As the greenhouse usually equips with various high-tech equipments, management tend to be very complex. A fully automated greenhouse control systems along with improved monitoring system brings obvious benefit such as labor saving, but far more importantly, it enables improved quality of production and information gathering that will make difference between earning a profit and suffering substantial losses.

2. LITERATURE SURVEY

The literature contains a large number of efforts for developing monitoring solutions that benefit from the advantages provided by wireless sensing technology. an automated irrigation system based on a distributed wireless network of soil moisture and temperature sensors that achieves water savings of 90% compared with traditional implementations. Sentinella is a smart monitoring solution for the assessment of possible causes of power inefficiency at the photovoltaic panel level based on WSNs. The employment of WSNs in smart grid applications and electrical energy monitoring solutions for large buildings was also investigated. A series of industrial WSNs achieving the acquisition of heterogeneous sensor signals, higher sampling rates, and higher reliability levels has been developed as well. However, most of the proposed solutions are based on the IEEE 802.15.4 standard and ZigBee applications, and they rely on gateways when the data has to be sent to the Internet,. Furthermore, in this case, additional applications have to be developed for encapsulating the data in Internet protocols, such as user datagram protocol (UDP) or transmission control protocol (TCP). Another promising technology providing high power efficiency is Bluetooth Low Energy (BLE), which was first introduced in 2010 with the goal of expanding the use of Bluetooth to power-constrained devices such as wireless sensors [19]. However, a lot of research work still has to be performed in this direction, for finally being able to receive relevant information from remote BLE-enabled devices requiring small amounts of data communication and energy. Furthermore, gateways are also required for sending the data to the Internet. Therefore, the use of Wi-Fi sensors, as the ones in the system presented in this paper, which connect directly to the existing IEEE 802.11 b/g infrastructure seems to be a better, more straightforward, and less expensive solution. This is beneficial especially for applications deployed in indoor spaces or urban areas, where there is a high probability that access points are present. Although the development of IEEE 802.11-based sensors may not be new, the power efficiency of the developed sensors represents a significant contribution, achieving a battery lifetime similar to the one provided by more power-efficient solutions, based on IEEE 802.15.4/ZigBee communication. The proposed monitoring system takes advantage of the existing IEEE 802.11 infrastructure, which currently has a coverage exceeded only by the one provided by cellular networks.

3. PROPOSED SYSTEM

Appropriate environmental conditions are necessary for optimum plant growth, improved crop yields, and efficient use of water and other resources. Automating the data acquisition process of the soil conditions and various climatic parameters that govern plant growth allows information to be collected with this system with less labour requirements. This IOT Greenhouse monitoring systems employs PC or phone-based systems for keeping the owner continuously informed of the conditions inside the greenhouse.The block diagram of proposed system is as shown in the figure below.

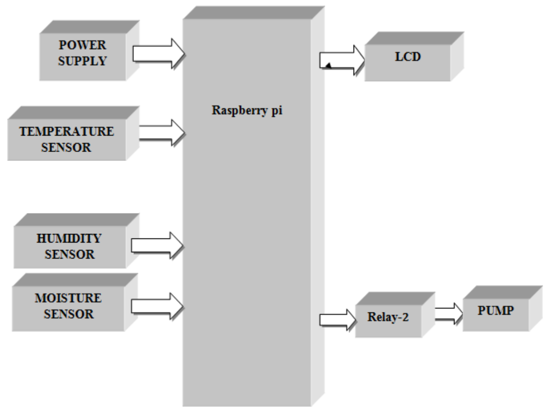

Fig1. Block diagram of proposed system

3.2 Block diagram explanation:

This is a microcontroller-based circuit which monitors and records the values of temperature, humidity, soil moisture and sunlight of the natural environment that are continuously updated as a log in order to optimize them to achieve maximum plant growth and yield. An integrated Liquid crystal display (LCD) is also used for real time display of data acquired from the various sensors and the status of the various devices. The system constantly monitors the digitized parameters of the various sensors. Monitoring and controlling of a greenhouse environment involves sensing the changes occurring inside it which can influence the rate of growth in plants. The important parameters are the temperature inside the greenhouse which affects the photosynthetic and transpiration process, humidity, moisture content in the soil, the illumination etc. The sensors used in this system are:

1. Soil moisture sensor
2. Light sensor
3. Humidity sensor
4. Temperature sensor
5. PH sensor
6. current sensor

Soil moisture sensor

The two copper leads act as the sensor probes. They are immersed into the specimen soil whose moisture content is under test. The conductivity of soil depends upon the amount of moisture present in it. It increases with increase in the water content of the soil that forms a conductive path between two sensor probes leading to a close path to allow current flowing through.

Light sensor

The light sensor is extremely sensitive in visible light range. With the light sensor attached to the system when the surrounding natural lights are low, it displays the digital values.

Humidity sensor

Humidity sensor is used for sensing the vapours in the air. The change in RH (Relative Humidity) of the surroundings would result in display of values.

Temperature sensor

It is an integrated circuit sensor that can be used to measure the temperature in the greenhouse. It measures and displays the temperature values periodically.

PH sensor

It is an integrated circuit sensor that can be used to measure the PH level in the greenhouse water. It measures and displays the PH values periodically.

CURRENT sensor

It is an integrated circuit sensor that can be used to measure the power consumed by AC loads in the greenhouse. It measures and displays the load values periodically. The hardware unit of the prototype of the system is represented by the block diagram. It contains a ARM7 micro-controller as the main processing unit and it gets inputs from the temperature sensor (LM35), Light sensor (LDR), Humidity sensor (HSM20G), PH sensor, current sensor and moisture sensor. From the data obtained from the sensors , displays the values on a LCD. The whole system gets power from a DC adapter. It also uses a wifi module which sends information from the system to the owner through internet router. The system operates according to the block diagram. The readings from the sensors are analog values. The analog input value is converted to a digital value using ADC and given to the micro-controller for further processing. In this system the temperature sensor detects the current temperature value and inputs it to pin of the microcontroller. The input is an analog input and it is converted to a digital input and calibrated .Then it is displayed. Similarly for humidity, moisture PH , current and Light sensor. The output values which is to be stored on to the cloud through Internet of Things (IoT).and based on the parameter values actuators will be actuated. Finally the output parameters are logged on to the cloud network periodically.

4. ADVANTAGES OF THE PROPOSED SYSTEM

- User friendly
- Easily implementable
- Focuses on main parameters
- Uses GSM because of their availability
- Easy network coverage
- Cloud computing provides Increased storage
- Easier group collaboration
- Resource continuity

5. SOFTWARE REQUIREMENTS

A) Open CV

Open CV Stands for Open Computer Vision it is source library of functions. Open CV is released under a BSD license hence it is free for both Academic and Commercial used It is open source library written in C/C++.Open CV support many languages like C, Perl, Ruby. It is originally developed by Intel. Mainly aim at real-time computer vision It is a cross-platform (Linux, OS X, Win2K, Win XP).

B) Raspbian OS

Raspbian is free OS based on debian optimized for the raspberry device an operating system is the set of basic programs and utility that make your Raspberry pi run. Raspbian provides more than a pure OS it's comes with over 35000 packages, precompiled software bounded in easy format of installation on your Raspberry pi device.

6. RESULT

The proposed system was fully developed and tested to demonstrate its feasibility and effectiveness. The screenshots of the smart home app developed has been presented in Figure bellow.

RESULT

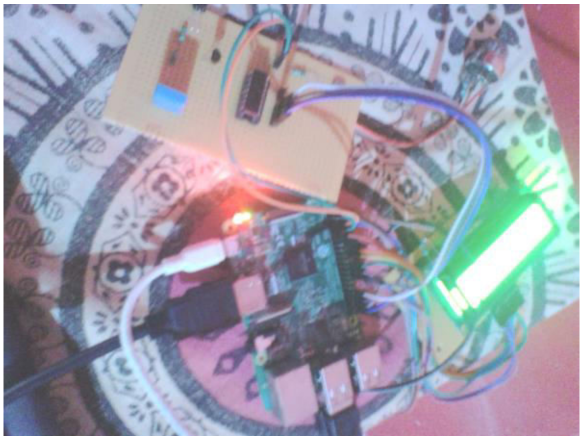

FIG: HARDWARE IMPLEMENTATION

7.CONCLUSION AND FUTURE SCOPE

This paper describes the design of a greenhouse monitoring system based on CloudIoT. Agriculture projects even in urban areas are on a rise in recent times, in unique forms. technological progress makes the agricultural sector grow high, which here is made by the CloudIoT. The IoT will dramatically change the way we live our daily lives and what information is stored about us. This cloud computing is free to use anytime and anywhere as long as the computer is connected with the Internet. This monitoring system percepts different parameters inside the greenhouse using sensors, cloud to provide the updates. The developed system can be proved profitable as it will optimize the resources in the greenhouse. The complete module is of low cost, low power operation hence, easily available to everyone. in future by developing a mobile application for IOT system to make more flexible to the peoples.

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