PROTOTYPE MODEL OF POLY HOUSE FARMING USING SENSOR AND IoT TECHNOLOGIES

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***Abstract*— In recent years yield from the agriculture fields was affected by the climate changes due to pollution and global warming etc. Another reason is that still our farmers are practicing conventional practices. On the other hand resources like land and water are diminishing These are the main challenges concentrated in this research by using green technologies i.e. poly house farming. Hence the work in this paper was focused on improving the yield from the agricultural domain by implementing end-end solution to control parameters such as temperature, humidity, soil moisture, CO2, light intensity, rainfall, tank level etc. This work is also concentrated on rain water harvesting. The data from the sensors was analyzed using cloud server and subscriptions are sent to the end users using GSM and Android app. It is observed that yield was increased with high quality and optimal resource utilization.**

***Keywords*— Polyhouse, Sensors and Actuators, IoT, GSM, Android App**

I. INTRODUCTION

Agriculture is the key industrial sector and contributing 15.87% to nation's GDP. Population growth and erratic climate changes due to pollution and global warming are affecting agricultural yield especially yield of some kind of flowers, fruits and vegetables which raises a crisis leads to the increased imports and payments hence burden the economy. Addressing these issues and earning more profits from this sector is possible by the adoption of modern farm practice techniques such as greenhouse farming (Polyhouse farming), hydroponic farming etc, will improve the living standards of our Indian farmers and also reduces unemployment by stopping shifting people from farming to other professions to some extent. This paper explains the method of implementation of protected cultivation using Polyhouse or green house cultivation using sensor technology, GSM, cloud and IoT. Greenhouse farming allows year-round cultivation, by having proper agronomy support one can arrive early or continue late in the market. Hence the sensitivity analysis of investment to return is low if one can have proper predictions on crops, market needs, seasonality and scale of investments, interest on borrowed capital etc. The suitable crops are tomato, cucumber, capsicum, rose, carnation, gerbera, anthurium, straw berry, bell peppers etc. Poly houses are primarily constructed to extend growing periods of crops or to increase off-season yields by controlling parameters such as temperature, nitrogen and light etc in the house.

II. MOTIVATION

Villages are the backbone of the country and most of the people are living in villages. Rural industries i.e. agriculture and allied sectors should play key role in the contribution of national income. But the farmers of India are facing so many problems due to climatic conditions. The motivation behind this research is introduce the technology in agriculture and developing it as rural entrepreneurship in concurrence with Gandhian vision using less resources and producing more quality yield from the farms. It has to increase rural employment and agricultural productivity. It will useful to realize the concept of "Think Globally and Act Locally". Especially it will useful to support the food needs of newly formed Andhra Pradesh state.

III. RELATED WORKS

Prathiba. Jonnala, Sadulla. Shaik. [1] have designed a prototype of polyhouses using AT89S52 microcontroller. This prototype can measure and control the parameters like Temperature, Humidity values. And by mobile communication SMS will be sent to farmer using GSM. T C Jermin Jeaunita, Sarasvathi V, Harsha M S, Bhavani B M, Kavyashree T [2] have implemented a greenhouse system based on IoT using Node MCU. This system uses MQTT protocol for device to device connection. This system can automatically detect and control all the paremeters like soil moisture, air humidity, light intensity inside the greenhouse. G.K. Banerjee, Rahul Singhal. [3] have proposed a method for polyhouses using PIC 16F877A Microcontroller. This system can detect the relative temperature and relative humidity and control them by using the relay switching the actuators. Susan Nnedimpka Nnadi, Francis E Idachaba. [4] implemented a Greenhouse model using Arduino mega. This model can keep the temperature, humidity, light and soil moisture in optimised condition and the sensed data is pushed into the cloud and android application. V. Chaithra, C. Harshitha, K. T. Shwetha, U. R. Sowmyashri, S Ramesh. [5] have proposed a prototype of polyhouse using Arduino which can detect and control the parameters like temperature, humidity, light and soil moisture automatically without any human interference. Earlier solutions existing in this area are focused on few parameters [7,8,10,11,13,14,15,16], less computational capabilities [9] and are using costly communication modules like ZigBee etc [6]. Few solutions are not connected to cloud [12].

A. NEED FOR POLYHOUSE

Polyhouse farming is beneficial if it is designed in such a way that smart farmers can produce high-value crops with high nutrition value, better taste, and freshness that fetch higher prices in local and regional markets useful to obtain higher incomes and higher returns on high initial investment. Polyhouses are very beneficial especially for organic farming. There are many other advantages due to this farming. The yield may be 10-12 times higher than that of outdoor cultivation depending upon the environmental conditions and type of crops which are grown in Polyhouse. Off Season cultivation of vegetables/fruits enables the farmer to have a better price realization. Reliability of crop increases under Polyhouse cultivation. Year-round production of the horticultural crops with less cropping period. Genetically and disease-free superior transplants can be produced continuously by minimal utilization of pesticides, chemicals to control the diseases and pests. Water requirement of crops is also very limited less evaporation and easy to control hence drip irrigation is employed in the Polyhouse farming. Though there are many advantages it needs lot of vigilance and maintenance operations which needs lot of manpower and incurs more operational expenditure. This work addresses the reduction of operational costs by using sensors and actuators to gather and synthesize real time data regularly in the field, and drawing valuable subscriptions required to the end user using IoT and cloud.

In this paper climate control poly house is constructed for monitoring temp, humidity, co2, light etc. along with the irrigation and rain water harvesting treatments automatically are considered. The working prototype of poly model is shown in Fig.1 and Fig.2.

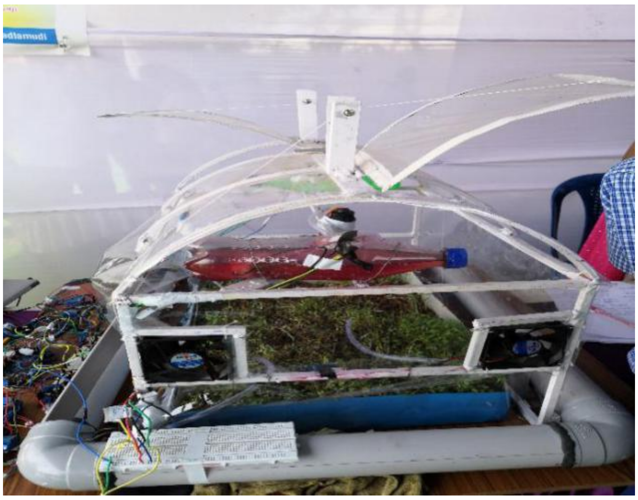

Fig.1. Automatic open of Ventilators to compensate co2 Level

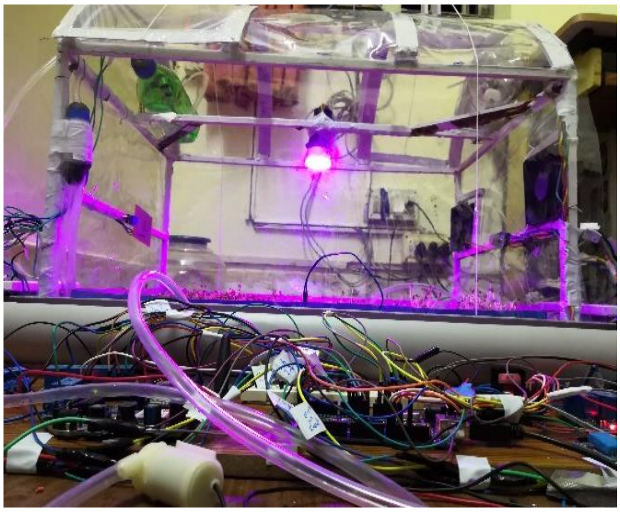

Fig.2 Grow llight on to compensate light intensity helps for Photosynthesis

III. PROPOSED METHOD

The block diagram used to connect all sensors and actuators and other communication modules with the CPU through GPIOs is shown in Fig.3. All sensors are connected to various GPIO pins and data from sensors and status from actuators are collected and monitored on PC as well as cloud server. Sensor DHT11 is used to sense and monitor temperature and humidity. These sensors are durable, unobtrusive and relatively inexpensive. If the temperature inside the house exceeds the threshold value then exhaust fans will automatically switch on by using relay switch. If the humidity exceeds the threshold value then hot water sprinkler will switch on using Relay Sprinkler. heater water level sensor is used to detect the water level inside the heater if the level is below the threshold value then sprinkler water inlet will automatically switch on by using Relay heater will filled. Soil moisture sensor is used to detect the moisture level present in the soil if the soil moisture level is low then Irrigation tank outlet motor will switch on automatically using Relay to water the plants this water is driven from the water tank, Irrigation water tank level sensor is used to detect the water level inside the tank if the water level is below the threshold value the automatically water will be filled in tank by switching on Irrigation water tank Inlet motor automatically using Relay. CO2 gas sensor is used to detect the co2 level inside the Polyhouse if the co2 level is below the threshold level the ventilators will automatically open, fresh air will come inside and closed after gas level gets normal condition. The ventilators are open with the help of 100RPS Gare motors these motors will drive with the help of LN298N motor driver. Light intensity sensor is used to detect the light intensity inside the polyhouse if the light level is below the threshold level then the Grow light will switch on automatically using Relay. Rain detection sensor is used to detect the rain condition and ventilator will operate based on the existing moisture level of soil. If the soil moisture is less than the threshold value ventilators will open automatically and rain fall directly on plants. If the soil moisture is sufficient then the rain water will be collected by automatically switching on the motor with the help of Relay and drive into soak pit which is useful to increase ground water level.

1. Microcontroller: This is the heart of the system. In this aurdino mega 2560 All sensor are directly connected to the microcontroller and data stored in a database. The Microcontroller performs action as per the data by using different controlling mechanism

2. Temperature and Humidity Sensor: DHT11 is a basic, ultra-low-cost digital temperature and humidity sensor. The temperature sensor threshold was set as 25. When it crosses 25 exhaust fans will be on and it will be off when it reaches to 25. When humidity falls below 40 hot water sprinklers will be on and off when it reaches to 40

3. Moisture sensor: The moisture control is defined by a threshold value which checks that if the soil moisture content falls below the set value of 400 then water drippers are activated, and then deactivated when optimum condition is restored.

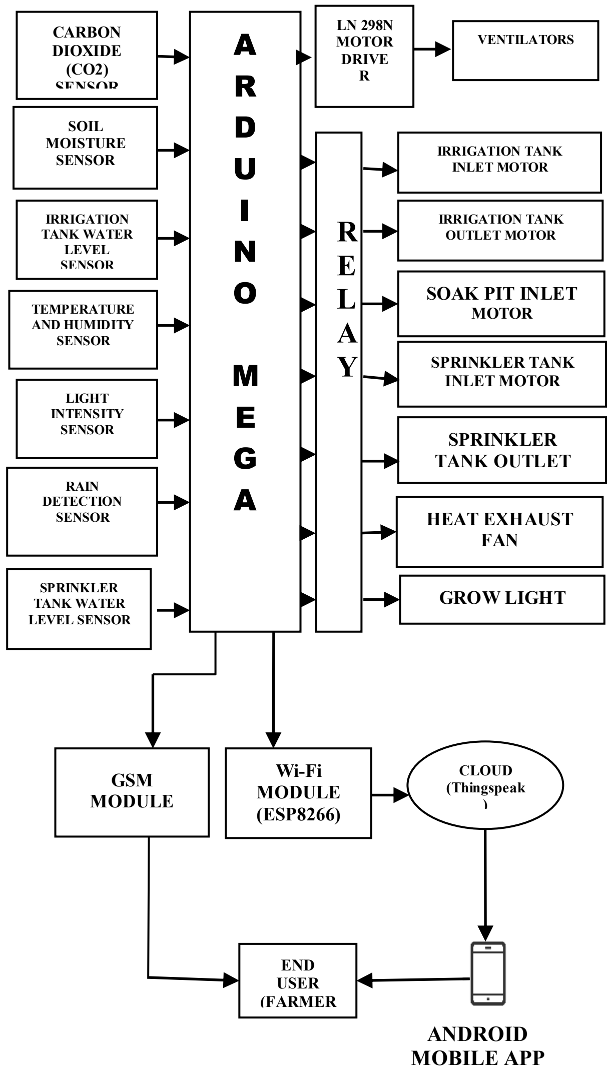

Fig.3 Block diagram of Polyhouse

4. Light sensor: This is mainly used to increase day light or compensate for inadequate natural lighting according to the desire of the user. The lighting condition is controlled by a set point of 50. When it falls below 50 light will put on it will be off when ever set condition restores.

5. Rainwater Harvesting: Polyhouses use the ground water for irrigation purposes which is leading to the depletion of the underground water. Hence, in the proposed research work concept of rainwater harvesting is considered to satisfy soil moisture level and to increase the ground water level through soak pit.

6. Relays: A relay is an electromechanical switch used to ON/OFF the actuator by taking the instruction from the microcontroller. All sensor sends data to microcontroller then microcontroller gives instruction to actuator through relay.

7. GSM Module: GSM Sim 900A is used in this work to communicate with the end user (farmer) during emergency.

8. Wi-Fi Modules: ESP8266 is used in this work to communicate with the cloud.

IV. ALGORITHM

Step1: Initialize all the seven sensors and actuators
Step2: Collect the data from the sensors time to time and transmit to the controller
Step3: CPU will process the data and activate /deactivate respective actuators based on conditions drawn by the controller using the sensor data
Step4: Update the status of sensors / actuators to the cloud server (Thingspeak), and also on Android APP using Wi-Fi.
Step5: In case of emergency S.M.S will be sent to farmer through GSM for the required action.
Step6: Repeat Step2 through step5

V. RESULTS

The Proposed system is implemented by generating a code using Arduino IDE environment and dumping into the microcontroller. The results observed from the sensors and display results of cloud are shown in Fig.3. and Fig.4. respectively. From the figures it was cleared that all the sensors and actuators are functioning in synchronism specified in the program. The same status is also observed from the Android App as in Fig.5.

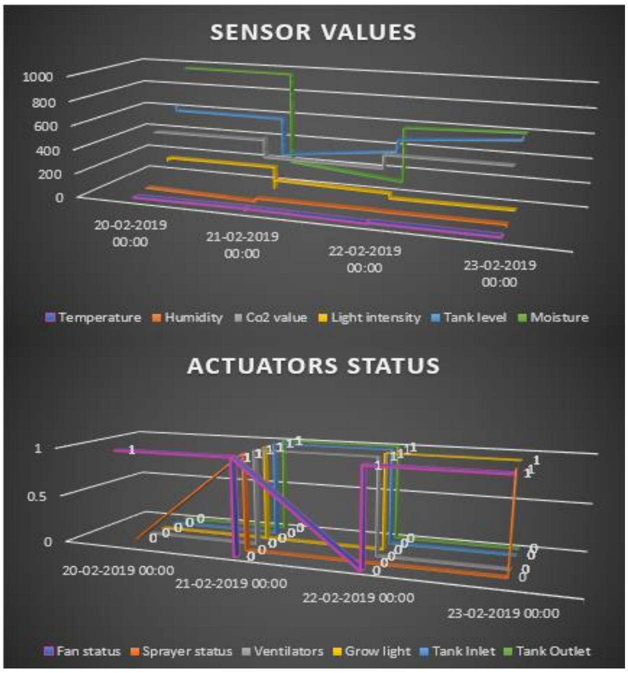

Fig.4. Working Status of Sensors and Actuators

Fig.5. Screenshot of Android App

VI. CONCLUSIONS

In this paper sustainable poly house agricultural solution with fully automation with respect to irrigation and crop management is explained. It has been observed that the yield under polyhouse or greenhouse farming can be achieved at a higher level about 4-8 times as compared to farming done in open field. Though the initial investment is high, but benefit cost ratio can be high if employed properly.

The important observations are it can produce higher crop productivity with the decreased use of pesticides, water, and fertilizer, which in turn keeps food prices down by the reduction of environmental and ecological impact. Finally, it is sustainable which satisfying food demands of growing population, conserve and protect resources and financially viable to growers and consumers.

VII. FUTURE EXTENTION

This system can be further improved by measuring few more parameters which effect yield such as pH and nitrogen which is important micronutrient in the soil for proper plant growth present in the soil. By adding crop rotation schemes soil fertility can be restored. By using efficient WAN system complexity can be reduced.

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