MANTECH Publications

Journal of Computer Programming and Multimedia
Volume 4 Issue 1

Survey on Smart Agriculture Using IOT

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DOI: http://doi.org/10.5281/zenodo.2579857

Abstract

One of the important applications of Internet of Things is Smart agriculture. Smart agriculture reduces wastage of water, fertilizers and increases the crop yield. In the current agriculture system the specification such as temperature, moisture, humidity are detected manually which increases the labor cost, time and also monitoring cannot be done continuously. In this paper irrigation process is done automatically using different sensors which reduces the manual labor. Here a system is proposed to monitor crop-field using sensors for soil moisture, humidity and temperature. By monitoring all these parameters the irrigation can be automated.

Keywords: *Internet of Things (IoT), Agriculture, Agriculture Precision, Raspberry Pi, Temperature Sensor, Smart Farming, Soil Moisture Sensor.*

INTRODUCTION

Most important factors for the quality and productivity of plant growth are temperature, humidity and light. Continuous monitoring of these environmental variables provides valuable information to the grower to better understand, how each factor affects growth and how to maximize crop productiveness [1]. The optimal greenhouse micro climate adjustment can enable us to improve productivity and to achieve remarkable energy savings especially during the winter in northern countries [2]. WSN composed of hundreds of nodes which have ability of sensing, actuation and communicating, has great advantages in terms of high accuracy, fault tolerance,

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flexibility, cost, autonomy and robustness compared to wired ones. Moreover, with the onset of IoT and M2M communications, it is poised to become a very significant enabling technology in many sectors, like military, environment, health, home and other commercial areas [3]. IoT is a general term, covering a number of technologies that allows devices to communicate with each other, with or without human intervention. This paper presents a novel approach to implement wireless greenhouse automation and monitoring system which in a timely manner provides a possibility for screen monitoring of detailed data about the conditions of the greenhouse. Furthermore, the suggested setup can be incorporated with other internet and messaging services (i.e. Web, WAP, SMS) to provide communication for farmers. The wireless sensor network (WSN) is one of the most significant technologies in the 21st century and they are very suitable for distributed data collecting and monitoring in tough environments such as greenhouses. The other most significant technologies in the 21st century is the Internet of Things (IoT) which has rapidly developed covering hundreds of applications in the civil, health, military and agriculture areas. In modern greenhouses, several measurement points are required to trace down the local climate parameters in different parts of a large-scale greenhouse in order to ensure proper operation of the greenhouse automation system. Cabling would make the measurement system expensive, vulnerable and also difficult to relocate once installed. This paper presents a WSN prototype consisting of MicaZ nodes which are used to measure greenhouses' temperature, light, pressure and humidity. Measurement data have been shared with the help of IoT. With this system farmers can control their greenhouse from their mobile phones or computers which have internet connection.

IOT TECHNOLOGY AND AGRICULTURE

Raspberry Pi

The Raspberry Pi is a credit card sized single-board computer developed in the UK by the Raspberry Pi Foundation with the intention of stimulating the teaching of basic computer science in schools. The Raspberry Pi has a Broadcom BCM2835 system on a chip (SoC), which includes an ARM1176JZF-S 700MHz processor (The firmware includes a number of "Turbo" modes so that the user can try to attempt over clocking, up-to 1GHz, without affecting the warranty), Video Core IV GPU, [5] and 256 megabytes of RAM.

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Figure: 1 Raspberry Pi

Arduino

The Arduino UNO is a widely used open-source microcontroller board based on the ATmega328P microcontroller and developed by Arduino.cc. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits.[1] The board features 14 Digital pins and 6 Analog pins.

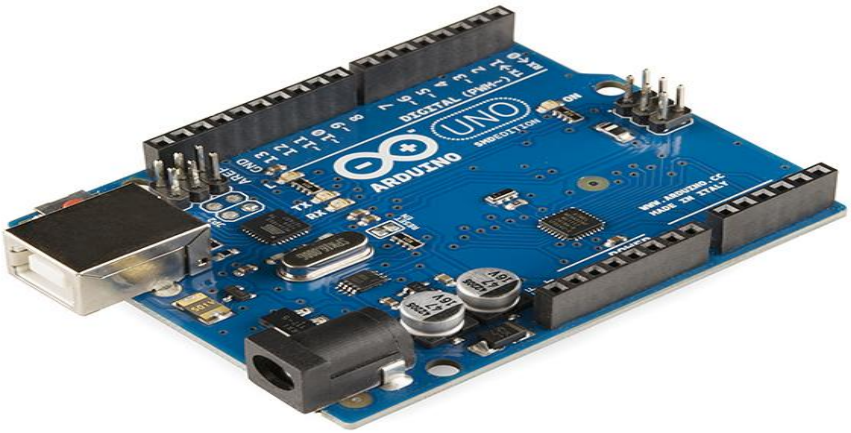

Figure: 2 Arduino UNO

Soil Moisture Sensor

The Moisture sensor is used to measure the water content (moisture) of soil. When the soil is having water shortage, the module output is at high level else the output is at low level. This sensor reminds the user to water their plants and also monitors the moisture content of soil. It has been widely used in agriculture, land irrigation and botanical gardening.

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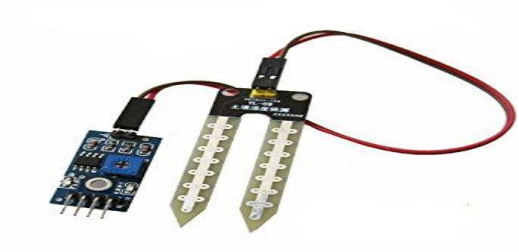

Figure: 3 Soil moisture sensor

DHT11 Temperature & Humidity Sensor

This DHT11 Temperature & Humidity Sensor features a temperature & humidity sensor complex with a calibrated digital signal output. By using the exclusive digital-signal-acquisition technique and temperature & humidity sensing technology, it ensures high reliability and excellent long-term stability.

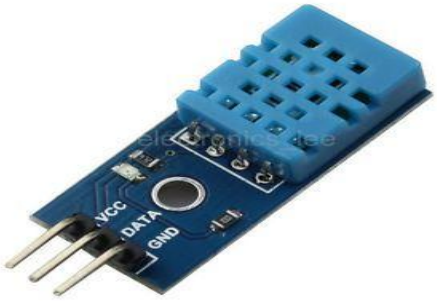

Figure: 4 DHT 11 Humidity & Temperature Sensor

LITERATURE SURVEY

In the literature there are numerous examples of versatile IoT application-oriented studies. In [4], an example of control networks and information networks integration with IoT technology has been studied based on an actual situation of agricultural production. A remote monitoring system with combining internet and wireless communications is proposed. Furthermore, taking into account the system, an additional information management sub-system is designed. The collected data is provided in a form suitable for agricultural research facilities. In their work Liu Dan et al. [5] take a CC2530 chip as the core and present the design and implementation of an Agriculture Greenhouse Environment monitoring system based on ZigBee connectivity. Additionally, the wireless sensor and control nodes take CC2530F256 as a core to control the environment data. This system comprises front-end data acquisition, data processing, data transmission and data reception. The ambient temperature is real-time processed by the temperature sensor of the terminal node and is send to the intermediate node through a wireless ZigBee based network. Intermediate node aggregates all data, and then sends the data to the PC through a serial port. At the same time, staff may view, and analyze the data, storage of the data on a PC is also provided. The real-time data is used to control the operation of fans and other temperature control equipment and achieve automatic temperature control in the greenhouse. Kun Han et al. [6] proposed the design of

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an embedded system development platform based on GSM communications. Through its application in hydrology monitoring management, the authors discuss issues related to communication reliability and lightning protection, suggest detailed solutions, and also cover the design and realization of middleware software.

Greenhouse technology was started by Dr APJ Abdul Kalam with the help of Swaminathan. It was first started in Leh-Ladakh to grow vegetables for the defence during extreme climatic conditions.

A greenhouse (also called a glasshouse) is a structure with walls and roof made chiefly of transparent material, such as glass, in which plants requiring regulated climatic conditions are grown.

Figure: 5 Fully Automated Greenhouse

Figure: 6 Partially Controlled Greenhouse

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Figure: 7 Naturally Ventilated Greenhouse

SYSTEM DESIGN

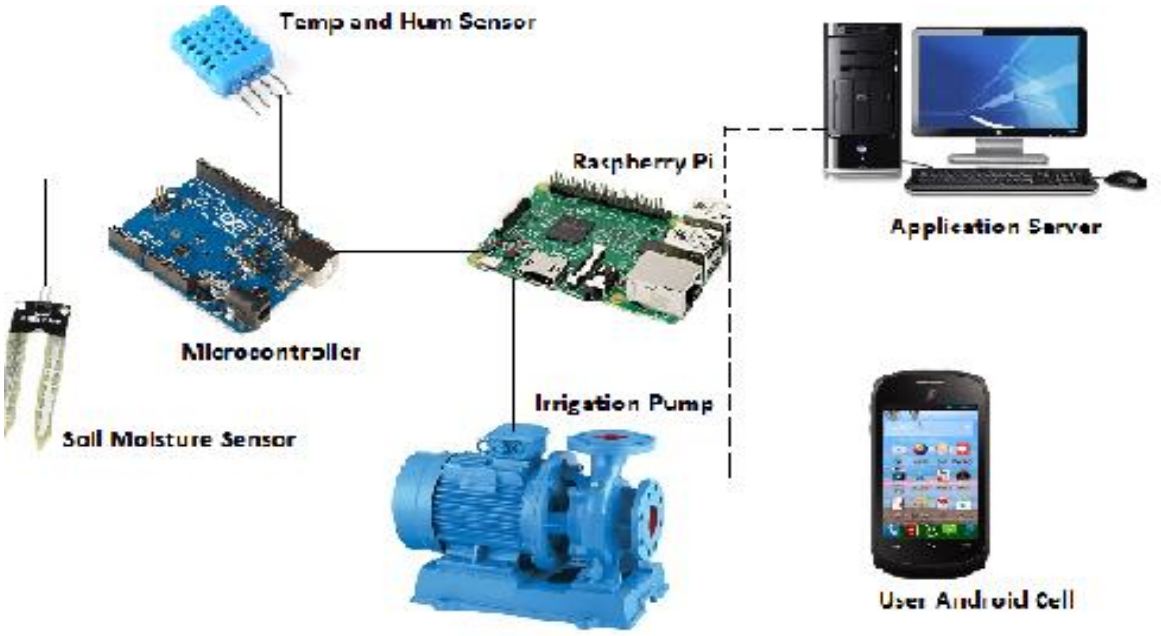

Figure: 8 System Architecture

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SYSTEM MODULE

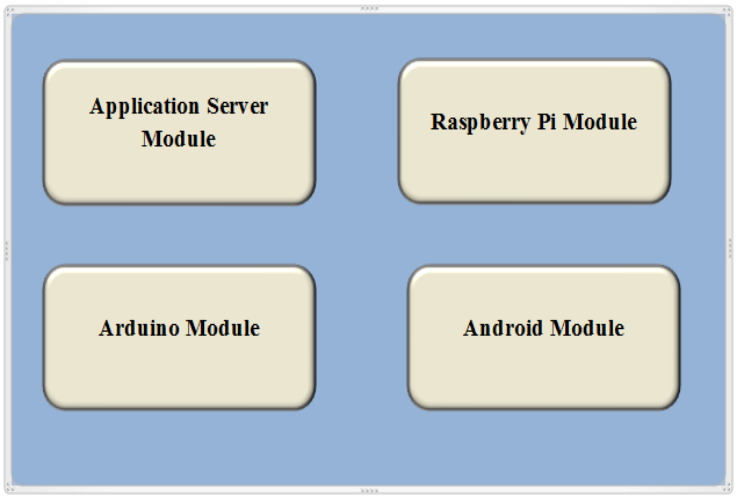

Figure: 9 System Modules

Arduino module: It is used to interface with moisture, temperature & humidity sensor.

Send these values to the Raspberry pi through the serial port.

Raspberry Pi: It receives data from Arduino and takes the decision to start/stop the motor.

Sends wireless data to the user.

Application server module: Receives data from Raspberry pie and records it into the database.

Displays real time graph of the received data

Android Module: Displays real time data (temperature, humidity, moisture) on the interface to the user remotely.

IMPLEMENTATION

This project can be implemented in a real greenhouse for growing good agricultural produce like ornamental flowers (Gerbera, Carnation, Anthurium etc.), which can be of export quality. The system will take care of automatic irrigation control and various parameters of the greenhouse can be monitored like Temperature, Humidity and Soil Moisture.

The Android Application will form the user interface and to record the parameter details we use an application server module. This recorded data can be used for analysis and help in taking decisions.

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Live Implementation and Real Time Data Analysis and Monitoring

Figure: 10 complete system with Arduino Board, Bread Board and Laptop giving results

Application Server

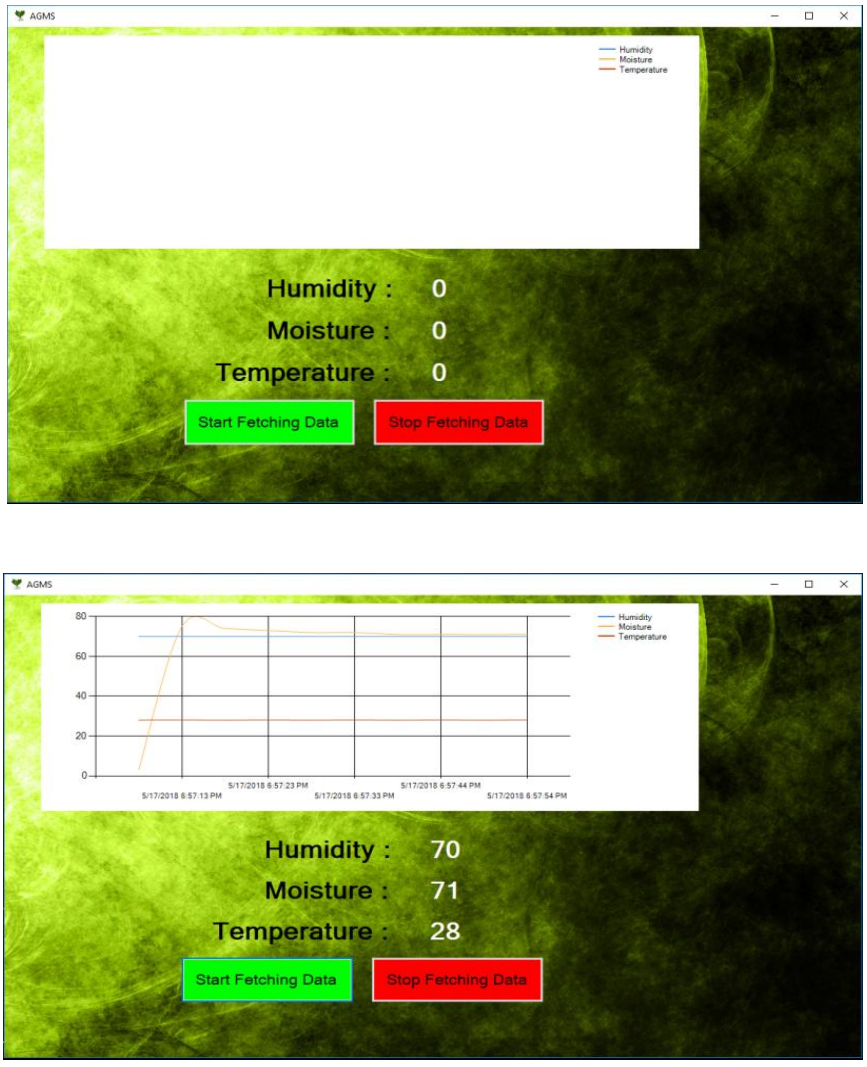

Figure: 11 Result Analysis with the specific readings using Application Server

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CONCLUSION

This concept can be implemented in a real greenhouse for growing good agricultural produce which can be of export quality. The system will take care of automatic irrigation control and various parameters of the greenhouse can be monitored like Temperature, Humidity and Soil Moisture.

The Android Application form the user interface and to record the parameter details we use an application server module. This recorded data can be used for analysis and help in taking decisions.

The main advantage of this paper is that, all the functions to be performed by the Fan and Sprinkler to control the climatic conditions like temperature, relative humidity and soil moisture levels in the Greenhouse environment are all automated and it does not require any human intervention. This is particularly an important factor because the presence and availability of the human cannot always be trusted on. For important structures like the greenhouses, we need a more dependable and reliable way for its management which is easily achieved by this project. Greenhouses are very important as they are responsible for the efficient growth of crops that are either necessary to feed the population or necessary for the economic growth of any country.

FUTURE SCOPE

Future work would be focused more on increasing sensors on this stick to fetch more data especially with regard to Pest Control and by also integrating GPS module in this IoT Stick to enhance this Agriculture IoT Technology to full-fledged Agriculture Precision ready product.

- Implementation of Foggers
- Implementation of sliders.
- Implementation of roof sheets.
- Implementation of controllable water motor.
- Detection of gases/minerals above/under the ground & detection of insects.

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Cite this Article

Shweta A M, Dr V. Nagaveni (2019). **Survey on Smart Agriculture Using IOT,** Journal of Computer Programming and Multimedia, 4(1), 6-15

http://doi.org/10.5281/zenodo.2579857

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