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Study on WSN based IoT for Greenhouse

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Abstract: - The aim of Indian Government for doubling the income by 2022 is the key objective. In Over 70% of population directly or indirectly dependent on farming and so the quality of food grains must be of high quality that can be achieved by some sort of controlled environmental approach and is known as greenhouse or glass house. While using greenhouse farming some technological implementation may improve the quality and functioning of the greenhouse. Using WSN in greenhouse farming may increase the intercommunication between sensors available at distributed sensor area and so the farmer may assume the proper requirement of water, light, air, humidity, and fertilizer and these also may automize using some sort of actuators. This article represents the various technological aspects and challenges and in terms of hardware implementation. Polyhouse an agricultural innovation to improve the crops quality by protecting crop from various outside environmental situation and another prominent technology that has been developed around is wireless senor network. This paper contains studies about polyhouse / greenhouse specific wireless sensor network architecture, components, tools needed for automation peripheral devices and in-depth information about Polyhouse / Greenhouse.

Index Terms **– Greenhouse, WSN, IoT, ESP8266.**

1. INTRODUCTION

Indian government has decided to double the farmers income by 2022 and is governed by Inter-Ministerial Committee in parallel government is focused on earning centeredness various schemes have been launched few of them are Soil Health Card Scheme, Pradhan Mantri Krishi SinchayeeYojna, National Agriculture Market Scheme, National Mission on Agriculture Extension and Technology (NMAET), Rashtriy Krishi Vikas Yojana with Har Medh Par Ped scheme [1]. The technological extension of farming is also one factor by which quality food grains can be grown on the same farm. Polyhouse / Greenhouse is also one of the most prominent technologies in which food grains quality is can be improved under some controlled environmental structure.

Greenhouse Effect – First let us consider the greenhouse effect according to oxford dictionary greenhouse is described as "The effect of hear retention in the lower atmosphere as a result of absorption and re-radiation by clouds and gases of long wave [2]. In general, the heat trapped due to sun light re-radiation between clouds and earth's surface or in a closed environment. This phenomenon keeps the earth warm and makes earth a place to live fig 1 represents re-radiation phenomenon. The natural effect by which earth surface get warms by absorption of reflected infrared radiation of Earth's surface is keyed as greenhouse effect that encounters the direct result on warming atmosphere of earth that maintains temperature of the dark side of earth with while sun is on other side. The trend was discovered by J. Fourier as early as 1827 and firstly quantified by S. Arrhenius in 1896[9].

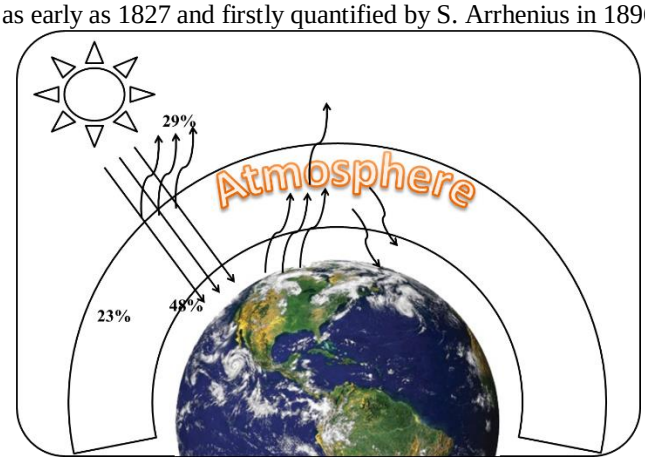

Figure 1 Re-radiation phenomenon

Initially solar radiation around 23% is being absorbed by ozone, dust and water vapor, 29% is being reflected-back to space by bright bodies of earth such as sea, snow, cloud while 48% is being absorbed by earth surface. Thus around 71% of sun radiation are absorbed by earth. Now, here the greenhouse gets started sun Earth surface starts radiating this stored energy in form of IR radiation a very less amount of IR radiation is being cross the earth atmosphere and pass through it while rest is reflected and scattered in all

directions due to clouds and molecules of greenhouse gases it finally results in warming up of lower atmosphere of earth and this natural phenomenon is described as Greenhouse effect.

Greenhouse Farming – It is structured with transparent or translucent material wall and roof in which climatic conditions are maintained and regulated as per required by the plant. The structures main feature is to hold the entire system and also to trap heat and farmer can also control over fresh air ventilation, water supply, fertilizers and $C0_2$, treatment as per need. Depending upon technology used greenhouse are classified into Low Technology based Greenhouse Farm, Medium Technology Greenhouse Farm and last High Technology [4] [5]. While based on size of greenhouse it is classified in to 4 main types – 1 Glass House, 2 Shade House, 3 Polyhouse or Screenhouse and 4 Crop-top Greenhouse [7].

Figure 2 Types of Greenhouses

2. Wireless Communication

Data 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. When a communication done over light and is done through visible light, Infrared light, free space optical communication. In case of sound waves greater than 20KHz ultrasound waves are used to communicate in between. In case of using radio waves communication transmission line uses encoder, encryptor, modulator, multiplexer, transceiver and similarly at the receiver end it contains transceiver, demultiplexer, demodulator, decryption, and decoder so it communicates between two or more devices. There are various communication technologies are also incorporated and are known as Wi-Fi uses 2.4GHz of frequency with a range about 20 meter [6]. Bluetooth a short-range communication technology that uses star topology [8]. Another communication technology Zigbee uses 2.4GHz frequency and IEEE network standards 802.15.4 that allow 64-bit address easily identify each device in the network its size of 128 bytes maximum while the payload of up to 104 bytes maximum [10].

3. 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 [6].

Block diagram of a general purpose WSN is shown in figure 3. Reasons behind the selection of WSN is over other communication network technologies are,

- In WSN any node can easily be reconfigured at any instance of time and can also be replaced by any other node, which is not possible in wired or any other technology.
- In WSN the precise position of node can be found that has been disconnected/ omitted by the network.

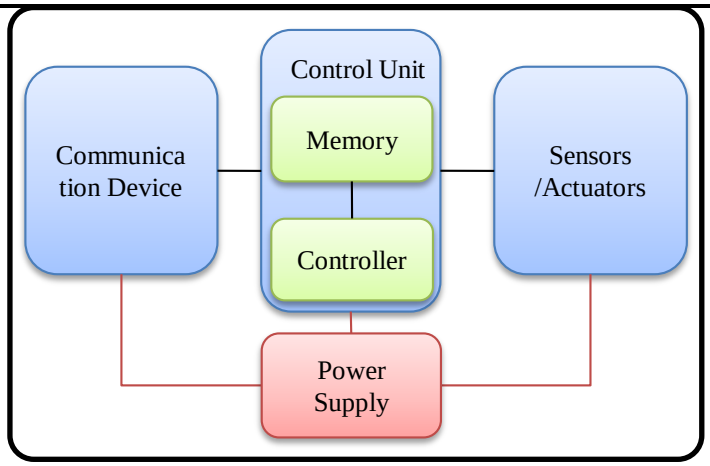

Figure 3 WSN Communication

4. Overview of Greenhouse IoT

The idea 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 [2]. Basic elements of IoT are shown in figure 4. Identification – ubiquitous code (uCode) or electronic product codes are responsible for identification of device, Sensing – data being collected by various sensor and stored over data base. Communication – sensed data is being transferred using wired or wireless technology. Computation – processing unit and software applications are responsible for computation of sensed and received data. Service the entire system is built to deliver some sort of services required by the system.

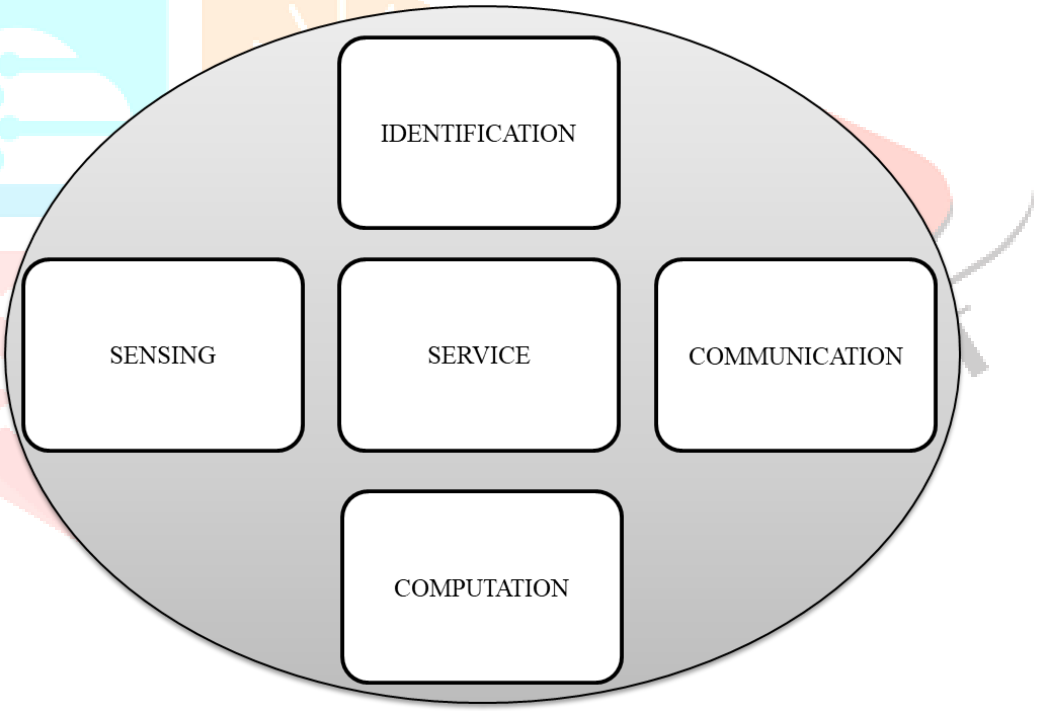

Figure 4 Elements of IoT

5. Application of IoT in Smart Greenhouse Farming

- **Maintaining Ideal Climatic Conditions**
  IoT sensors allow farmers to collect various data points at unprecedented granularity. They provide real-time information on critical climate factors including, temperature, humidity, light exposure, and carbon dioxide across the greenhouse. This data prompts relevant adjustments to HVAC and lighting settings to maintain the best conditions for plant growth while driving energy efficiency. In parallel, motion/acceleration sensors help identify doors that are unintentionally left open to ensure a strictly controlled environment.
- **Control over Infection and Disease outbreak**
  Crop infection is a persistent farming challenge, with every outbreak taking a heavy toll on the crop margins. Agrochemical treatments are available at hand, but farmers often do not know the best time to apply them. Applications done too frequently raise ecological, safety and cost concerns, while failing to use treatments could lead to detrimental disease outbreaks. With the help of a machine learning platform, data on greenhouse environments, external weather and soil characteristics reveal valuable insights into existing risks of pest and fungi. Leveraging this information, farmers can apply treatments exactly when needed to ensure a healthy crop at the lowest chemical expense.

- **Enhanced Fertilization and Irrigation**
  In addition to ambient parameters, smart greenhouses enable farmers to stay on top of their crop conditions. This ensures irrigation and fertilization activities are on par with the actual needs of cultivated plants for maximized yields. For example, readings on soil volumetric water content indicate whether crops are under water stress. Likewise, measurements of soil salinity give useful insights on fertilization requirements. Based on this data, sprinkler and spraying systems can be automatically turned on to address real-time crop demands while minimizing manual intervention
- **Improve Security**
  Greenhouses with high-value crops are a vulnerable target for thieves. As traditional surveillance networks with CCTVs are expensive to implement, many growers do not have an effective security system in place. In this context, IoT sensors in smart greenhouses provide an affordable infrastructure to monitor door status and detect suspicious activities. Connected with an automated alarm system, they instantly notify growers when a security issue arises.

6. NodeMCU – ESP8266

To incorporate IoT's features in greenhouse a microcontroller enabled with Wi-Fi / Internet is required which either be done by wire or wireless. In case of providing ease of implementation Wi-Fi enabled System on Chip (SoC) ESP8266 is best suits for wireless and efficient communication. It contains – One ADC, One 10-Bit DAC, Seventeen General Purpose Input/output GPIO's, Secured Digital Input/output (SDIO), One I2C, One I2S, Two USART, One Serial Peripheral Interface, Four PWM with 16 Mbyte of SPI Flash memory the entire system is controlled by a low power 16 bit RISC architecture based on Tesilica L106 32-Bit microcontroller [11].

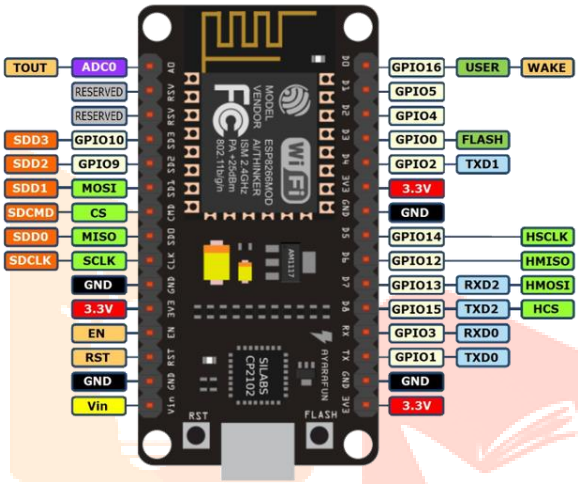

Figure 5 Pin out Diagram of ESP8266

7. Conclusion

In order to increase the farmers income, one must have to increase the production under controlled environmental condition in a Greenhouse. This paper presents study about various communication technologies that involve in greenhouse automation. The paper is mainly focused on application of IoT in greenhouse.

REFERENCES

1 https://pib.gov.in/Pressreleaseshare.aspx?PRID=1539485
2 [4] Allaby, M. ed., 2013. A dictionary of geology and earth sciences. Oxford University Press.
3 [9] Atzori, Luigi, Antonio Iera, and Giacomo Morabito. "The internet of things: A survey." Computer networks 54.15 (2010): 2787-2805.
4 A. Pardossi, F. Tognoni, and L. Incrocci, "Mediterranean greenhouse technology," Chronica Horticulturae, vol. 44, no. 2, pp. 28–34, 2004.
5 C. A. van der Spijk. Greenhouse Technology Adoption Among Small and Medium-Scale Tomato Farmers in Kenya. Accessed: Dec. 20, 2019. [Online]. Available: http://www.3r-kenya.org
6 Nassa, V.K., Wireless Communications: Past, Present and Future. Dronacharya Research Journal, 50, July-Dec 2011.
7 Rayhana, Rakiba, Gaozhi Xiao, and Zheng Liu. "Internet of Things Empowered Smart Greenhouse Farming." IEEE Journal of Radio Frequency Identification 4.3 (2020): 195-211.
8 Sairam, K. V. S. S. S. S., N. Gunasekaran, and S. Rama Redd. "Bluetooth in wireless communication." IEEE Communications Magazine 40.6 (2002): 90-96.
9 Svante Arrhenius (1896). "On the influence of carbonic acid in the air upon the temperature of the ground". Philosophical Magazine and Journal of Science. 41 (251): 237–276.
10 XBee Series 2 OEM RF Modules, by MaxStream, Inc. - a Digi International brand
11 ESP8266EX Datasheet, V4.3, Espressif Systems IOT Team