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Optimal Energy Management of Greenhouse by using ARM LPC1768

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***Abstract*— Plants are grown in greenhouse like a building or complex. This structure varies from small size to big sized buildings. The moderately closed environment of a greenhouse has its own particular kind of management necessities, compared with open air irrigation reproduction system. In order to have desirable production in a Green-house, it is necessary to regulate the artificial micro-environment. By controlling the main physical variables temperature, humidity, fogging system etc. as well as the variables involved in the rates of plants growing nutrients, sun radiation, water, CO_2, Artificial light etc. The plant's production quality and the energy and water consumption can be optimized. Arm controller receives data on greenhouse environment conditions from a number of sensors and transfers the data to and from a Personal computer. Accordingly, it changes the state of greenhouse control devices namely, heaters, fans, bulb, fogging system etc. According to the necessary condition of the crops. The proposed model is to control the greenhouse and reduce the energy cost while maintaining the required operational constraints.**

Keywords- ARM LPC1768, Sensors, Motors, Heater , Fog generator , CO2 Generator. Cooler.

I. INTRODUCTION

India economy is mainly dependent on the agriculture product. Agriculture is the main role job in India. Increase the food production technology in India is important in this situation [1]. But due to isotropic climate conditions lack of water reservoir, wind and excessive solar radiation reduce the agriculture product. Lot of energy and water also wasted by agriculture purpose. In USA 16% of the energy is conserved by greenhouse and poultry forms [2]. Energy consumption in greenhouse and improve the quality of crop production is main role in India.

Plants are grown in greenhouse like a building or complex. This structure varies from small size to big sized buildings. Cold frame is a mini reproduction model of greenhouse [3]. Greenhouse is like a structural building which has roofs and walls. Roofs and walls are made up of glass or plastics. Plastics greenhouses are mostly used polyethylene film and several sheets of polycarbonate material. Glass greenhouses are mostly used acrylic glass material. Now a day's semiautomatic nurseries are present, and it requires lot of man power. But in this proposed system is automatic and does not require man power.

The moderately closed environment of a greenhouse has its own particular kind of management necessities, compared with open air irrigation reproduction system. Bugs and infections and extreme of warmth and moistness must be controlled in greenhouse system and water need is important in greenhouse system. Drip irrigation production system is present in most of the greenhouses. Huge inputs of warmth and light might be required, especially with winter generation of warmth climate vegetables. In this framework ARM LPC1768 controller gets information on greenhouse environment conditions from various sensors and exchange the information to and from a PC. Appropriately, it modify the condition of the greenhouse control instruments namely heaters , fans, bulb, fogging system and CO_2 generator and according to the necessary state of the plants or crops. The proposed model is to control the greenhouse and reduce the energy cost while maintaining the required operational constraints. Greenhouse can provide an excellent controlled environment for plants production. It provides uniform lighting, heating, and water with nutrients, all plants. An optimal environment provides high quality products as well as possibility of energy and water optimization. In order to have an optimal production in a green-house, it is necessary to regulate the artificial micro-environment. By controlling the main physical variables temperature humidity, fogging system etc. As well as the variables involved in the rates of plants growing nutrients ,sun radiation,water,CO_2,Artificial light etc. the plant's production quality and the energy and the water consumption can be optimized by using greenhouses.

This proposed system presents the hierarchical control approach and ARM LPC1768 optimization model of greenhouses. In greenhouses, man-made lighting system, CO_2 generation, and atmosphere control systems takes considerable power thus, this model of greenhouse proper for their ideal job is designed, with the goal that it can be executed a surveillance regulator in existing nurseries framework. Some of advantages of greenhouse are low cost production, better control pests, high product quality , save of water and energy, more than one crop per year and greenhouse can be controlled by using ARM controller.

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The main goal of this thesis is to monitor the different parameters in the greenhouse climate conditions to provide better operating conditions and these parameters are controlled by the various control equipments.ARM controller is managing the greenhouse environment and result is shown in the computer screen. Power and water energies are conserved by this project.

II. SYSTEM DETAILS

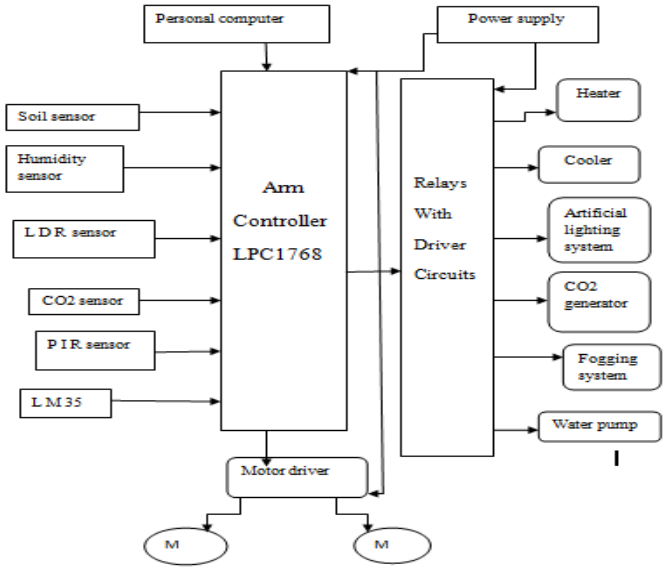

Fig.1: Block diagram of the optimal energy management greenhouse control system

Optimal energy management of greenhouse consists of ARM LPC1768 controller, temperature sensor (LM 35), LDR, humidity sensor, soil moisture sensor, CO_2 sensor and PIR sensor, control devices and the computer. ARM LPC1768 controller is connected by all of these 6 sensors. ARM LPC1768 is the principle processing unit of this project. The sensor senses the various conditions and gives information to ARM controller for operating. From the information acquired from the sensors the program controls the actuator equipments heater , two cooler fans, water supply motor ,fog generator and CO_2 generator to achieve the framework demands. It likewise utilizes a TERA TERM ARM online compiler presentation to show the information acquired from the sensors and actuators. Framework design is made out of insert ARM based framework board.

A. ARM LPC1768

ARM is a group of direction set engineering for personal computer processors in view of a lessened guideline set figuring design. The ARM based controller is suitable for applications which require minimum consumption of power and high integration. The microcontroller is an ARM processor, USB programming and having a set of peripherals and communication interfaces obtained in a small and practical DIP package. The ARM controller is designed for monitoring multiple inputs and outputs, processing and controlling the outputs. The microcontroller is easy and made for rapid prototyping.ARM is suitable to conduct experiments on strip boards, bread boards and PCBs. ARM LPC1768, which works with the pivotal implant instrument suite, it will make a working model quicker than at any other time. The firmly coupled blend of equipment and programming makes it simple to investigate plans rapidly, so it has more preferences. ARM LPC1768 board is shown in Fig.2.

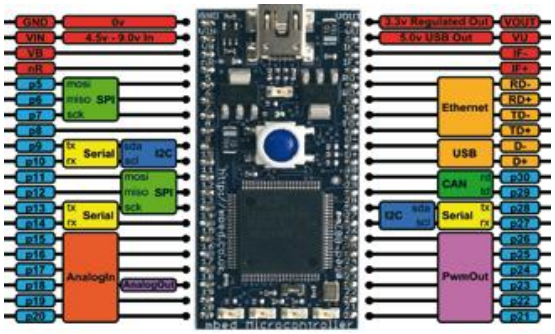

Fig.2: ARM LPC1768 board

B. LM35Temperature Sensor

LM35 is a precision temperature sensor for measuring the internal temperature of greenhouse. This sensor adjustments are accuracy incorporated circuit warmth detectors, whose income voltage is straight parallel to the Celsius warmth. It gives an electrical output which is proportional to temperature. It generates an output voltage higher than the thermocouples and no need of amplifying the output voltage. The temperature sensors are available in various types and these are widely used for different purposes including simple home to high scientific use.

C. Soil Dampness Sensor

Soil dampness sensor is for measuring the dampness level of the dirt regarding rate. It is a basic water sensor that can be utilized to recognize soil dampness. At the point when the dirt dampness module distinguishes low dampness it yields an abnormal state. Sense level customizable with little potentiometer. It has both Anolog and computerized yields utilizing a LM393 comparator chip. The module is fundamentally trying resistance between the information terminals. It can be utilized for detecting soil dampness as a part of greenhouse.

D. LDR SENSOR

LDR is light needy resistor which is utilized as a light sensor. It is utilized to sense the light intensity in greenhouse. Light Two cadmium sulphide photoconductive cells with ghostly reactions like that of the human eye. The cell resistance falls with extending light power. Applications incorporate smoke recognition, programmed lighting control, clump numbering and robber caution frameworks. Photograph conductive cells are utilized as a part of a wide range of sorts of circuits and applications.LDR for measuring sunlight based radiation level in greenhouse.

E. CO2 SENSOR

Delicate sensible of MQ-7 stream detector is SnO2. This detector has minor radioactivity in pure wind. The sensor radioactivity is superior to alongside the wind move up. It has good combustible gas in wide range. It has superior sensitivity to natural gas. It has easy drive circuit. It has long life and low cost. CO_2 sensor is used for measuring concentration of CO_2 in greenhouse.

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F. Humidity Sensor

Humidity sensor is used for measuring amount of wet matter in greenhouse. Humidity detector yield will be a changeable voltage as for the mugginess grade. Mugginess will be calculated in rate. The motivation behind utilizing this sensor is to quantify the measure of moistness noticeable all around. This sensor works on the principle of relative humidity. This sensor is essential in the applications where the relative humidity is to be converted into standard electrical output. The sensor has special type of plastic whose electrical characteristics change due to the change in humidity percentage present in the environment.

G. PIR SENSOR

PIR sensor is utilized to sense the movement, It is constantly used to distinguish the human has moved in or out of the nursery. So in greenhouse this purpose PIR sensor is connected. This sensor is little, modest, low power, simple to and don't destroy. So that reason these sensors are regularly initiate in device and appliance used as a portion of houses. The PIR detector is a tool that recognizes displacement by calculating differences in infrared levels radiated by surround items.

III. SOFTWARE REQUIREMENTS

A. mbed Online Compiler

The mbed is a stage and working framework depends on 32-bit ARM Cortex-M micro controllers. These are web associated gadgets and these are otherwise called Internet of Things gadgets. Applications can be created in mbed stage utilizing the mbed device, which is free online code proof-reader and compiler so that the code will be composed and ordered in a web program. The mbed IDE can be used for code document generation and it also give workspace. It has ability to export and import to share the code.

The mbed programming improvement pack gives the mbed C and C++ programming stage and instruments for making microcontroller firmware that keeps running on clever gadgets. It comprises of the core libraries that give the microcontroller drivers, systems administration, RTOS and runtime environment, assemble devices and test and repair scripts. A parts database gives driver libraries to segments and administrations that can be associated with the micro controllers to manufacture a last product. The operating system is free for developers and for development, supported by 100+ of OEMs and major chip vendors. It gives support for standards such as Bluetooth, cellular, threads, Wi-Fi and HTTP. Click on the developer site and then create a new account with the user name and password. The screen appears as shown in Fig.3.

Fig.3: To make a private account in mbed online compiler.

B. Flow chart

The flow of proposed system that is green house management system is as show in Fig .4.

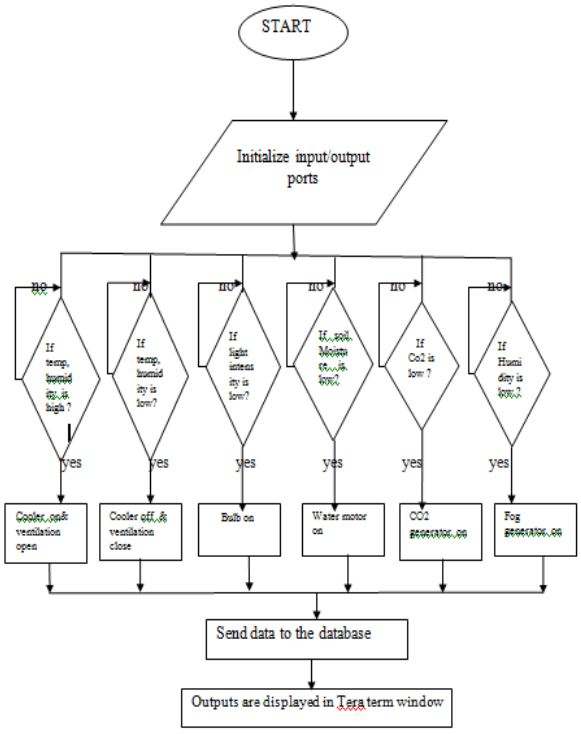

Fig.4: Flow chart of green house management system

IV. RESULTS

At the point when ARM board is associated with the PC through USB link, it acts as a USB mass stockpiling gadget. Serial convention is utilized to send and get control data and information by electronic modules and PC. The serial connection is offbeat also, has two unidirectional channels, one is for sending and another is for accepting. The dialog box is appearing on the computer screen. At that point by tapping on the mbed organizer, it contains of an excel document. This excel document is made for the storage of information at regular intervals which are measured by the controller. The excel file comprises of various stored information. The excel file is shown in Fig.5.

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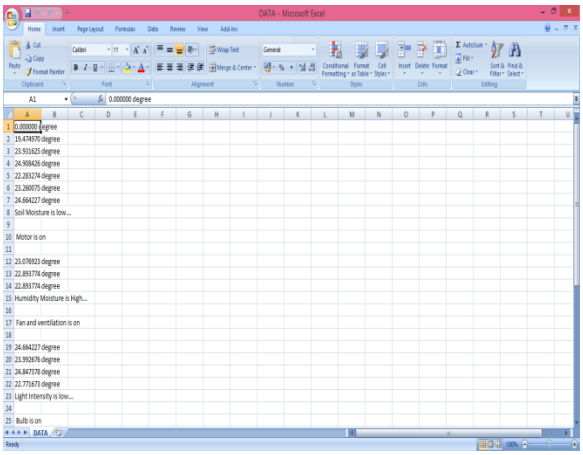

Fig .5: Excel sheet showing the information

The ARM controller is display the results in TERATERM window. The results are shown in below Fig 6.

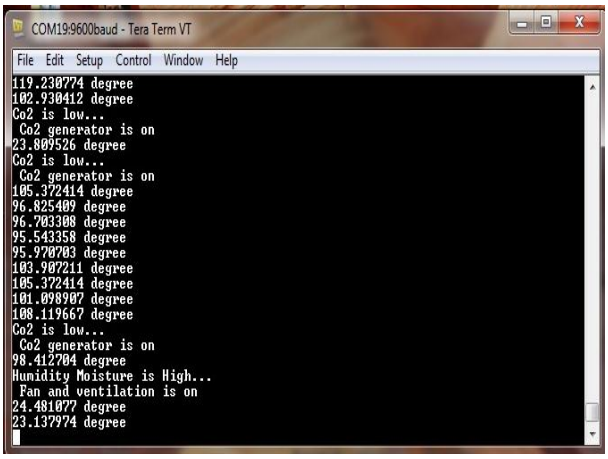

Fig 6: TERA TERM window displaying the data of different sensors

The TERA TERM window comprises of various put away information. The information which is measured by various sensors and checked by ARM controller. The proposed greenhouse framework parameters are showing in this TERA TERM window. The estimation of temperature, dampness, light power, CO2 concentration and soil moisture level and PIR sensor measured qualities in the greenhouse are shown in the TERA TERM windows at regular intervals. These environment parameters are not in suitable range, it also shows weather these parameters are high or low. If temperature or humidity is high, then the fans and ventilations are on. If CO2 concentration is low then CO2 generator is on. If soil moisture content is low then water pump is on. If light intensity is low then man mad bulb is on. Any person present in this greenhouse this also detected by PIR sensor. These are all information is displayed in this above TERA TERM window.

V. CONCLUSION

The different parameters which are present in the proposed greenhouse environment for example, temperature , dampness , light power, CO2 focus, fog ,moisture content in soil and any person present in the greenhouse are measured by the LM35 sensor, humidity sensor, LDR sensor, MQ-7 sensor, soil sensor and PIR sensor respectively. When the temperature and humidity is high, cooler will be on and control the humidity and temperature in greenhouse by using ventilation opening and closing technique. When artificial lighting system in greenhouse light intensity is low, bulb will be on .when concentration of CO2 in greenhouse is low, CO2 or Fog generator will be on. When moisture content in the soil will be low, water pump motor will be on. These parameters are monitored and controlled by ARMLPC1768 controller automatically. The results will be displayed in TERATERM screen of the computer. This greenhouse is giving low cost production, high product quality, save water and energy, more than one crop per year, and less man power. This greenhouse is providing an excellent controlled environment for plants production.

VI. FUTURE SCOPE

The system can also be enhanced by installing roof top solar penal for electricity generation will help to meet the electricity requirement as well as if the generation is more than the requirement for greenhouse and can supply the same to grid. Internet of thing can be connected to greenhouse. Then any places in the world greenhouse can be monitored and controlled easily without others help or man power. These are the future scope of this proposed system.

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