Smart Agriculture System using IOT

S. Ayesha Tanveer, Namala Meghana Sai Sree, Bheemisetty Bhavana, Devana Hima Varsha
Department of ECE
Madanapalle Institute of Technology & Science
Madanapalle, India
ayeshaarz27@gmail.com, 18699A0454@mits.ac.in, 18699A0415@mits.ac.in, 18699A0436@mits.ac.in

2022 IEEE World Conference on Applied Intelligence and Computing (AIC) | 978-1-6654-7988-2/22/$31.00 ©2022 IEEE | DOI: 10.1109/AIC55036.2022.9848948

Abstract -- Agriculture is an important sector in Indian Economy, and it plays a vital role in the life of Rural India. The current technologies used by farmers requires a lot of manpower to function and also it requires continuous monitoring. Smart Agriculture using IOT is the automated way of performing agriculture where each thing required for plants is organized automatically based on the environmental conditions. This paper presents a design of simulation of such a system which is carried out in a visual simulation tool called Cisco packet Tracer. The simulator supports all the components for an IOT network design and the MCU board is programmed in python language for 2 cropping seasons kharif and Rabi in which the corresponding actuator will be set and reset to provide the required climate for the high productivity of the crop irrespective of the season. The entire status of the field will be notified to the farmer through the IOT server which can be monitored remotely by the farmer through his smart phone.

Keywords -- *Internet of Things, Cisco Packet Tracer, IOT Server*

I. INTRODUCTION

Today Internet has become most predominant thing across the world connecting not only human being but also a wide variety of appliances across the globe (commonly called as IoT). The Internet of Things is a model in which a processor and different kinds of sensors and actuators communicate with each other to perform a particular application [16]. To have the interconnection and intelligence, the IoT network is embedded with processors and Transceivers which get the inputs from sensors and act through Actuators. The storage and processing of data obtained from the sensors can also be done in the network itself or in a remote server through which it can be accessed by the end user. Digital Technologies like the Internet of Things is driving a huge change in agriculture too [15]. In agriculture field Iot enables the devices embedded with sensors to connect each other through Internet. The entire agricultural area can be monitored remotely and controlled Simultaneously, and it can connect devices including water sprinklers, pumps, and sheds weather stations, Home Gateway, and remote servers. The traditional method of farming requires a lot of manpower to function properly and requires continuous monitoring of the agricultural land. To keep in track with the advances in the Digital Era it will be recommended to include IoT in the agricultural practices too so that we can have advances in the productivity[1]. This also makes agriculture a normal phenomenon not only applicable to farmers, but even normal people can also perform it along their backyards.

In India, the agricultural crop year will be starting from the month of July, and it will be up to the month of June which is broadly divided into 2 cropping seasons a) kharif season b) Rabi season. Each type of crop requires specific set of climatic conditions for its proper growth and good yield. The crops which are grown in kharif season are also called as Monsoon crops because their seeds are sown in the beginning of the monsoons (June) and they are harvested after the end of Monsoons (September). The crops grown in the Rabi season are also called as winter crops since they are seed in the beginning of winter season (November) and harvested in the spring season (April).

Kharif Crops:

The crops which are grown in Kharif season are mostly dependent on the rainfall. The quantity of rain decides the yield of kharif crops and in the absence of required amount of rainfall a constant water level should be provided by the lawn sprinklers. Kharif crops requires hot weather and high relative humidity conditions in the environment. Mostly Rice, Maize, Ground Nuts, cotton are grown in the kharif seasons

Rabi Crops:

The crops which are grown in the rabi season require cold and dry weather conditions. Cultivation of rabi crops is only through continuous irrigation because no rain will be there in the rabi season. Wheat, Barley, Mustard are the common crops grown in rabi season.

In the proposed work, the Micro controller board in the Cisco packet Tracer is programmed in such a way that it provides the necessary environmental conditions to the crop according to the season despite of the climatic conditions of the surroundings

Architecture of IoT

The Architecture of IoT is confined to specific type and it may change from application to application. Basically, for Agricultural purposes IoT [19] can be broadly divided into the following layers.

978-1-6654-7988-2/22/$31.00 ©2022 IEEE
DOI: 10.1109/aic.2022.80

Authorized licensed use limited to: NIELIT Jorhat. Downloaded on February 22,2024 at 03:53:32 UTC from IEEE Xplore. Restrictions apply.

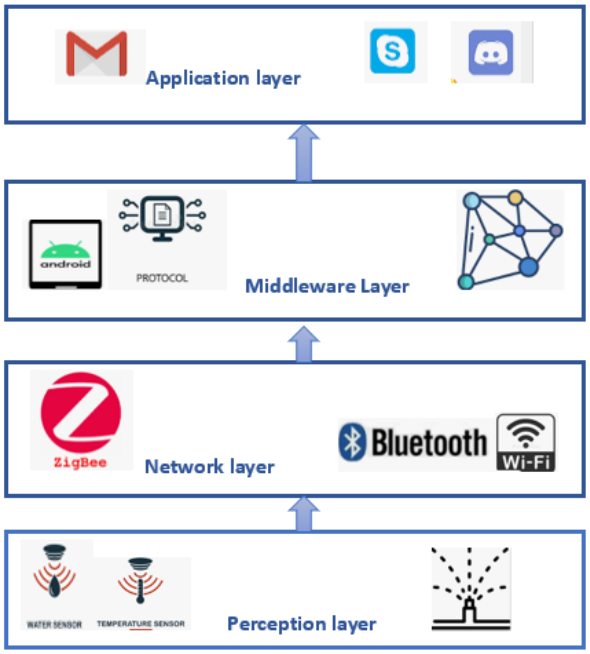

Figure:1 Layers of IoT

Perception Layer is the physical layer which will be having sensors and Actuators which are connected through the micro controller board to perform Real Time Operations. Network Layer is responsible for Connectivity between the Hardware at the Perception Layer with the Software at the Middleware Layer to aid data transfer. The Middleware layer acts as an interconnection between different components of the IoT Network [26]. The communication among the Network protocols, operating systems are provided in this layer. Finally in the Application layer the data obtained from the lower layers is reached to the end user (i.e., any website or any Android application).

An IoT based system requires even very less power because the power to the Hardware devices can be even produced by mini solar cells equipped in the field itself [18]. IoT based Farming methodologies avoids continuous monitoring by the farmer and it facilitates agricultural activities in even in our backyards. The main objective of this paper is to design a prototype of IoT based Agricultural Area Monitoring System in Cisco Packet Tracer.

Cisco Packet Tracer is an open-source Network Simulation Tool through which we can simulate IoT networks using the components present in it [7]. The IOT devices in the Cisco packet Tracer enables the user to simulate the different IOT applications like Smart Home, Smart Building, Industrial applications [2] as well as for agricultural purposes also. The issues and challenges of IOT in agriculture is reviewed in [5]. The proposal of IOT framework is explained in [25] with environmental sensing and controlling using actuators. Real time monitoring of agricultural field is done in [22] and [23] which used zigbee modules connected to Raspberry pi board and alert system using sms. In [20] temperature and humidity is monitored using sensors using cc3200 chip interfaced with camera and sends pictures through MMS to farmers using wifi. The simulation of IOT networks in cisco packet tracer is done in [10], [11] and [12] for fire detection and alert system, Hybrid wind solar energy desalination plant and regulating climatic conditions for poultry products applications. Simulation of smart Agriculture system using Arduino Board is proposed in [6] which used soil moisture sensor and pump actuator. In [9] a control center is used along with Micro controller unit to combine all the temperature, humidity, soil moisture and water sensor in cisco packet Tracer.

II. PROPOSED NETWORK CONFIGURATION

The proposed architecture presents a smart agriculture system which is a prototype and can be implemented in either nurseries or even can be implemented in our back yards where we can have our own plantations. The Simulation is carried out in Cisco Packet Tracer Software Version 8.1.0. Packet Tracer is an innovative Network Simulation tool through which we can create a network and configure them using a personal computer or even a Android based Mobile phone. The following figure shows the Network Topology diagram of a Smart Nursey implemented in cisco packet Tracer.

The proposed model is used to monitor the Temperature, Humidity Level, Smoke Level in the environment and water Level in the soil. From the network diagram of the Smart agriculture system, we are having 3 different connectivities among its peripheral components.

1. Home Network:

The Home Network comprises of the Nursery area, and we are having 2 different connectivities in the Home Network. One is between the MCU Board and the IOT devices (sensors & Actuators) for measuring the different environmental parameters of the surrounding area and the other one is between the Home Gateway and the IOT devices. A Home Gateway is a device which acts as a bridge between the Network provider and the Home Network. Along with the Ethernet ports it is also having wireless access point which can be configured to provide secure wireless connections to the connected IOT devices. It assigns IP addresses to the IOT devices connected to it after getting it from the ISP Router. The MCU board is connected to the sensors and Actuators through its analog and digital pins and is programmed to receive the analog values read by the sensor and converting them into corresponding digital levels. It is again connected to the home gateway to update the values measured by the sensors to the farmer.

Authorized licensed use limited to: NIELIT Jorhat. Downloaded on February 22,2024 at 03:53:32 UTC from IEEE Xplore. Restrictions apply.

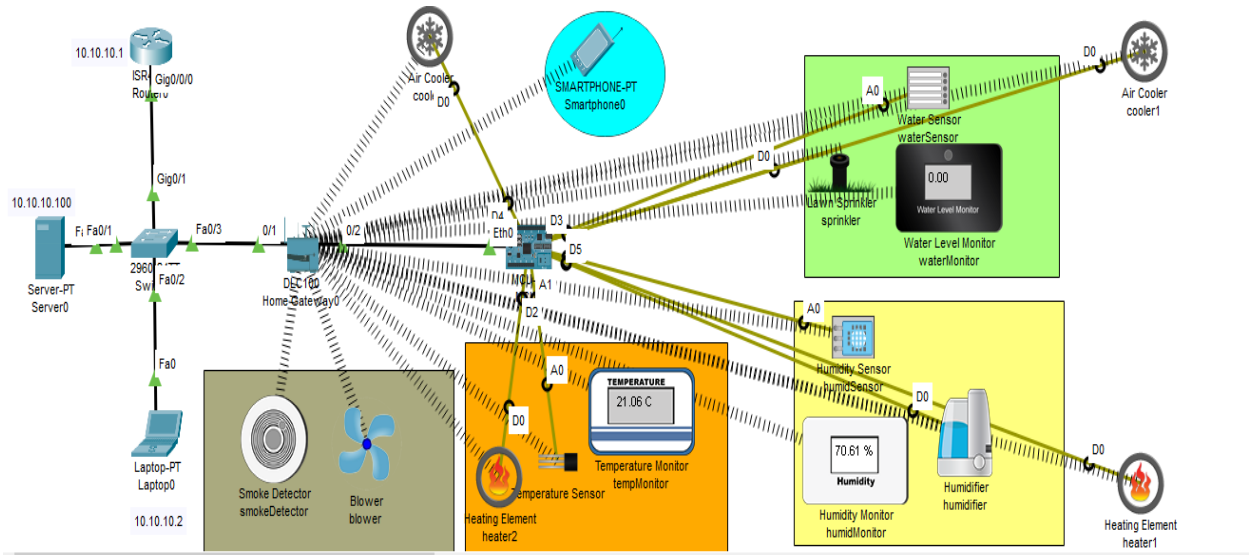

Figure 2: Configuration in Cisco Packet Tracer

2. WAN Network:

The second part of connectivity is between the Home Network and the Internet Service provider (ISP) router. It can be done by a simple copper straight through cable. The Home Gateway gets the IP address from the ISP Router as soon as the connection is established. The ISP router is configured with DHCP protocol, and it assigns the IP addresses dynamically to all the connected IOT devices.

3. IOT Server:

The other connectivity is between the server and the IOT devices which enables them to be configured remotely from any place. The IOT server uses a static IP address and creates a registration ID for that static IP address. All the IOT devices present in the system has to be logged in to the Registration server so that they can be remotely accesses through a web interface over a smart phone[13]. When all the devices have been configured to the IOT server and by opening the web page (static IP address of the IOT server) on a smart phone we can the list of connected devices and also their measured values of the surrounding environment.

The most important requirement for the growth of plants can be the water [14] that we irrigate our plants and the next comes the environmental conditions like Temperature, and Humidity. Here the Nursery is equipped with the Micro controller Board (MCU) and the required sensor and actuators which are connected to the MCU Board through its analog and Digital pins. In the given project Temperature, Humidity and water level for the crops are the parameters which are measured using the Analog sensors interfaced through the MCU board and in turn based on the measured values and the climatic conditions of the environment the corresponding actuators like Heating Units, cooling Units, Humidifiers and the Lawn sprinklers will be turned ON/OFF.

The table below shows the Sensors and their corresponding Actuators used in the project

Sensors	Actuators
Water Level Sensor	Lawn Sprinkler
Temperature Sensor	Heating Element
	Cooling Element
Humidity Sensor	Humidifier
Carbon Monoxide Detector	Blower

Table 1: Sensors and their corresponding Actuators used in the model

III. RESULTS AND ANALYSIS

The parameters and the average values measured for a simulation time of 1 hour for both kharif and rabi season and their graphical representation is shown below:

Water Level- The water sensor measures the water level in cms and it gives to the MCU Board's analog pin. Based on the programming in the MCU board the board will trigger the actuator (Lawn Sprinkler) to ON when the water level goes less than 10 cms. Average value of water level for a duration of 1 hour is obtained by measuring the water sensor values at each minute. The simulation results showed an average water level of 9.55 cms in kharif season and 17 cms in rabi season.

Temperature –The entire area of the Nursery is equipped with 2 heating units and 2 cooling units to maintain an average temperature of 31.18 ^{0}C in the kharif season and 20 ^{0}C in Rabi season.

Humidity – Humidity represents the content of water vapour in the air. Kharif crops require high humidity levels and rabi crops require dry humidity. The humidity sensor outputs the water vapour level in terms of analog voltage ranging from 0 to 255 which represents humidity of 0% and 100 % respectively. The

Authorized licensed use limited to: NIELIT Jorhat. Downloaded on February 22,2024 at 03:53:32 UTC from IEEE Xplore. Restrictions apply.

average value of humidity measured for a duration of 1 hour is 198 (77%) in kharif season and (44%) in rabi season. The MCU Board is programmed in such a way that it provides a high temperature in the range of 25-30 ^{0}c and 80% of Humidity in kharif season and a temperature of <20^{0}c, humidity less than 40% and water level of 20cms in the Rabi season

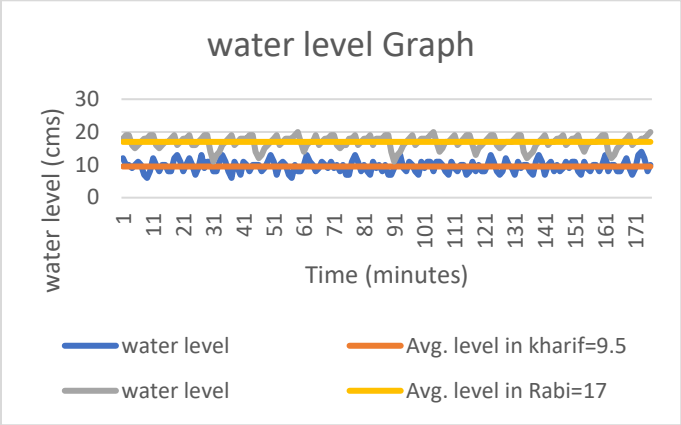

Figure 3: water level measured by the sensor

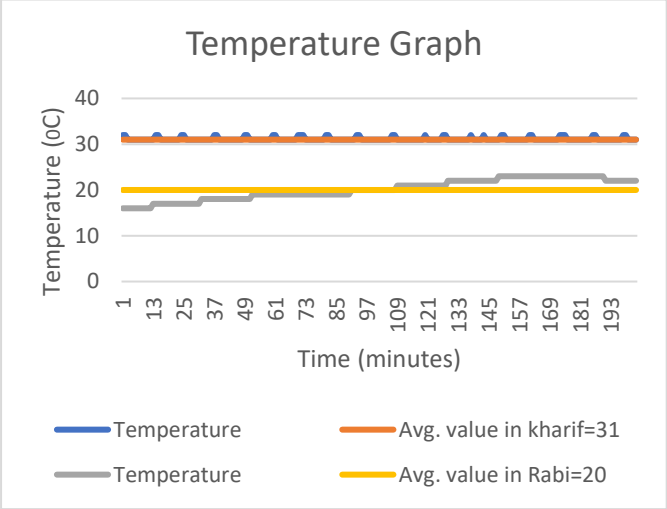

Figure 4: Temperature values

Simulation Mode:

Cisco packet Tracer is having 2 modes one is Real Time mode in which the designing of a particular system is being done and a Simulation mode which describes in detail about routing of data packets between each device in a network. We can even find the event list and time required can also be known. In an IOT network before starting of transfer of data packets between IOT devices their MAC address has to be obtained by querying through the server by executing the ARP protocol.

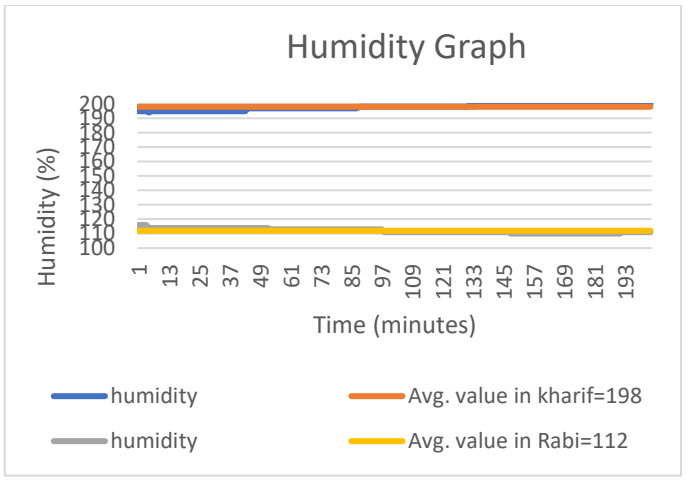

Figure 5: Humidity values

This has to be done with all the IOT devices in the network before starting of actual communication in the network. As soon the network is set to ON the router will assign IP address for all the sensors and actuators through DHCP protocol. For example, the simulation between water sensor and Lawn sprinkler is happened in the following steps:

Watersensor→HomeGateway→Switch0→Server→switch0→Home Gateway→lawn sprinkler.

Along with sending information to the sprinkler the corresponding value of water level is updated in the IOT server also which can be viewed from any smart phone.

IV. CONCLUSION

Our project is mainly about growing crops in smarter way by using a IOT based software called cisco packet tracer. For implementing our project remotely, the software has all the required equipments in it. All the sensors and their corresponding actuators are having dual connections i.e., one to the MCU board and the other to the Gateway device through which it can sense the parameters in the environment and can update the same data in the IOT server simultaneously. This method of agriculture system doesn't require continuous monitoring of plants and everything is automated which eases the procedures of irrigation for the plants which is the main objective our project. Further this project can be extended by adding the Soil sensors which will tell the farmer about the various minerals in the soil.

REFERENCES

[1]. V. Suma, "Internet of Things (IoT) based Smart Agriculture in India: An Overview" , Journal of ISMAC (2021)Vol.03/No.01,DOI:https://doi.org/10.36548/jismac.2021.1.001; ISSN: 2582-1369 (online)

[2]. Gwangwava, N. and Mubvirwi, T.B. (2021) Design and Simulation of IoT Systems Using the Cisco Packet Tracer. Advances in Internet of Things, 11, 59-76. https://doi.org/10.4236/ait.2021.112005

Authorized licensed use limited to: NIELIT Jorhat. Downloaded on February 22,2024 at 03:53:32 UTC from IEEE Xplore. Restrictions apply.

[3]. Rumee, A. R. (2021). IoT system for remote monitoring of mangrove forest the Sundarbans. Journal of Computer SciencesInstitute, 20,254-258. https://doi.org/10.35784/jcsi.2703

[4]. O. K. T. AL sultan and A. R. Suleiman, "Simulation of IoT Web-based Standard Smart Building Using Packet Tracer," 2021 7th International Engineering Conference "Research & Innovation amid Global Pandemic" (IEC), 2021, pp. 48-53, doi: 10.1109/IEC52205.2021.9476125.

[5]. M. R. M. Kassim, "IoT Applications in Smart Agriculture: Issues and Challenges," 2020 IEEE Conference on Open Systems (ICOS), 2020, pp. 19-24, doi: 10.1109/ICOS50156.2020.9293672.

[6]. Vadapalli, Adithya & Peravali, Swapna & Dadi, Venkatarao. (2020). "Smart Agriculture System using IoT Technology" Publisher: International Journal of Advance Research in Science and Engineering (2319-8354). 09. 58-65.

[7]. Manaligod, H.J.T., Diño, M.J.S., Ghose, S. et al. Context computing for internet of things. J Ambient Intell Human Comput **11,** 1361–1363(2020)https://doi.org/10.1007/s12652-019-01560-3

[8] Sahana B, D. K. Sravani , Dhanyashree R Prasad "Smart Green House Monitoring based on IOT", IJERT, Vol.8, Issue.14, August 2020.

[9]. Thera, David. Internet of things simulation using cisco packet tracer. Diss. Izmir Institute of Technology (Turkey), 2020.

[10]. Mirtskhulava, Lela, et al. "Environmrnal Monitoring in Flammable Climate Zones over IoT Cloud." International Journal of Simulation--Systems, Science & Technology 21.2 (2020).

[11]. Umair Yaqub, Ahmad Al-Nasser, Tarek Sheltami,"Implementation of a hybrid wind-solar desalination plant from an Internet of Things (IoT) perspective on a network simulation tool","Applied Computing and Informatics",Volume 15, Issue 1,2019,Pages 7-11,ISSN 2210-8327.

[12]. N. Afeez, S. A. Adeshina, A. Inci and M. M. Boukar, "A framework for Poultry weather control with IoT in sub-Saharan Africa," 2019 15th International Conference on Electronics, Computer and Computation (ICECCO), 2019, pp. 1-5, doi: 10.1109/ICECCO48375.2019.9043202.

[13]. Ardiansyah, Deden, et al. "Wireless Sensor Network Server for Smart Agriculture Optimatization." IOP Conference Series: Materials Science and Engineering. Vol. 621. No. 1. IOP Publishing, 2019.

[14]. Neha K. Nawandar, Vishal R. Satpute,"IoT based low cost and intelligent module for smart irrigation system",Computers and Electronics in Agriculture,Volume 162,2019,Pages-979-990,ISSN0168-1699, https://doi.org/10.1016/j.compag.2019.05.027.

[15]. M. Ayaz, M. Ammad-Uddin, Z. Sharif, A. Mansour and E. -H. M. Aggoune, "Internet-of-Things (IoT)-Based Smart Agriculture: Toward Making the Fields Talk," in IEEE Access, vol. 7, pp. 129551-129583, 2019, doi: 10.1109/ACCESS.2019.2932609.

[16] "Internet of Things (IoT) and its Challenges for Usability in Developing Countries" International Journal of Innovation Engineering and Science Research, Vol. 2 , Issue. 1 January 2018 by Egemen Hopalı, Özalp Vayvay

[17] R. N. Rao and B. Sridhar, "IoT based smart crop-field monitoring and automation irrigation system," 2018 2nd International Conference on Inventive Systems and Control (ICISC), Coimbatore, pp. 478-483, 2018, doi: 10.1109/ICISC.2018.8399118.

[18]. Zaharov, Alexandr A., et al. "Use of open-source Internet of things platform in education projects." 2018 Global Smart Industry Conference (GloSIC). IEEE, 2018.

[19]. S. Verma, R. Gala, S. Madhavan, S. Burkule, S. Chauhan and C. Prakash, "An Internet of Things (IoT) Architecture for Smart Agriculture," 2018 Fourth International Conference on Computing Communication Control and Automation (ICCUBEA), 2018, pp. 1-4, doi: 10.1109/ICCUBEA.2018.8697707.

[20]. S. R. Prathibha, A. Hongal and M. P. Jyothi, "IOT Based Monitoring System in Smart Agriculture," 2017 International Conference on Recent Advances in Electronics and Communication Technology (ICRAECT), 2017, pp. 81-84, doi: 10.1109/ICRAECT.2017.52.

[21]. Tarkaa, Nathaniel S., Paul I. Iannah, and Isaac T. Iber. "Design and simulation of local area network using cisco packet tracer." The International Journal of Engineering and Science 6.10 (2017): 63-77.

[22]. K. A. Patil and N. R. Kale, "A model for smart agriculture using IoT," 2016 International Conference on Global Trends in Signal Processing, Information Computing and Communication (ICGTSPICC), 2016, pp. 543-545, doi: 10.1109/ICGTSPICC.2016.7955360.

[23]. Nikesh Gondchawar, Prof. Dr. R. S. Kawitkar, "IoT based Smart Agriculture" at International Journal of Advanced Research in Computer and Communication Engineering Vol. 5, Issue 6, June 2016; ISSN (Online) 2278-1021 ISSN (Print) 2319 5940

[24] Sneha Angal, "Raspberry pi and Arduino Based Automated Irrigation System", International Journal of Science and Research (IJSR), Vol. 5 Issue. 7, July 2016.

[25]. Wu, Hao, Fangpeng Chen, Hanfeng Hu, Qi Liu, and SaiJi. "A Secure System Framework for an Agricultural IoT Application. " In International Conference on Computer Science and its Applications, pp. 332-341. Springer Singapore, 2016.

[26]. Fu Bing, "The research of IOT of agriculture based on three layers architecture," 2016 2nd International Conference on Cloud Computing and Internet of Things (CCIOT), 2016, pp. 162-165, doi: 10.1109/CCIOT.2016.7868325.

Authorized licensed use limited to: NIELIT Jorhat. Downloaded on February 22,2024 at 03:53:32 UTC from IEEE Xplore. Restrictions apply.