

Design & Development of Prototype IOT Based Smart Agriculture System

Sudhindra.F.¹, Vani.R.M.², Annarao.S.J.³

Technical Officer-I, University Science Instrumentation Centre, Gulbarga University, Kalaburagi, India¹

Prof & Head University Science Instrumentation Centre, Gulbarga University, Kalaburagi, India²

Head, Dept. of E&CE, HKE's Women's Poly Technique College, Kalaburagi, India³

ABSTRACT: Information, Communication and engineering technology in the present era has not only created world wide revolution in digital technology but also made our life easier & simpler. Internet of thing in one among them. The concept of IOT is being implemented in a variety of fields from kitchen to aerospace, from medical science to agriculture and from industrial automation to home security systems. IOT is an idea that facilitates electronic devices/sensors to connect with each other and access services via the Internet, for remote monitoring with the help of sensors for wireless sensing of real time data and sending them into the required form and forward this data through the network. With this little knowledge of IOT one can connect any thing to any device/sensor and accesses from any in the world. Now the concept is applied for smart agriculture. Agriculture needs very scientific approach for optimal use of water & other natural environmental conditions & resources. In this paper we propose IOT based prototypic smart agriculture system, where we can control some environmental condition like temperature & humidity by using smart phone in controlled environment.

KEYWORDS: Internet powered PC/Laptop/Cell phone, Atmega326 MC, ESP8266 Microcontroller, Temperature & Humidity Sensors.

I. INTRODUCTION

It is a 21st century, much of our day to day activities are dependent on wireless communication and internet. Out of many of internet services, now a days internet of things are more in talk. Because IOT is an idea that permits physical objects which are having some computational & Sensory capability to connect each other and access services of internet, for remote monitoring & control of these physical devices. Such devices can monitor and control the physical parameters. In IOT technology physical devices are connected to Internet and access the information remotely. The wide range of applications of IOT includes home automation, industrial automation, medical application and in agriculture too, where extensive use of IOT is expected in the future. India is a agricultural country, it is a established fact that the use of scientific technologies & optimum use of natural resources like water, manure, moisture, humidity & temperature in agriculture have always yielded more production. In this work we present the IOT concept as a basis for monitoring and control of environmental conditions used in crop production processes in agricultural fields. Autonomous sensor devices gather data within monitoring systems and participate in the control process by sending signals to the actuators. Such an IOT based system provides users with the opportunity to remotely monitor environmental conditions and crop production process. The realization of IOT nodes is based on Arduino platforms with available shields and compatible sensors, characterized by good library supports. Here we have considered temperature & humidity as controlling environmental parameters which have direct effect on crop production.

II. RELATED WORK

The literature survey reveals that, the modern technologies like wireless communication, cloud computing and IoT for control various electrical & electronics devices have been implemented by various researchers. IoT based home

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 9, Issue 2, February 2020

automation with the help of Intel Galileo which has the combination of Cloud networking, wireless communication etc for remote control of various electrical appliances like fans, lights as reported by Vinay Sagar et al [1]. Tejal Deshpande et al uses the home automation using IOT, smart phone and Arduino mega for controlling Temperature, lights and mood lighting etc [2]. The use of Raspberry PI method for home automation system with the help of IOT is claimed by P.B. Kulkarni et al [3]. Home automation & Security of smart home is achieved by the use of combined technologies like RFID, SMS, Email & real-time algorithm based IOT by Khushal Shingala [4]. Again the application of Raspberry PI method with and smart phone for home automation is proposed by Kalyani Pampattiwar et al [5]. In an another application of IOT, it is used for Women's safety, by combining various technologies like transmitter, receiver, GSM, GPS, temperature sensor, heart beat sensor with ARM-7 microcontroller is proposed by R.A.Jain et al [6]. As the application of Iot is very wide, it can also be used for theft detection using raspberry PI, which includes image processing, camera, motion sensing etc reported by Umera Anjum et al [7]. A author Anandkrishanan S et al adapted IOT for LPG gas leakage & monitoring with SMS alert by applying GSM technique [8]. Some researchers have implemented the IOT technique for smart city underground water leakage & theft detection, Vehicle theft detection, smart parking system and smart agriculture system [9][10][12][13]. Prashnat Salunke et al reported IOT driven healthcare system for remote monitoring of patients [14]. Electromyogram (EMG) (measurement of electrical signals of muscles) is important physiological parameter of human. Gaurav Raj et al reports measurement of EMG by using sensors & IOT [15]. we have implemented the IOT technique for Home Automation System wherein some electrical devices are controlled by smart phone [16].

III. THE SYSTEM OUTLINE

The aim of this work is to present the idea of IOT for monitoring and controlling of environmental parameters that are essentially require in farming & agriculture. Independent sensor devices collect the data and control process by sending signals to the relays/actuators. Such system provides users to remotely monitor environmental conditions. Such a IOT based system for monitoring & control of environmental parameters like temperature & humidity is designed and developed in the laboratory. The system hardware is designed by using Arduino platform & Atmega 328 microcontroller and establishing the IOT services to the sensors from Wi-Fi LAN or the Internet or cell phone. This is done by Ethernet or Wi-Fi modules. For that purpose, Arduino and ESP8266 Module is used for wireless network connections. This prototype design monitors two environmental parameters such as Temperature & Humidity. The developed system helps the users in saving the inputs, achieve cost reduction and increase the agriculture production.

IV. METHODS AND MATERIALS

The developed IOT based prototype smart agriculture system block diagram is shown in the fig 4.1.It has the following blocks

1. ATmega328 MC
2. ESP8266 is a Wi-Fi unit
3. Temperature Sensor
4. Humidity Sensor
5. Signal Conditioning Circuit
6. LCD Display Unit
7. Buzzer & Drive Circuit
8. Relays & Relay Driver Circuit
9. Power Supply Circuit

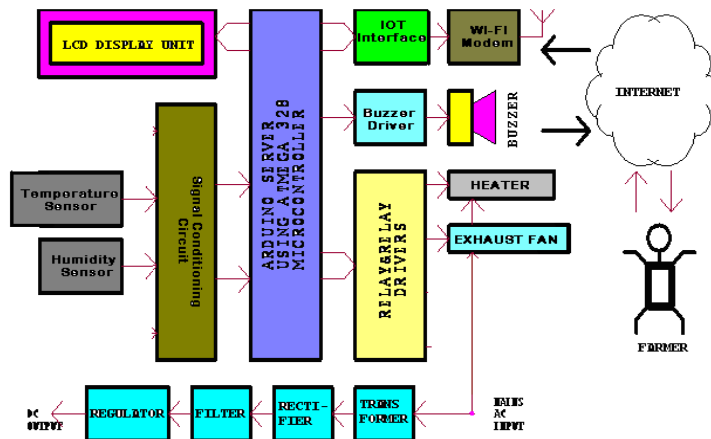


Fig. 1 The Block Diagram of the proposed system

4.1 ATmega328 Microcontroller: The microcontroller is the main important part of this system. It is a single - chip computer that contains the processor (the CPU), non-volatile memory for the program (Rom or Flash), volatile memory for data input and output (ram), a clock and an i/o control unit, also called a "computer on a chip," The ATmega328 is a single chip microcontroller created by Atmel and belongs to the mega-AVR series. This Atmel's 8-bit AVR RISC-based microcontroller combines 32 KB ISP flash memory with read-while-write capabilities. The Atmega 328 microcontroller is interfaced with ESP8266 a Wi-Fi unit, Temperature Sensor & Humidity Sensor, LCD Display Unit, Buzzer & Drive Circuit, Relays & Relay Driver Circuit etc.

4.2 ESP8266 Microcontroller: It is a networking platform that establishes the internet connection to the microcontroller. It has the following specification: 3.3 power supply, RAM 32K + 80K, processor speed 80-160MHz and 802.11 b/g/n/d/e/i/k/r supports. With full power, the transmitting current consumption can be 170mA but in sleep mode it requires 10uA. It can also work on solar panel with recharging the battery.



Fig. 2 Image of ESP8266 (curtesy)

4.3 Temperature Sensor: Temperature sensor is used to measure the atmospheric or ambient temperature of the agriculture field. The sensor used in this work is LM35. It is an industry standard semiconductor transducer, suitable for the temperature range of -50°C to +150°C. It is a voltage o/p device. It produces 10mV/°C of surrounding temperature. This voltage is amplified suitably to be sensed by the ADC and for calibration. These signals from the sensor are fed to signal condition for signal conditioning. It provides the required gain to the temperature signal. It also facilitates for the calibration of the sensor output signal. This analog signal is then fed to an ADC channel of internal ADC section of the Atmega 328 microcontroller, for converting it into a binary (digital) number for further processing.

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 9, Issue 2, February 2020

4.4 Humidity Sensor SY-HS-220: Humidity is defined as the quantity of water present in air. This humidity in the air has an effect human and many manufacturing processes in industries and is very important in agriculture. The sensor HS-100 that responds to changes in relative humidity is a capacitor. Here, the capacitor consists of two conductive electrodes that are separated by a thin film of polymer. The surface of the capacitor this sensor is also coated to protect it from contamination and condensation. The output of the sensor is proportional to the relative humidity of the atmosphere. The HS-100 has a linear output of 26 milli volts per 1% of relative humidity (RH) from 10 to 95% RH. It is an analog signal which is fed to another ADC channel of the microcontroller.

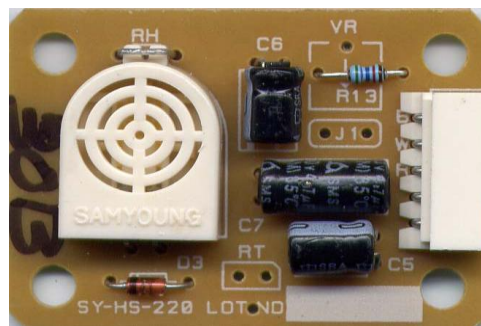


Fig. 3 Humidity Sensor SY-HS-220 (courtesy)

4.5 Signal Conditioning circuit: The output signal from most of the sensors is very small in amplitude. Hence it needs to be amplified. Amplification is done in the signal conditioner. The design & development depends on the type of sensor connected to it. It is usually an instrumentation amplifier. It also has a filter to remove the unwanted signal from the original signal.

4.6 LCD Display Unit: We have a LCD display unit for displaying various prompts and status information of the system at on site. A 2-line, 16 character type LCD display module is used. The microcontroller sends the signals to LCD module through its port pins. The LCD can be interfaced on 6 pins of any port since 4-bit interface mode is used here. Initially in program, it is configured to work on 4-bit mode, hence requires only 4-bits for data/commands transfer and two handshake signals enable (En) and register select (RS). The write pin is connected to ground since no read operation from the LCD needs to be done. The controller communicates with the LCD module through ASCII codes.

4.7 Buzzer & Driver Circuit: When any parameter abnormality is sensed by the microcontroller through the sensors, an audio tone produced by a buzzer to alert. The controller controls the sound produced by buzzer through a drive transistor. The buzzer driver consists of an NPN transistor operated in CE configuration. It supplies current to the buzzer element connected in its collector. The microcontroller sends TTL level signals, a logic 'one' to turn on the buzzer and a logic 'zero' to turn it off.

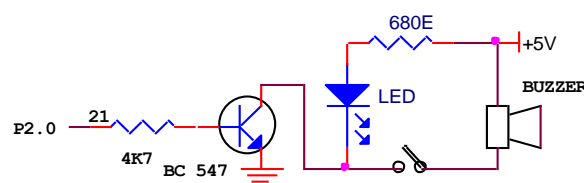


Fig. 4 The circuit diagram of buzzer & driver circuit

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 9, Issue 2, February 2020

4.8 Relays & relay driver circuit: The electromagnetic, single contact type relays of 12V DC to control on/off operation of mains operated loads like heater (for Temperature) and fan (for humidity). To a relay any load can be connected through the relay contacts. The relays operate the loads to switch them on or off along with providing highest isolation from power circuit to control circuit. These relay drivers are consists of a NPN transistor operated in CE configuration. It supplies current to the coil of the electromagnetic relay connected in its collector. The microcontroller sends TTL level signals, logic 'one' to turn on a relay and logic 'zero' to turn off.

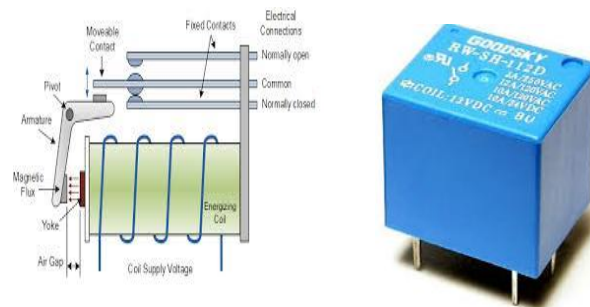


Fig. 5 Images of Relay & its circuit (courtesy)

4.9 Power Supply: The power supply section will provide a regulated D.C supply to all other subsystems of the main system. The regulated power supply section will provide a constant voltage at 1 Amp current rating. It derives power from AC mains and converts it into DC power at low voltages. It has a step-down transformer, rectifiers, filters and regulators. It supplies +5Volts to controller, LCD, EEPROM, Relay Drive Circuit and Buzzers.

V. SYSTEM SOFTWARE

The software program is written in Arduino IDE of version 1.6.1. It is an open source platform. It is having both a physical microcontroller and software/IDE Environment that runs on the computer, is used to write and upload program to the board. This IDE uses a simple version of C++. This Arduino platform is used by the electronics beginner. It connects to the Arduino hardware which is used to upload programs.

VI SYSTEM OPERATION

This system design is based on the Atmega 328 controller and a Wi-Fi unit ESP8266, for giving connectivity to the internet. The system has different sensors like LM35D as temperature sensor & HS-100 as humidity sensor. The loads like heater (for temperature), and fan (for humidity) are controlled through the relays and LCD display is provided for displaying atmospheric parameter values and status of the sensors. It use of 'Thingspeak' web service & it is an open API service for the different of sensors to monitor the recognized data at cloud level and putting it on channel ID and read API key as assigned by web services. The Atmega 328 controller, in the Arduino board will collect data from these sensors & processes them, compares them with the pre-set values and control the loads accordingly and transfer the data to the Wi-Fi unit for uploading to Thingspeak.com of Cloud service. This prototype system works on AC mains but it can be put on solar charged battery also.

VII. EXPERIMENTAL RESULTS & DISCUSSIONS

The designed prototype model is deeply tested in the laboratory. The features of Wi-Fi and IOT are implemented to the system for long & short distance monitoring & control of devices in agriculture applications. The IOT-based system can be used on farms or agricultural fields. The independent sensor will collect data for the monitoring system, and further send signals to the actuators/relays in the control process. This system has the ability to connect physical objects (sensor devices) which are on the farm and can be accessed through the Internet, thus can be remotely monitor environmental conditions and thereby crop production process. This system helps the users to accomplish savings in inputs, achieve cost reduction and trace the crop production process on the fields. Following are the screenshots of results plotted for on Thingspeak Cloud platform.

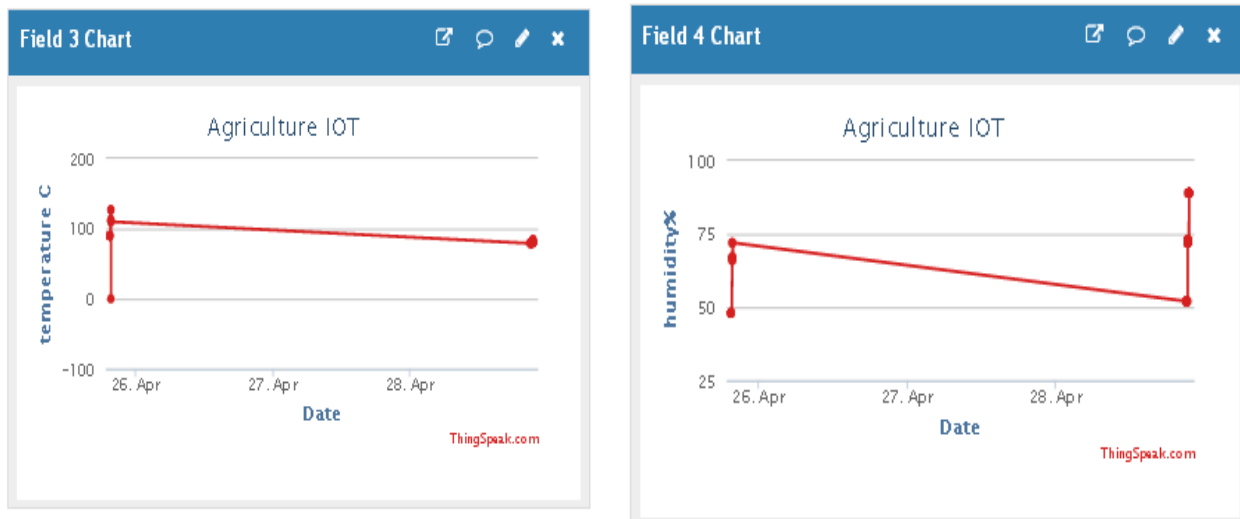


Fig.6. Screenshots of results plotted for on Thingspeak Cloud platform showing environment temperature in deg C & Humidity in % age

VIII. CONCLUSIONS

It is attempted to design & develop an IoT based Smart agriculture system. The designed system is very flexible, accurate and worked reliably and can be practically used. By providing the web interface and automation user can easily monitor the system and it will minimize the human intervention. This system has proved reliable solution in providing remote control and sensing for indoor/outdoor environmental monitoring systems. Normal market available sensors have been integrated with the system to monitor and compute the values of temperature and humidity in atmosphere using IoT technology. The developed system has: 1) display weather information, 2) alert when weather conditions match using decision tree technique and 3) keep weather information statistics.

REFERENCES

- [1] Vinay Sagar K.N and Kusuma S.M "Home Automation Using Internet of Things", International Research Journal of Engineering and Technology, Vol-2, Issue-3, pp 1965-1970, June-2015.
- [2] Tejal Deshpande and Nitin Ahire "Home Automation Using the Concept of IoT" International Journal of Computer Science and Network, Vol-5, Issue-3, pp 441- 445, June-2016.
- [3] B.P.Kulnami., Aniket V Joshi., Vaibhav V Jadhav and Akshaykumar T Dhamange "IoT Based Home Automation Using Raspberry PI", International Journal of Innovative Studies in Science and Engineering Technology, Vol-3, Issue-4, pp.13-16, April-2017.
- [4] Khushal Shingala and Jignesh Patel "Automatic Home Appliances and Security of Smart Home with RFID, SMS, Email and Real Time Algorithm Based on IOT", International Research Journal of Engineering and Technology, Vol-4, Issue-4, pp.1958-1964, April-2017.
- [5] Kalyani Pampattiwar., Mit Lakhani., Rinisha Marar and Rhea Menon "Home Automation using Raspberry Pi controlled via Android Application", International Journal of Current Engineering and Technology, Vol-7, Issue-3, pp 962-967, June-2017.

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 9, Issue 2, February 2020

- [6] R A Jain., Aditya Patil., Prasenjeet Nikam., Shubham More and Saurabh Totewar “Women’s Safety Using IOT”, International Research Journal of Engineering and Technology, Vol- 4, Issue-5, pp 2336-2338, May-2017.
- [7] Umera Anjum and B Babu “IOT Based Theft Detection using Raspberry Pi”, International Journal of Advance Research, Ideas And Innovations In Technology, Vol-3, Issue-6, pp 131-134, June-2017.
- [8] Anandhakrishnan S., Deepesh Nair., Rakesh K., Sampath K and Gayathri S Nair “IOT Based Smart Gas Monitoring System”, IOSR Journal of Electrical and Electronics Engineering, pp 82-87, June-2017.
- [9] J. Vinoj and S. Gavaskar “Smart City Underground Water Leak and Theft Detection System with IOT”, International Journal of Scientific Research in Computer Science, Engineering and Information Technology, Vol-3, Issue -6, pp 632-640, Aug-2017.
- [10] K Kanimozi., D Mukesh and M. Ashok “A survey of IOT Based Vehicle Theft Detection”, International Journal of Modern Trends in Engineering and Research, Vol-4, Issue-2, pp 27-30, Feb-2017.
- [11] Vandana Sharma and Ravi Tiwari “A Review paper on “IOT” & It’s Smart Applications” International Journal of Science, Engineering and Technology Research, Vol-5, Issue-2, pp 472-476, Feb-2016.
- [12] Y Raghavendra Rao “Automatic Smart Parking System using Internet of Things (IOT)”, International Journal of Engineering Technology Science and Research, Vol-4, Issue-5, pp 225-228, May-2017.
- [13] Fan TongKe “Smart Agriculture Based on Cloud Computing and IOT” Journal of Convergence Information Technology, Vol-8, Issue-2, Jan-2013.
- [14] Prashant Salunke and Rasika Nerkar “IoT Driven Healthcare System for Remote Monitoring of Patients”, International Journal for Modern Trends in Science and Technology, Vol-3, Issue-6, pp 100-103, June-2017.
- [15] Gaurav Raj., Neelam Rup Prakash and Jagjit Singh Randhawa “IoT Based EMG Monitoring System”, International Research Journal of Engineering and Technology, Vol-4, Issue-7, pp 355-361, July-2017.
- [16] Sudhindra.F., Vani.R.M and Annarao S.J “Design and Development of IOT based Home Automation System” International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering (IJIREEICE), vol-7, Issue-10, PP 30-34, Oct-2019.