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STUDY ON GREENHOUSE AND MONITORING WSN SYSTEM INCORPORATING IOT

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ABSTRACT

In India is a country where farming plays a vital role in economy while over 40% of total population is involved in directly or indirectly into agriculture industries thus this review article includes a brief overview of greenhouse technologies includes structural details in contrast with automation technologies. Wireless sensor network (WSN) and internet of things (IoT) together can make the controlled climatic agriculture globally controllable and accessible. This article also contains the hardware approach towards greenhouse controlling system.

Keywords: WSN, IOT, Sensors, ESP8266E, Greenhouse.

I. INTRODUCTION

As we very aware of the fact that Indian economy is largely depending upon farming or business relating to farming in a survey report has been published by H. Plecher in 2020 according to which over 40% of workforce employed in agriculture in India [1]. India is a country with rich geographical, multicultural, and multilingual country whose 68% of population is still living in rural area and over 58% of population is either directly or indirectly related to farming industries. Thus, a vast range of challenges are raised against Indian government to increase the overall per capita income of India. Good production quality of food grain items while keeping the quantity of production high, food security for citizens, plant diseases and treatment, socioeconomical status of farmers and workforce belonging to farming. To fight against these challenges Indian government has implemented various schemes but the most quality and quantity of food grains production plays a vital role to increase the farmers income. There are various technologies that can implemented to increase the production / growth of plants. Protective agriculture techniques are very helpful for to grow farmers income and so the quality of grains / plants [2].

Greenhouse Effect

The scientific phenomenon of greenhouse effect is implemented in such kind of structures. Greenhouse effect is defined as – "The effect of heat retention in the lower atmosphere as a result of absorption and reradiation by clouds and gases of long-wave" [3]. Figure 1 shows the greenhouse effect that encounters due to earth atmosphere. 23 % of radiations are absorbed by Ozon layer then 29% of sun radiation is reflected back to space by bright bodies of earth while 48% of incoming radiation is being absorbed by earth surface which starts the effect of keeping the earth surface warm during the night time this is done by radiation of sun light from earth surface in the form of IR radiations out of which some part gets in to space while most of the IR radiation are reradiated to earth surface due to earth atmosphere.

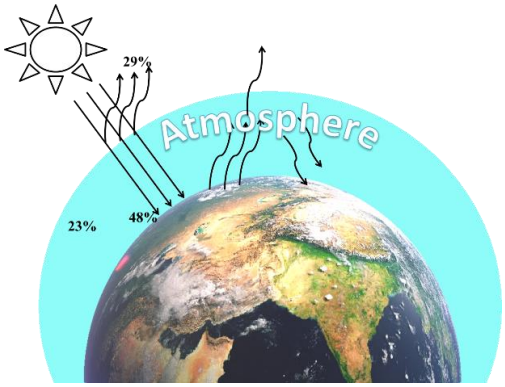

Figure 1: Sun radiation distribution in contrast with Greenhouse Effect

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Greenhouse farming

Greenhouses are often use for growing plant and vegetables. Main factors affecting plant growth are sunlight, water, soil moisture, temperature, humidity, etc. These physical factors are controlling manually inside greenhouse either by human begins or by automated system [4]. A typical greenhouse / glass house is shown in Figure 2. The life thriving achievement of greenhouse farming is to maintain a controlled and required climatic condition under the closed structure to improve the overall improvement of plants and food grains. There are various modern farming technologies that are incorporated together to improve the plants growth inside the greenhouse are Aeroponics – soilless farming that is done in the presence of air or mist, Aquaponics – a closed loop of aquaculture and agriculture, Hydroponics – requires less or no soil but maintains the mineral rich water solution, Monoculture selection of specific crop to grow in particular area, Vertical farming – this farming technology may be used in urban areas where farm land is low while requirements are high.

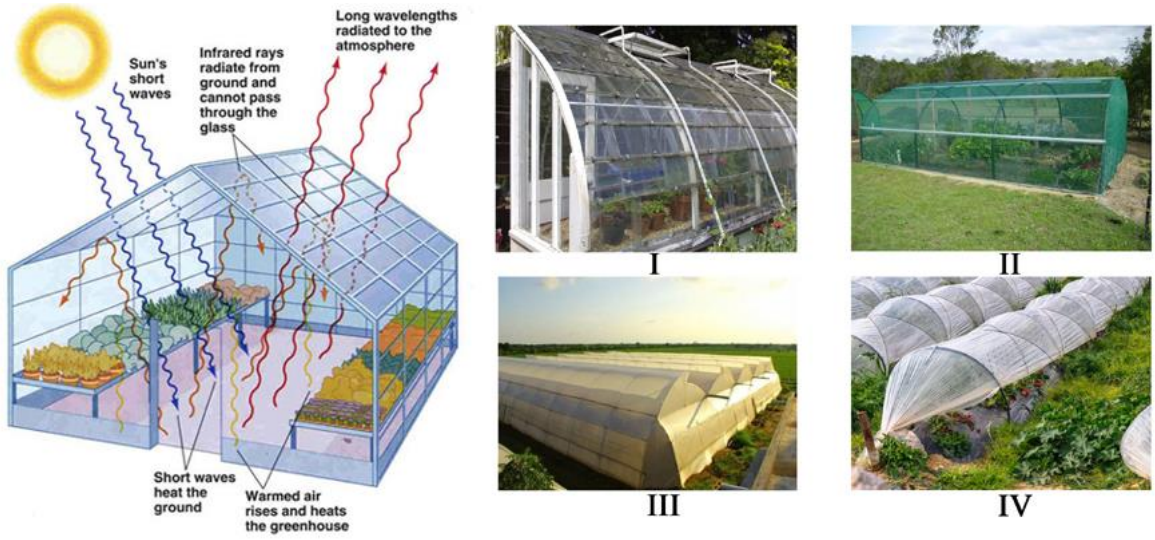

Figure 2: Typical Greenhouse / Glasshouse and structure types of greenhouses

Depending upon the structure there are major four types of greenhouse structures are shown in figure 2 –

- **Glasshouse** – Covering wall is made of glass such kind of greenhouse structures are used in cold and temperate climatic conditions [5].
- **Screen/Polyhouse** – Covering wall is made of transparent of translucent plastic material with some sort of window for supply fresh air [6].
- **Shade house** – Covering wall is made of woven material which helps fresh air, sunlight, and moisture can pass through it [7].
- **Crop top greenhouse** – It does not have side walls; it is structured like an umbrella for plant.

Based on automation technological approach used to design greenhouse structure are divided into three major parts Low Technology based Greenhouse Farm – these are used in cold and temperate climate areas, Medium Technology based Greenhouse Farms – greenhouses are metal structured and side walls are of either plastic or glass, High Technology based Greenhouse – metal structured and walls are of glass and have highly controllable climatic conditions.

II. LITERATURE SURVEY

"An embedded system is a microprocessor-based system that is built to control a function or a range of functions" [8]. Embedded system is embedded as part of an entire device often including mechanical and hardware parts. In contrast to a personal computer, it is designed to be flexible and to gather a wide range of end node-user needs. Embedded systems control various devices in common use nowadays. Embedded systems are controlled by one or most important processing cores that are typically digital signal processors (DSP) The key characteristic is being devoted to handle a particular task. They may require very powerful processors and broad communication [8]. Lilong Chai presented dual-roof solar greenhouse system that improves heat prevention capacity of greenhouse system [9].

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As we have discussed the three major greenhouse technologies those are LTG, MTG and HTG Greenhouse, LTG have manual control, MTG have moderate automation and HTG have higher level of controlled automation subsystem that is monitored and controlled by a controlling system known as embedded system. Shweta S. Patil, Ashwini V. Malviya proposed another solution for Agricultural Field Monitoring System using ARM and some sort of Wireless Sensor Network for making the agriculture filed sensing wireless and messaging feature for feedback purpose [10]

A water management system for sustainable irrigation is designed using wireless sensor network based IoT which concludes with system with over 25% water saving over conventional watering system using a small gardening system for 2 weeks. The communication between sensors is of two types first is Node to Node directly send information sensor node to sensor node using Lora Protocol and second is node to server communication using MQTT protocol [11]. Another irrigation system is developed an optimal irrigation management plan an IoT framework named smart & green framework. A framework is consisting of "A specific implementation of a skeleton of infrastructure used for the conception of a work" [12]. They do not use soil moisture sensor it uses some computational method for estimation of the soil moisture used by crop, weather condition, and irrigation data. This architecture is structured into four layers first is physical, communication, application, services layers [13].

III. THEORY

Wired Communication

In order to carry signals from transmitter to receiver on either end like in telephone line, optical fiber cable carrying light signals, coaxial cable for higher bandwidth, cooper wires are used simple wire connection. From the communication point of view coaxial cable and optical fiber cable are very useful coaxial cable are bulky in size, reduces crosstalk, lowering the losses. Optical fibers can be considered as extended version of coaxial cable which uses light for data transmission; range of optical fiber is ranges from 2-200 μm, crosstalk resistance, electromagnetic (EM) interference resistance and the cheapest solution for wired communication [14].

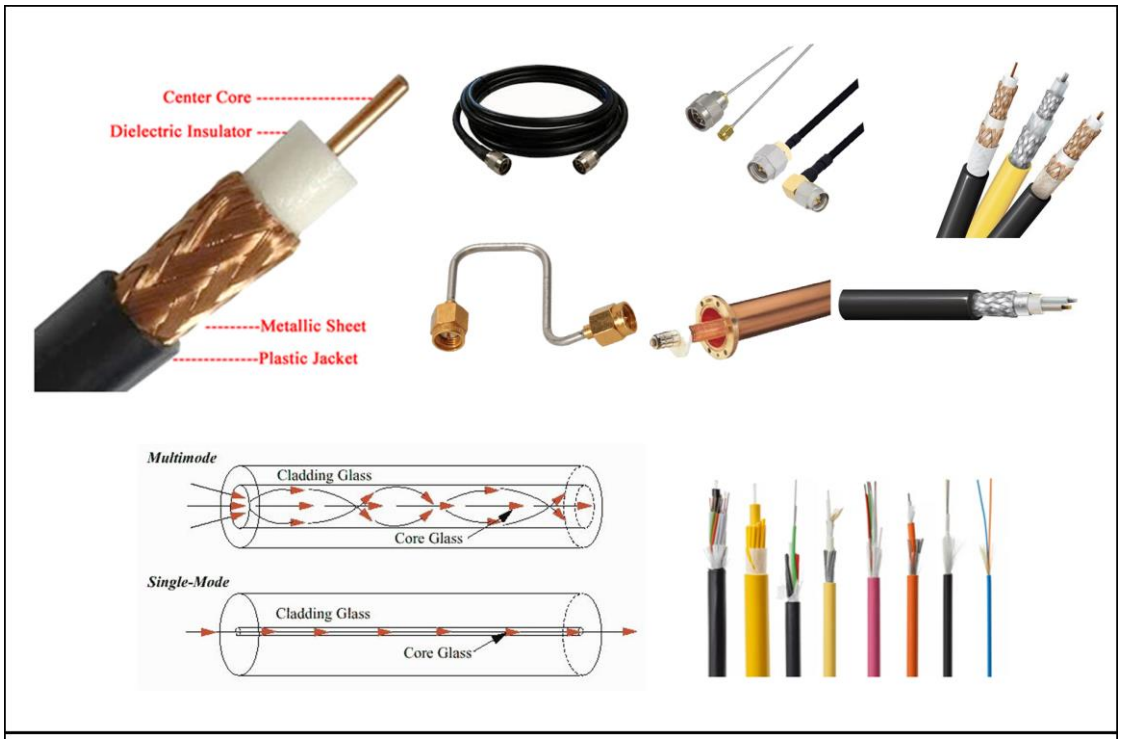

Figure 3: Wired communication cables

Wireless Communication

Data signals are transmitted over invisible radio waves, light, sound wave. From television remote to cellular phones everyday life has already been taken to next level by wireless technology. In a general sense sharing of information over two or more devices using any medium rather wire. Electromagnetic wave is propagating

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through space, carrying EM energy which includes microwaves, radio waves, visible light, IR, Ultraviolet, Gamma rays, X-Rays.

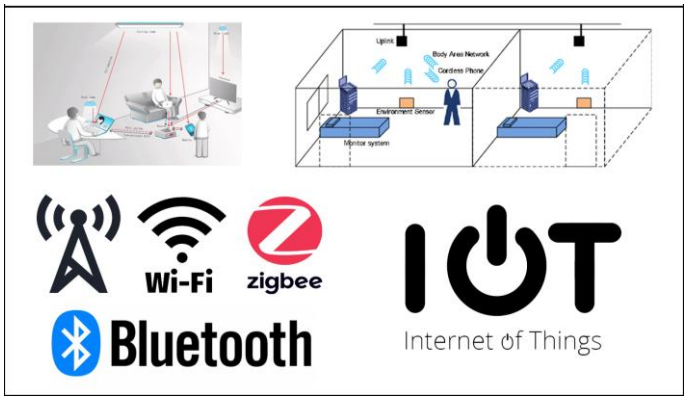

Figure 4: Various wireless technologies

Wireless sensor network

WSNs are the networks which formed with the group of devices that are equipped with some sensors to sense the specific space. The devices are meant to measure and record various parameters of environmental conditions of diverse locations. considering the WSN we can say a sensor network is collection of sensor nodes and each sensor node is consisting of sensors, control unit and a radio transceiver. The WSN is a type of Ad-hoc network whose main functions are monitoring and collecting the data and are self-distributed and organized system [15]. Any node in WSN may contain components shown in figure Power Supply – In case of wireless operation a Battery powered system is preferred. Sensor / Actuator – may contain in all connected nodes or may be obsolete in Router / Gateway / Sink Node. Controller Unit – Inbuild memory for storing temporary data, and controller for control over operations. Communication Device – It may change as per communication technology has chosen.

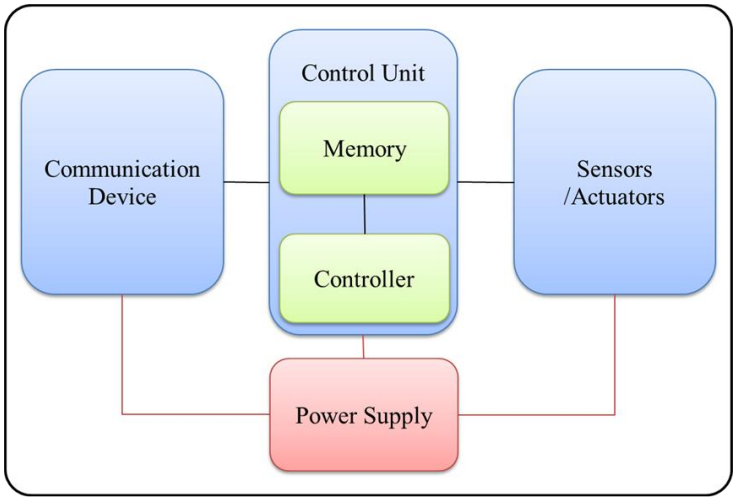

Figure 5: Block diagram of WSN Node

Internet of Things

The impression of IoT realized from increasing number of physical computing devices that are connecting to network of network i.e., to internet. A physical device is a device that has hardware device connected to network with specific application in the network. A smart home is an example of IoT that is enabled with Heating Ventilation and Air Conditioners monitoring and controlling. IoT empowered the physical devices to think, hear, see, and perform their job by talking together while sharing their information together. IoT can be seen as a technology that smartens the technologies collectively giving access to the Internet for monitoring and/or controlling purpose [16]. Elements of IoT shown in figure Identification - The ubiquitous codes (uCode) or electronic product code (EPC), Sensing - of collecting data from related object, Communication- Depends

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upon technology, Computation - processing unit and software application, Service - Collaborative Aware Services, Information Aggregation Services, Identity-related Service, Information and Ubiquitous Services.

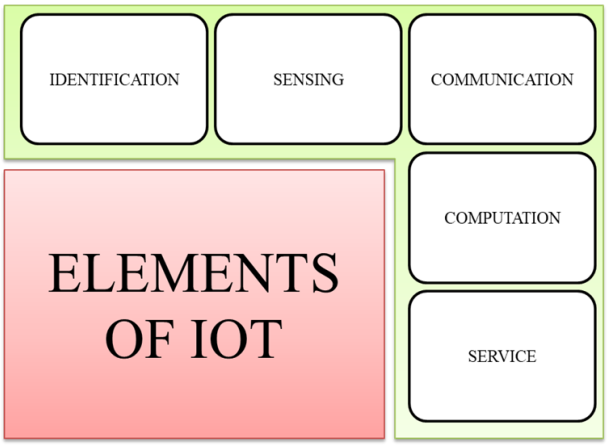

Figure 6: Basic Elements of IoT

ESP8266 NodeMCU

A SoC is a chip that integrates almost all components of a computer or any electronics device. It may contain digital, analog, mixed-signal, and often radio-frequency function these all features on a single chip. ESP8266E is a specially designed for mobile applications that have a high space and power constrains. ESP8266 is enabled with Wi-Fi to communicate sigh other devices of either of same type or other type of device [17]. There are around 17 GPIO's, One I2C, One I2S, Two USART, Four PWM Pins, One IR Controller, One 10-Bit ADC, Integrated TCP/IP protocol stack, Wi-Fi 2.4 GHz support. Figure shows the pinout of ESP8266E.

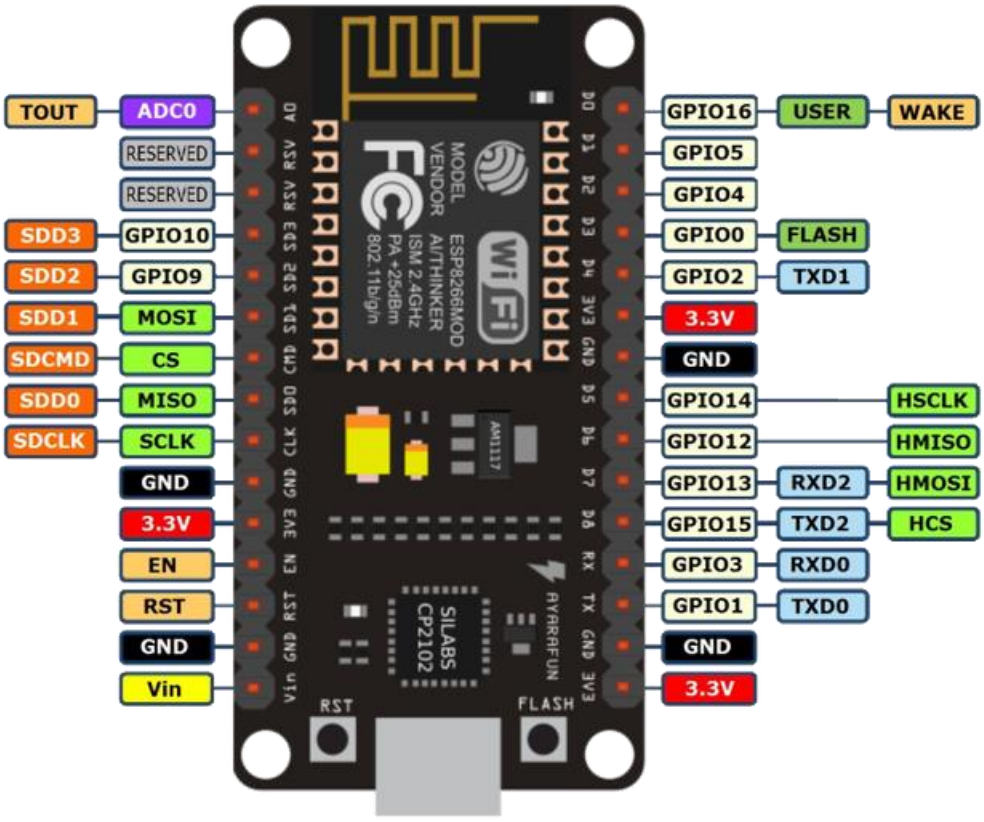

Figure 7: ESP8266E Pinout

Sensor

- **Light Sensor** – converts visible light / IR light into electrical energy. Light dependent register (LDR), photo diode, photo voltaic cell, photo conductive cell.

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- **Humidity Sensor** – The amount of water vapor in the air is known as Humidity. Higher the water vapor in the air the higher the humidity and so higher it feels wetter outside.
- **Temperature Sensor** – An electronic device that converts temperature of its outer environmental situation and convert in to electronic signal that will recorded monitored and then controlled by controlling unit.
- **Moisture Sensor** – The volumetric water content in soil is known as soil moisture there are various technologies used to detect soil moisture sensor out of them soil resistivity is the most commonly used soil moisture measuring technology.
- **Non-Dispersive Infrared (NDIR) Gas Sensor** – These devices are simply spectroscopic devices known for gas analysis using an IR source with light chamber and a wavelength filter and a photodiode. Gases are observed by specific wavelength that has been absorbed by gas molecules by means of opto-electrical absorption technology. All sensors are visible in figure.

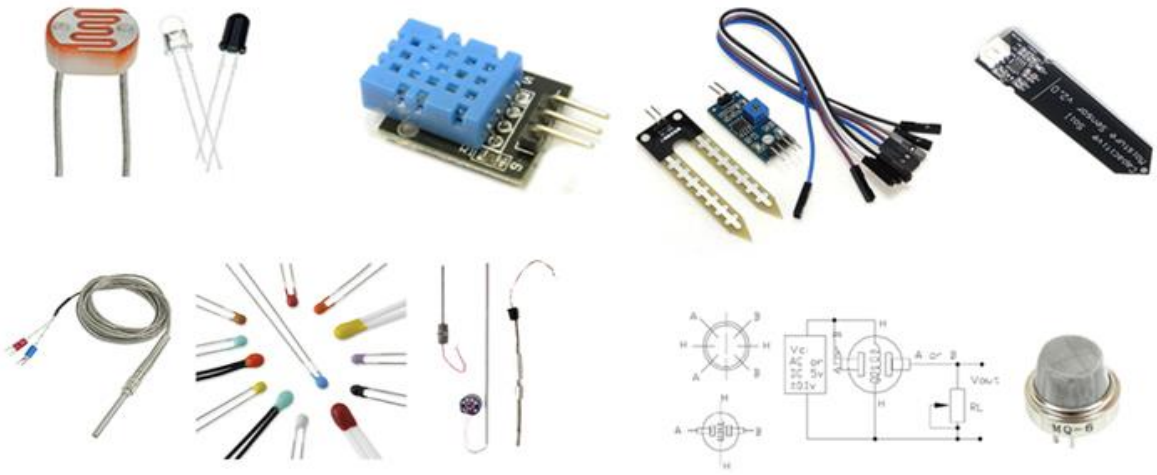

Figure 8: Sensor devices

IV. CONCLUSION

Smart greenhouse and monitoring system have been discussed in this article; things we have discussed can be implemented in any automatic greenhouse controller. ESP8266E microcontroller consumes less power which is Wi-Fi enabled and offers a higher functionality of operation. LDR may use for visible light detection, combined DHT11 detector senses relative humidity and temperature at the same time, NDIR gas sensor may be used to detect CO_2 and lastly the soil moisture sensors use conductive moisture sensor. With the help of Internet of things IoT we can connect the entire system to internet and then can be controlled and monitor from anywhere.

V. REFERENCES

[1] Distribution of the workforce across economic sectors in India 2020, Published by H. Plecher, Oct 20, 2020
[2] Jensen, M.H. & Malter, Alan. (1995). Protected Agriculture: A Global Review. 253.
[3] Allaby, M. ed., 2013. A dictionary of geology and earth sciences. Oxford University Press.
[4] Taleizadeh, Ata & Hazarkhani, Bita & Moon, Ilkyeong. (2020). Joint pricing and inventory decisions with carbon emission considerations, partial backordering and planned discounts. Annals of Operations Research. 290. 10.1007/s10479-018-2968-y.
[5] Grower's Guide: What are Cold Frame Greenhouses, ShelterLogic, Watertown, CT, USA, 2018.
[6] Empowered Smart Greenhouse Farming." IEEE Journal of Radio Frequency Identification 4.3 (2020): 195-211.
[7] Difference Between Shade and Green Houses? Clear Up the Confusion Here, C-MAC, Girraween NSW, Australia, Jul. 2019. [Online]. Available: https://www.cmac.com.au.
[8] Zhang, Yan Ping, and Li Min Liu. "The Embedded System Research for Multi-Definition Terminology." Advanced Materials Research. Vol. 694. Trans Tech Publications Ltd, 2013.
[9] Chai, L. , Wang, B. , Liu, M. , Wu, Z. and Xu, Y. (2014) Dual-Roof Solar Greenhouse—A Novel Design for Improving the Heat Preserving Capacity in Northern China. Natural Resources, 5, 681-686.

[10] Shweta S. Patil , Ashwini V. Malviya, Agricultural Field Monitoring System Using ARM, IJAREEIE, Vol. 3, Issue 4, April 2014, pg. 8781-8787

[11] Glória, A., Dionisio, C., Simões, G., Cardoso, J. and Sebastião, P., 2020. Water management for sustainable irrigation systems using internet-of-things. Sensors, 20(5), p.1402.

[12] Pressman, R. Software Engineering: A Practitioner's Approach, 7th ed.; McGraw-Hill, Inc.: New York, NY, USA, 2010.

[13] GS Campos, N., Rocha, A.R., Gondim, R., Coelho da Silva, T.L. and Gomes, D.G., 2020. Smart & green: An internet-of-things framework for smart irrigation. Sensors, 20(1), p.190

[14] Saedi, Taha, and Hosam El-Ocla. "Improving throughput in lossy Wired/Wireless networks." Wireless Personal Communications 114 (2020): 2315-2326.

[15] Networks Deepmala Verma, Gajendra Singh, Kailash Patidar "Review of Vampire Attack, In Wireless Sensor Networks", Dept of CSE, Shri Satya Sai Institute of Science & Technology, Sehore.

[16] Atzori, Luigi, Antonio Iera, and Giacomo Morabito. "The internet of things: A survey." Computer networks 54.15 (2010): 2787-2805.

[17] ESP8266EX Datasheet, V4.3, Espress if Systems IOT Team.