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Review on IoT in Agricultural Crop Protection and Power Generation

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Abstract - *Agriculture is the science and art of cultivating plants. Agriculture plays major role in the economic development of our country and this is the primary occupation from many years. In order to increase the productivity of the crops and to minimize the expenses of agricultural practices we adopt smart agriculture techniques using IOT. It includes various features like solar power generation and advancement in modern agriculture crop protection using greenhouse/polyhsouse. It makes use of GSM technology for intimating the cultivators about various environmental factors continuously via SMS. The sensors are placed at different locations in the farm, by which the parameters can be controlled using remote or through internet services and by interfacing the sensors operations are performed with microcontrollers. India is the second most populated country. Power generation and supply is always a big problem. This paper mainly addresses power generation and rainwater harvesting as a power generation method using solar energy along with crop protection.*

Key Words: Crop protection, Security, GSM technique, power generation, Sensors, polyhouse.

1. INTRODUCTION

In these days, farmers are shifting from agriculture to other professions due to lack of financial protection. Climatic change, water resource are the significant challenges for the farmer. More than 95% farmers in India uses the traditional farming technique. In order to earn more profit from agriculture, modern farming technologies must be adopted such as greenhouse farming, hydroponic farming, tissue culture, vertical farming etc. Greenhouse farming is a technique of adopting modern farming technologies to provide favorable environmental conditions to the plants. This technique is used to protect the plants from adverse aerial conditions like wind, cold, excessive radiation, extreme temperature, diseases and insects. The characteristic feature of the greenhouse farming to create an ideal microclimate around the plants. By adopting the greenhouse farming it is possible to modify the internal environmental conditions, so that they can grow any plant in any place at any time by providing acceptable environmental conditions with minimum labor. These greenhouses are metal framed structures covered with transparent material with large enough area to grow crops under fully controlled environmental conditions to yield required growth and productivity. Modern greenhouses provide monitoring of total area using timely computer screening installations such as heating, cooling, lighting to grow plants in optimal conditions and managing microclimate. The development of greenhouse crops is classified as an important technology to increase the quality and quantity of agricultural products by providing microclimate conditions for plants growth, watering the plants depending on the required amount and time. The adoption of the greenhouse technology also addresses the optimization of water resource management, power utilization by saving government's subsidiary electricity. The automation in agriculture sector proves an efficient and economic method of irrigation.

Fig-1: Polyhouse

1.1 Related Work

In some regions the water supply is insufficient, in that regions there is necessity of preserving of the water for agriculture. Conserving of rainwater helps in various agricultural needs. This can be achieved using rainwater harvesting and other advanced irrigation techniques helps in better use of water. The main key to overcome is to establish a various domain of concern such as land, farm, water tank etc. There are some advancements irrigation engineering techniques i.e., drip irrigation, site-specific variable rate irrigation. By using these techniques, the farmer gets benefitted by the reduced water consumption and reduced soil evaporation loses. Initially irrigation project cost is high because of this, taxes to the cultivator is more in the form of levy. The proposed system requires more operating knowledge for farmers. By using sprinkler irrigation method crops can damaged because by changing the sprinkler system many times, also water should be clean while using the sprinkler method. [1]

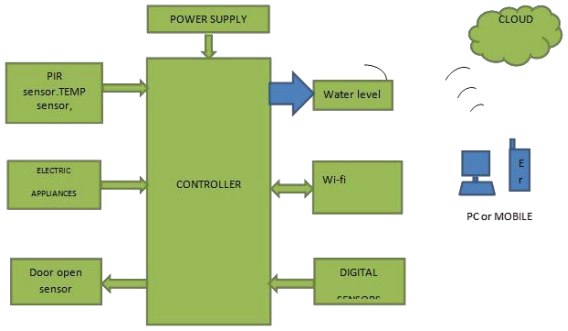

Fig -2: Block Diagram

To monitor temperature, humidity and moisture in the soil of agricultural land done by using IOT. Large number of crops have been destroyed due to difference in weather condition. Sensors collect the field information i.e., more accurate and measure the various parameters like temperature, moisture, humidity content in soil which helps to reduces the problems in agricultural field. The RFID technology is used to track and identify the object or a crop and also it helps in communication by sending or receiving information. The moisture contents in the soil is sensed by using the moisture sensor and it will identify the amount of water supply required to the crop and sends data to RFID and enables the sensor to supply water which automatically turn on the water source and turn off it when need is satisfied. The process of encryption of data stored in RFID systems can be quite expensive. Also, the cost of RFID tags is higher when compared with other alternatives. [2]

The internal parameters of Greenhouse can be controlled by modifying temperature, humidity, concentration CO2, micro/macro nutrients. We know that greenhouse is the climatic model has nonlinearity, strong coupling, feedback-feed forward linearization and decoupling. To overcome from this PSO-PI is used. Firstly, nonlinear multiple inputs multiple outputs MIM0 system. This transferred to SISO to eliminate the temperature and humidity coupling. The major disadvantage is when PI used alone it works poorly. [3]

Automatic control of temperature in green house is done by using a technology called commercial embedded system. The system is designed in such a way that it can provide the appropriate air temperature in the region where the crops are grown. The measured data is given to the algorithm of cascaded PID and it is implemented in embedded system. Manipulates actuators like heating, cooling and fans with respect to the actuators. It is difficult to distribute the fresh air to entire greenhouse. The main disadvantages are lack of water, salinity, higher air temperature and levels of humidity. [4]

The system to monitor agricultural land is developed by using WSN. From the level of production and quality of crops increases. The main advantage of this is no manual interface. The factors on which production, Quality and growing level depends are temperature, humidity and water level. We can also call WSN as WSAN where physical and environmental conditions like temperature, sound, pressure and other are monitored using autonomous sensors which are distributed. To monitor and crop production microcontroller along with sensors are used. Depending upon the threshold value motor is automatically controlled. Through IOT monitored data is sent to cloud.so that farmers can get the data easily. Disadvantages are low response of WSN, less accuracy and cost of the technology is more. [5]

The parameters such as air humidity, temperature, ground moisture and environment lightness can be controlled under greenhouse environment. The data collection of these parameters can be done by using hierarchical WSN technology. The lower level consists sensor nodes, the middle level consists of router nodes. This node transmit data from sensor nodes to a coordinator node. The coordinator node (highest level), is used to communicate with a central base, where all data received are analyzed in each sensor node and the water pump is controlled in response to the soil sensor node. Sensor values are captured by microprocessor by reading the analog port. These values are converted to a scale from 0 to 9. A lower value represents dry soil, and a higher value represents wet soil. If the value indicates that the soil is dry, the coordinator node will send a message to the actuator in which it turns on the water pump. The inconsistent use of intermediate nodes can lead to complexity in routes and it causes multiple route request messages in response to a single route request message thus it can lead to heavy control overhead. [6]

To monitor agricultural land conditions, to control water irrigation and to take proper decisions, actions for that is the main agenda of this paper. In this paper WSN is used. WSN contains nodes of sensors where each node can detect physical parameters like light, heat, pressure and other. WSN has networking capability so that monitoring can be done continuously. WSN are very popular and advantageous method of data collection from that communication, efficiency, reliability of the system is improved. WSN is very powerful to collect the data and process the data. The cost and energy consumption of this system is less. [7]

The greenhouse which can monitor real time sensors, control the switches and the data is analyzed dynamically and efficiently by using Splunk platform. Hardware of this have two parts sensors/actuators, severs. Raspberry Pi and notebooks are in servers. The information from sensors/actuators is given to web applications to facilitate the users. So that it is easy to control actuators and switches. Disadvantages are Splunks very expensive, dashboards functional but not as effective as some other monitoring tools. We need to spend lots of time to learn those tools [8]

Management of greenhouse using IOT is done by using sensors networks and technologies based on web. This IOT

contains technologies and processors which have capacity of process large data. Hardware devices connections are done by short distance wireless communications technologies like Bluetooth, Wi-Fi and Zigbee. To manage system parameters like temperature, humidity by using remote and to view the greenhouse status, Zigbee is more advantageous to make system more secure we need to adopt higher technologies. The transmission rate of this system is less. If we adopt Zigbee then cost will increase further. If we want to make the system smaller, use less sensors, simplify Zigbee networks, improve area of green house will increase system complexity. [9]

The economy water in underground is increased by irrigation system through smart climate agriculture which concentrate more on climatic changes which affects the security offered. This simple system which can be built by using less cost and that system can monitor soil moisture using sensor and schedule plant irrigation using GSM. We can control and monitor the system using Zigbee also automates the irrigation through simple WSN. No self-power generation in this system and power is externally supplied by the battery. [10]

In tropical countries green houses are suffering from controlling the changes in temperature and humidity. This research paper finds a solution for controlling some parameter under greenhouse condition in tropical countries which consists of humidity and temperature. The different inside and outside parameters of greenhouse is monitored in the first step. In accordance with the monitored data system of climate control is designed in the next step. The greenhouse construction is done in such a way that it is flexible for the air flow and ventilation process by measuring the internal conditions inside the polyhouse by using the system which can monitor climate and that system which is outside the green house. The disadvantage regarding to this research is damaged sensors and errors in data processing system can cause problems in decisions which may be lead to excess use of water, fertilizers and other dissolution of resources. [11]

Greenhouse with manual systems are monitored by workers every day. Temperature and humidity monitoring causes discomfort to the worker as visit the greenhouse every time and controlling the parameters. The adoption of IOT in greenhouse provide the solution for the existing practical problems. These includes temperature, humidity and moisture contents so these sensors configured to microcontroller to analyses the parameters. The watering of crops is provided with suitable type of irrigation. Once the threshold values of sensors fall below the reference values, the microcontroller decides and take suitable control actions via cloud platform. Thus, enabling the sensors to meet the required threshold values. The disadvantages of system are there is no adaptions of IOT in greenhouse it fails to provide manual control, and real time communication to the farmer. [12]

The growth and development of crops in greenhouse are mainly influenced by the air temperature and climate distribution. The outside and inside parameters like air temperature, radiation of soil and humidity are measured. To predict and simulate the generated energy annually at different angles is done by Polyson program. The BIPV panel is installed at a tilt angel of 30 degree which is placed just to cover south roof part (BIPV panel parameter depends on temperature). Installation of semitransparent photovoltaic on greenhouse depends on temperature parameter. When solar radiation falls on the semitransparent photovoltaic it converts solar energy into electrical energy so that power is generated. The disadvantage is power generation is less. [13]

The advancement and installation of IOT in greenhouse leads to smart system automation and control of internal parameter through scientific and efficient manner. This automation of greenhouse adopted is done through stages such as, layer of recognition, network construction, management service and compressive applications. The layer perceptual recognition layer is used to collect various greenhouse environment factors which has direct contact with the sensors installed at different places in greenhouse. The hardware of the system includes greenhouse gateway devices which mainly functions with the reliable communication with cloud services, heating device control, equipment of irrigation, ventilation and high compensation in green house. The sensors nodes mainly function to collect sensed information send to gateway devices. Information from nodes of sensors are transmitted through serial port of wireless communication system. These highly intermediate nodes lead to inconsistent data with multiple route access in response to the single route access which leads to heavy control overhead. [14]

The agricultural automation improves irrigation, protects land and manage the health of crops. To improve irrigation, to monitor things, a system to identify and classify affected plants autonomous rover is used. Autonomous rover performs in three levels. First level which is basic consist of motor, encoder, chassis and battery. Second level consist of main board and motor driver for controlling. For autonomous navigation last level has IMU and GPS. Because of less humans to do physical work many people lost their jobs. [15]

Water management system using IOT is designed where Lora communication cannot connect to internet manually as well as automatically. From the sensors embedded in the farm tunnels and other locations system receives real time data. After that capacity check and water scheduling will happens. To that particular data and time of watering scheduled, system gives notification to the user so that water pump will be switched on to water the Usage of multiple technologies leads to complexity and many other factors affects price. [16]

The automation of the greenhouse system consists of execution of miniature system with a scale of 1:10. The

development board is equipped arduino, humidity, temperature and light intensity measuring sensors. The microcontroller development board arduino is configured with converters, circuit brakes to drive motors when necessary. The data collected by the sensors such as temperature, humidity sensors are interfaced with serial communication to the computer. Considering all the factors, it is very difficult to analyze and decide if automation system is efficient or not. [17]

The application of excessive pesticide to the plant cause harmful impacts on the environment. The IOT feature of managing crops production in precision agriculture optimizes the quality of crops by applying required nutrients. The application of machine learning algorithm and graphical user interface are deployed with sensing networks to gather the required field data of some crops such as potatoes, cabbage, tomatoes etc. The gathered data from sensing nodes are fed to machine learning algorithm displaying both data and warning message through a graphical user interface. [18]

2. CONCLUSIONS

The advancement in modern agricultural can help crop to grow efficiently. It is difficult to consider if automation system is efficient or not in a greenhouse. The measured data is not so accurate to make the intelligence decision. The automated irrigation system uses less cost, feasible, optimizing water resources for agricultural production and allows crops to cultivate where there is scarcity of water so that sustainability will improve. The solar energy and rainwater harvesting as a source for power generation. The strengthening of the agricultural sector includes watershed management, drip irrigation and resource management. The advanced modern innovations in agriculture as applicability in infrastructure development, supply chain management, traceability, quality, logistics and distribution.

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