International Journal of Engineering & Technology, 7 (4.19) (2018) 1016-1020

International Journal of Engineering & Technology

Website: www.sciencepubco.com/index.php/IJET

Research paper



Smart Greenhouse Multıfactor Monıtorıng Usıng Iot

Varsha Modani[1], Ravindra Patil [2], Pooja Puri [3]

[1] *D.K.T.E. Society's Textile & Engineering Institute, Ichalkaranji, India*
[2] *D.K.T.E. Society's Textile & Engineering Institute, Ichalkaranji, India*
[3] *D.K.T.E. Society's Textile & Engineering Institute, Ichalkaranji, India*
**Corresponding author Email: modani.varsha18@gmail.com*

Abstract

Agriculture plays vital role in the development of agricultural country. Agriculture supports directly or indirectly the economic growth of the country. The biggest thing that holds back the development in the agricultural productivity and efficiency is manual interventions. Agriculture put lots of emphasis on human care in detection and control of different factors such as environment which leads to wastage of manpower and also the desired results are not achieved due to human monitoring error. Greenhouse agriculture in large extent is in urgent need to control the environment factors which give optimum growth of plants. With internet era, proposed work is an integration of greenhouse with IoT. In proposed work Intel Galileo Gen 2 board is used to monitor and control environmental factors for greenhouse like temperature, humidity, soil moisture and light intensity. The user gets updated constantly about the condition of the greenhouse factors using IoT technology. To transmit the data over internet ESP8266Wi-Fi module is used. The experimental results are displayed on ThingSpeak cloud platform. This system avoids the use of dedicated server PC, with the help of internet connectivity user can access the data from anywhere at any time.

Keywords: *ESP8266; Greenhouse; Intel Galileo Gen 2; sensors; ThingSpeak IoT cloud platform.*

1. Introduction

Today in this Modern world automation has entered in every sector. In some important sectors like Agriculture & Horticulture which are partially automated needs more advanced technology and modernization can be done. Ever since man became civilized and civilized societies developed, agriculture has been primary employment. Greenhouse is a vital part of the agriculture and horticulture sectors. Plants growth depends upon climatic conditions under which directly or indirectly plant grow and hence they produce. So a controlled climatic parameter is must for their good growth. In our economy Agriculture plays a critical role and it is the backbone of economic system in our country. Due to global warming, the environment cycles are changing, and resulting into variation of temperature in all regions. Also water resources are getting depleted. A day is not far off when we have to save every drop of water. To increase the productivity and efficiency on large scale the environmental parameters need to be controlled for social needs, it is very important to apply knowledge, skills, and technologies. One of the main sources of livelihood is agriculture and also has major impact on economy of the country. Nowadays a major trend in the development of sophisticated agriculture is greenhouse agriculture. For optimum growth conditions of the crop, greenhouse agricultural factors are needed to control. Enormous manpower is required to detect and control the environment factors resulting in many monitoring error, which can affect the growth of crops. And to overcome all this, an IoT based technology is developed to achieve an intelligent control of factors in greenhouse, which provides suitable environment for the optimum growth of crops.

For physically disabled or handicapped persons, it's difficult to move from one place to another. For these people it's very essential to develop a system which requires less human interaction and more technology modernization. It is also necessary that the technology should be provided in competitive price which consumes less energy. IoT is new form of communication between people and physical things. This network enables sensors, softwares to collect and interchange the data. IoT creates more opportunities to integrate digital and physical world. IoT allows objects to be sensed and controlled from anywhere with a good connectivity. Many sectors will be revolutionize and automize through the development of IoT. The automation based on IoT is an innovative concept and wide development space for monitoring and controlling agriculture sector through its intelligence and can improve the quality of measurement and analysis. Till the date many methods have come into existence for automation of greenhouse. In one of the methods, environmental parameters of greenhouse are sent via GSM/GPRS. In another method ZigBee wireless network is used where light intensity, temperature and humidity sensors are used for detection of greenhouse environmental factors. Sensor data like temperature, humidity, soil moisture and light intensity are the main parameters to be monitored in this system. The system has sensor placed in the field. An algorithm was developed with threshold values of temperature, soil moisture and light intensity based on surveyed criteria data is programmed into processor and action takes place accordingly. The data is sent through IoT to PC located in remote place using cloud platform. This proposed work will help to reduce overall cost and save energy

2. Literature Survey

This paper includes application of IoT (Internet of Things) in smart homes. Internet technology has spread everywhere .This technology is used for monitoring and controlling the home appli-

Copyright © 2018 Authors. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

ances. With the use of Wi-Fi in smart phone home appliances can be monitored and controlled. Here raspberry pi is used as server system [1]. In this paper home appliances like lights, fan and door lock are remotely controlled easily through website. Here raspberry pi acts as server system which is connected to relay hardware circuit. Smart phone sends alert message if any fire accident takes place [2]. The idea of smart home is adopted for designing intelligent greenhouse. To meet the requirement of optimum plant growth, greenhouse environment parameters temperature, humidity and light intensity are monitored and controlled. To achieve precision parameters embedded technology with zigbee network is used [3]. Today's modern world has shown rapid development in agriculture sector. Greenhouse establishes controlled environment for optimum growth of crops. Even in adverse weather conditions automation helps to control environment parameters inside greenhouse. This system uses GSM and RF technology for monitoring greenhouse environment [4].To achieve low cost and wide range of signal coverage, GSM communication technology is used in this system. Monitoring of temperature and humidity of environment is done from the remote place by using GSM technology. With this technology monitoring of greenhouse parameters can be done anytime and anywhere [6]. To maintain high quality greenhouse parameters CMOS 8 bit processor AT89S52 and Ethernet controller is used. Intelligent controller helps to achieve accuracy of greenhouse parameters temperature and humidity. Fuzzy control technology is used in this paper [7]. Nowadays expansion of IoT applications are spread everywhere. The significant challenge of use of IoT application is to ease human life in better ways. Home appliances can be monitored and controlled remotely with the help of internet connectivity. [8].

3. Problem statement

Proposed work focused on monitor and control of greenhouse environment factors such as temperature, humidity, light intensity and soil moisture using IoT technique with the help of Intel Galileo Gen II board. To monitor and trace the environmental factors are mentioned above along with the sunlight by using Intel Galileo Gen II board. Environment parameters are continuously changing may affect the plant growth. This system keeps controlled environment inside greenhouse. This system allows user to get updated continuously of the conditions inside the greenhouse via internet connectivity using ThingSpeak cloud platform.

4. System Architecture

In the proposed work Intel Galileo gen-2 (soc quark x1000) board is main part which is 32 bit processor. This board has total 20 pins. Each of 14 digital pins can be used as input or output. It has six analog input pins. Operating frequency of Intel board is 400MHZ. In this system, Intel Galileo connects to the internet through Wi-Fi as shown in figure 1. When the Galileo recognised its connection with sensors it will start reading the parameters of sensors. After reading the parameters the values are compared with threshold values.

When the mentioned greenhouse parameters are not up to the threshold value then controlling action is activated to start the electric appliances. At the same time, the data regarding temperature and humidity, soil moisture and light intensity displays on PC via internet connectivity's, 8266 Wi-Fi module is connected to Galileo board which establishes internet connection . The sensor data are continuously sent to the thingpeak cloud using internet connection. The received data can be saved in excel sheet and it can be analysed anywhere at any time using IoT platform. The main priority is to control the temperature because it is the primary parameter in the crop's growth. Based on the relative humidity value the temperature set-point can be adjusted to control the humidity within a determined range. The DHT11 temperature and humidity sensor is used. When temperature exceeds threshold value then necessary action is taken that is fans are made ON to cool down the greenhouse area to protect the crop. Excess heat may damage plant growth to avoid this cooling action is taken. Sensing and measuring of moisture is done with the help of soil moisture sensor. By using this sensor one can automatically water the plant. This sensor measures water content in soil .To save the crop proper watering is needed. In order to have better growth and excellent yield of crop, require good light intensity. Quality of light refers to its wave-length composition. When light intensity is less than threshold value then lamp is turned on to get optimum plant growth. Due to adverse weather conditions natural lights keeps on changing. When natural lights are low, the Intel processor activates artificial lights automatically which helps to keep controlled environment inside greenhouse.

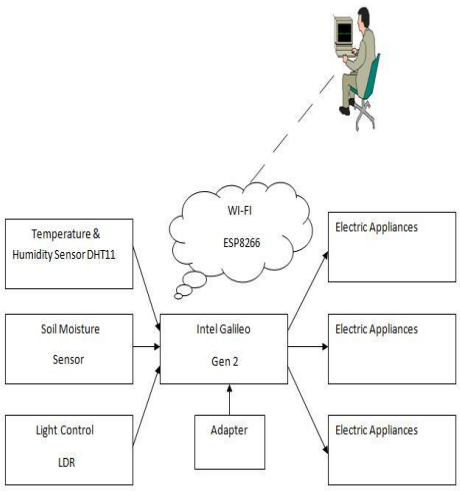


Fig. 1: Implemented system block diagram

To transmit the data over internet we have used ESP8266 Wi-Fi module. We have used ThingSpeak website to upload the data over cloud as shown in figure 2



Fig. 2: Implementation of ESP8266

ESP can be implemented in two ways, to make your web server first connected to Wi-Fi router or make ESP as access point. Here SSID and password of mobile hotspot network is given where the ESP connects. The AT commands generates OK reply when Wi-Fi module gets connected with Galileo board. AT+CWMODE defines Wi-Fi mode that is 1 represents station mode, 2 represents AP mode and 3 represents both. AT+CWJAP joins the AP Wi-Fi. AT+CIPSTART set up TCP connection. AT+CIPSEND sends data where 0 and 1 represents single and multiple connections respectively. AT+CIPCLOSE closes TCP connection. ThingSpeak server IP address 184.106.153.149 is defined. The data is transferred on ThingSpeak cloud platform. ThingSpeak provides instant visualizations of data posted by Galileo board to ThingSpeak.

The user can visualize measured data globally in ThingSpeak web browser.

5. Experimental Setup

Figure 3 shows experimental setup of greenhouse multifactor parameter monitoring and controlling. If the temperature may rise, it would trigger the devices for cooling. Humidity sensor sense the vapor in the air. When there is the change in humidity of the surroundings which would trigger the Intel processor to activate the sprayers. In certain areas plants may get low light intensity or no natural illumination, illumination for plants may be provided by artificial sources. The lights are spontaneously gets trigger by processor when the natural light of surrounding is low. When soil moisture is below 300 that is dry soil at that time it is necessary to water the plant by making water pump ON. Good condition of soil gives proper yield of crop. For good root establishment of crop it is necessary to irrigate plant properly. Water pump is controlled by Galileo unit with the soil moisture sensor attached to it. It will turn on the water pump when the soil moisture sensor detects the dry conditions in soil.

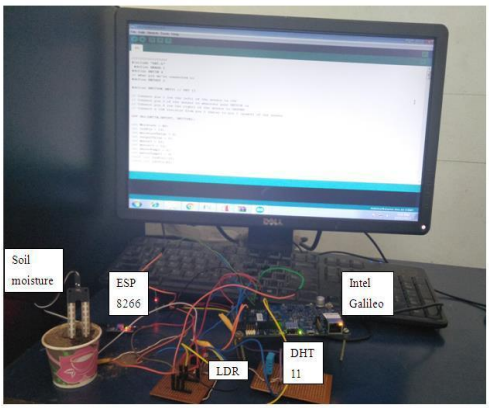


Fig. 3: Experimental setup of Galileo with sensors and wifi module

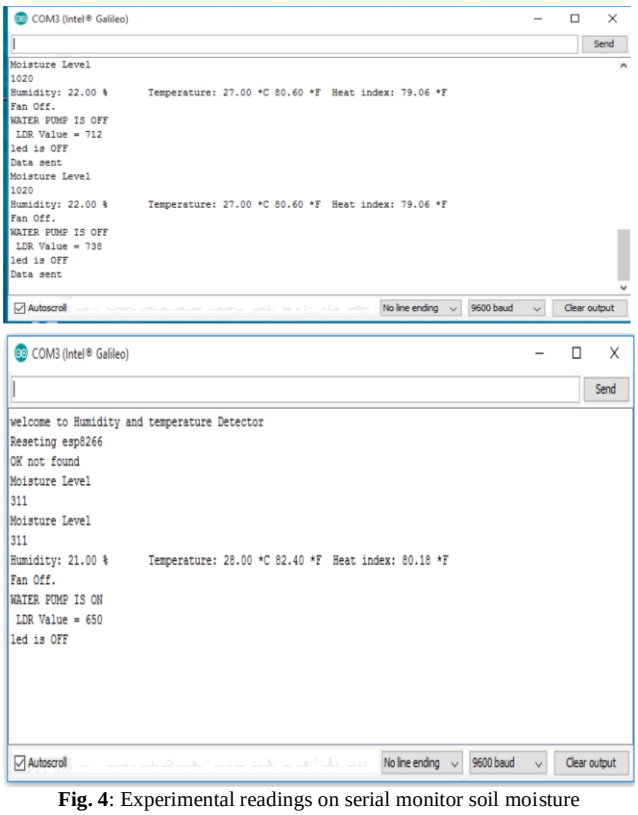


Fig. 4: Experimental readings on serial monitor soil moisture

Experimental readings on serial monitor for soil moisture measurement using Intel Galileo gen 2 board as shown in figure 4.Here we can observe the change in moisture level from 1020 to 311.Here manual controlling of parameter is replaced by automation. Depending on moisture value compared with threshold values, water pump will be turned ON or OFF. Experimental results on ThingSpeak cloud platform for soil moisture measurement using Intel Galileo gen 2 boards is shown in figure 5. It shows variation in moisture level from 311 to 1020 graphically.

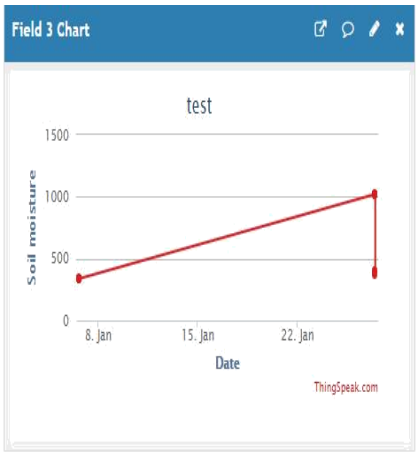


Fig. 5: Experimental results of soil moisture on ThingSpeak IoT cloud

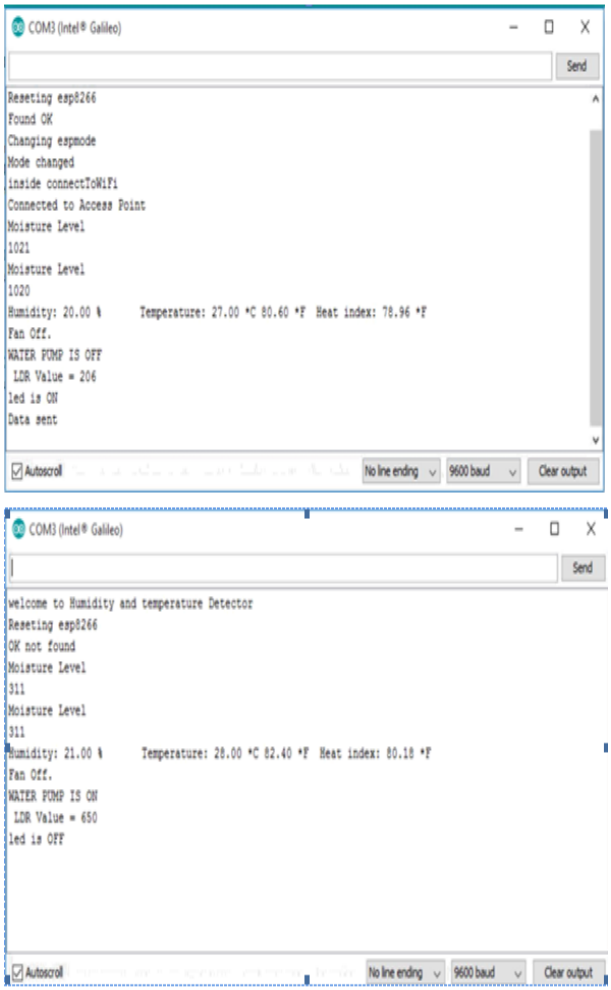


Fig. 6: Experimental readings on serial monitor temperature, humidity & light intensity

Experimental readings on serial monitor for temperature, humidity and light intensity measurement using Intel Galileo gen 2 boards. Here we can observe change in light intensity which makes LED

ON or OFF. Here in serial window shown in figure 6 we can observe ESP module gets connected to Galileo will indicate OK reply. First ESP module connects to access point and then data will be sent to web browser.

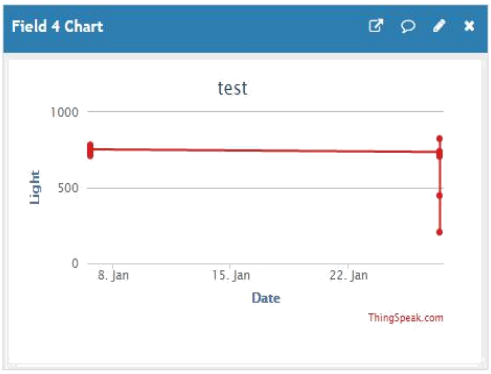


Fig. 7: Experimental results of light intensity on ThingSpeak IoT cloud

Figure 7 shows experimental results on ThingSpeak cloud platform for light intensity measurement using Intel Galileo gen 2 boards. It shows variation in intensity of light from 206 to 650 graphically.

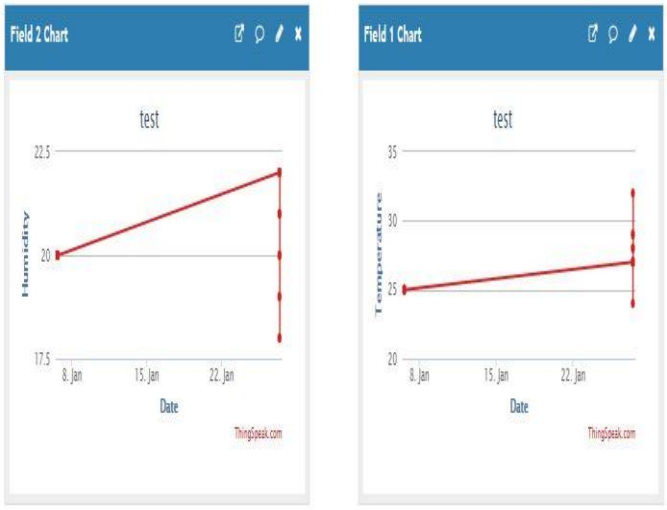


Fig. 8:.Experimental results of temperature and humidity on ThingSpeak IoT cloud

Figure 8 shows experimental results on ThingSpeak cloud platform for measurement of temperature and humidity.

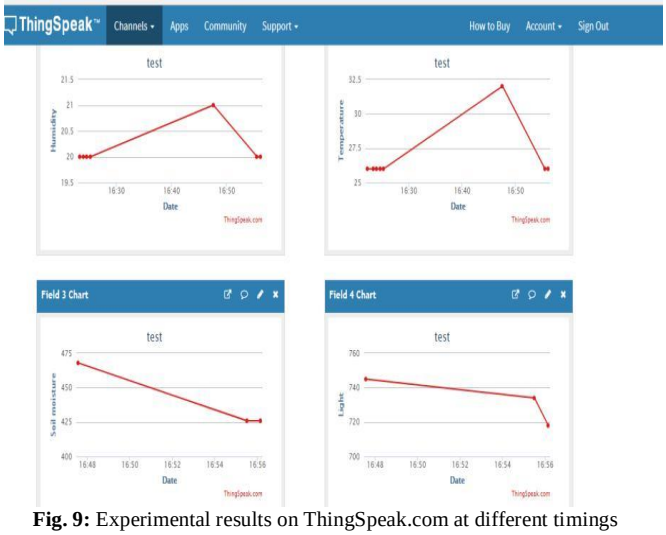


Fig. 9: Experimental results on ThingSpeak.com at different timings

Figure 9 shows remote place which is nothing but cloud platform .It displays the real time values showing variation in temperature, humidity, moisture and light intensity of greenhouse through Wi-Fi by using ThingSpeak cloud platform. Parameters can be seen on Y-axis with respect to date and time as shown in figure. The user can log in to ThingSpeak.com and visualize the results at any time. Four channels indicate parameters of greenhouse graphically. In field 1 and 2 variation in humidity and temperature is indicated. In field 3 and 4 variation of moisture and light intensity is shown with respect to different timings. The user at remote place can visualize current data of greenhouse on web browser that is a ThingSpeak. The data about temperature, humidity, moisture and light intensity are shown appropriately on cloud platform with the help of IoT technology. Four channels indicate parameters of greenhouse graphically. In field 1 and 2 humidity and temperature is indicated. In field 3 and 4 soil moisture and light intensity is shown.

Table 1: Experimental results from ThingSpeak.com to excel sheet

1	created_at	entry_id	field1	field2	field3	field4
2	2018-01-06	34	25	20	1021	814
3	2018-01-06	35	25	20	1021	801
4	2018-01-06	36	25	20	1022	808
5	2018-01-06	37	25	20	1021	807
6	2018-01-06	38	25	20	1021	801
7	2018-01-06	39	25	20	1022	800
8	2018-01-06	40	25	20	1021	803
9	2018-01-06	41	25	20	1020	796
10	2018-01-06	42	25	20	364	778
11	2018-01-06	43	25	20	358	727
12	2018-01-06	44	25	20	353	729
13	2018-01-06	45	25	20	351	718
14	2018-01-06	46	25	20	349	786
15	2018-01-06	47	25	20	348	723
16	2018-01-06	48	25	20	344	726
17	2018-01-06	49	25	20	344	716
18	2018-01-06	50	25	20	343	708
19	2018-01-06	51	25	20	342	733
20	2018-01-06	52	28	23	342	712

Table 1 shows experimental results from ThingSpeak.com to excel sheet .The data is saved in excel sheet so that it can be seen any time by user. Four fields belong to environment parameters with real time values. Field 1 and field 2 represent temperature and humidity values and field 3 and field 4 belongs to moisture level and light intensity readings respectively.

6. Conclusion

The user is updated with data about temperature, humidity, moisture and light intensity on PC, through wireless data transmission from Wi-Fi unit. This system has been found to control greenhouse parameters and data made available to the end user. This system is small in size, so we can place it anywhere and installation is also easy. It is experimentally tested that the real time environmental factors are successfully monitored and controlled by

taking appropriate actions at Intel processor. Utilization of different sensors helps to handle the real time data efficiently. It can interact with other hardware through the network. Then the collected data and analysis result will be available to the end user through the Wi-Fi. The smart way to monitor parameters and an efficient, low cost system is presented in this paper. Data monitoring using sensor is much less labor intensive than periodic sampling by workers for most applications. With the help of latest technology farmer can increase his profit by solving different problems that are faced in his routine life.

References

[1] Vishwajeet Hari Bhide, SanjeevWagh: "i-learning IoT: An intelligent self-learning system for home automation using IoT", Communications and Signal Processing (ICCSP), 2015 International Conference Print ISBN:978-1-4799-8080-2 INSPEC Accession Number:15600141

[2] D. Pavithra, RanjithBalakrishnan: "IoT based monitoring and control system for home automation Communication Technologies (GCCT)", 2015 Global Conference on INSPEC Accession Number: 15636808, Thuckalay

[3] WeiminQiu, Linxi Dong, Fei Wang, Haixia Yan: "Design of intelligent greenhouse environment monitoring system based on ZigBee and embedded technology": Consumer Electronics - China, 2014, INSPEC Accession Number: 14904735

[4] Zhao Xiaoyan, Zheng Xiangyang, Duan Chen, Chen Zhaohui, Sang Shangming; Zhang Zhaohui: "The design and implementation of the greenhouse monitoring system based on GSM and RF technologies": Computational Problem-solving (ICCP), 2013

[5] Hesong Huang, Hongning Bian, Shuchuan Zhu, Jibo Jin: "A Greenhouse Remote Monitoring System Based on GSM": 2011 International Conference on Information Management, Innovation Management and Industrial Engineering (Volume: 2)ISSN: 2155-1456

[6] Jifeng Ding Jiyin Zhao, Biao Ma: "Remote Monitoring System of Temperature and Humidity Based on GSM": Image and Signal Processing, 2009. CISP09.ISBN:978-1-4244-4129-7 INSPEC Accession Number: 10956234

[7] BaoJieJi Wan ZhongLei, Shao Long Ji, Cai Hong Zou, "Design and analysis of intelligent greenhouse environment control system based on multi-sensor information fusion Computing", Control and Industrial Engineering (CCIE), 2011 (Volume: 1) ISBN: 978-1-4244-9599-INSPEC Accession Number: 12218331

[8] Pranay P. Gaikwad ,Priyadarshini, Jyotsna P. Gabhane ,Snehal S. Golait "A survey based on Smart Homes system using Internet-of-Things" , Computation of Power, Energy Information and Communication (ICCPEIC) 2015, INSPEC Accession Number:1544064, Conference Location Chennai

[9] Su Yang Su Tong, Liu Liang: "Remote farm environment monitoring system based on embedded system and ZigBee technology": Signal Processing, Communications and Computing (ICSPCC), 2015, ISBN: 978-1-4799-8918-8 INSPEC Accession Number: 15619940

[10] Tongtong Yin, Wenjie Feng, ZheyingLi: "Temperature and humidity wireless sensing and monitoring systems applied in greenhouse":Computer Science and Network Technology (ICCSNT),Volume:2 , INSPEC Accession Number: 12675206