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A Smart Green House

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Abstract: India is a country where the economy is dependent on agriculture. Due to the increased population, demand for food also gets increased. So, productivity must be increased to meet these needs. Here this topic's relevance came. A smart greenhouse system is proposed which will monitor and control the internal parameters (internal temperature, humidity, soil moisture and light intensity variations etc.) of a green house. ATmega328P microcontroller is used. Whenever the sensor values reach a certain threshold, the sensors will send a signal to microcontroller which will then process it and send to computer via zigbee. There are different kinds of activities that are designed in the system.If the soil moisture required is low,a sprinkler can be activated, to increase the moisture level. It also can deactivate the sprinkler automatically.If the green house is too humid, the rooftop can be opened to lower the humidity level.If the temperature level is high, a fan can be operated to lower it. If the plants inside it needs much light, it can be also provided with this automation technology. The software is Arduino 1.6.7 IDE using C programming and compiled using the AVR-GCC compiler. The corresponding automation output values are displayed in the computer and also the caution indications in the green house is send to the farmer's mobile phone as message via a GSM.

Keywords: ATmega328P, Zigbee, GSM, Sensors, Greenhouse monitoring and controlling.

I. INTRODUCTION

A greenhouse is a building in which plants are grown. Farmers are unaware about the exact conditions of weather,So the activity performed by them is not precise. They perform their activity as per their feeling and observation, so every time it may not give the accurate result. So to give accurate result about what activity should performed in green house by the farmers in different environment conditions,this system is used.

Greenhouses may be used to overcome shortcomings in the growing qualities of a piece of land, such as a short growing season or poor light levels, and they can thereby improve food production in marginal environments.That is by using automated greenhouse we can increase the productivity.

Now-a-Days, with the fast development of the Greenhouse industries, the greenhouse control technology is of higher requirements because of how to obtain accurate and reliable measurable information. In some of the countries, most of existing greenhouse control systems used wired communication, which faces with wiring problem.

The wiring problem includes high cost, installation and maintenance difficulties and that broken node is likely to cause the entire system out of work. By using wireless communication we can overcome these kinds of problems.

The wireless communication does not require wiring, it's low cost and easy to maintain and you can also increase or decrease the measurement node arbitrarily.

II. SYSTEM DESIGN

The transmitter section of proposed system is shown below:

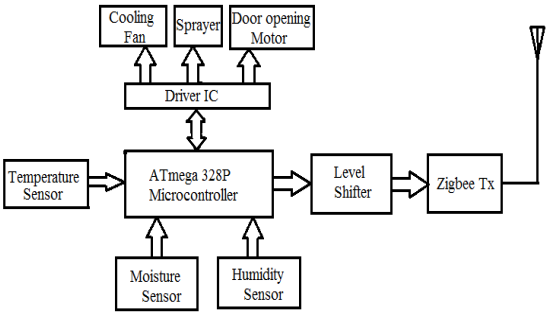

Fig.1. Block diagram of Transmitter module

The receiver section of the proposed system is shown below:

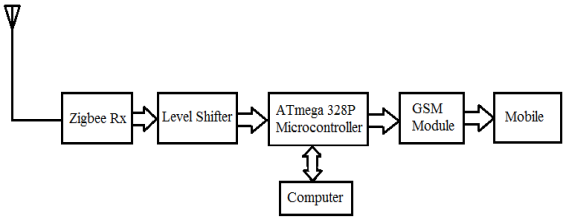

Fig.2. Block diagram of Receiver module

AT mega 328P microcontroller is used for the monitoring and controlling purpose.It reads the measured analog

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values from all sensors. The output for the sensor is then fed to microcontroller Microcontroller sends these values to receiver section through Zigbee. Zigbee transmitter and receiver modules provides efficient wireless communication.And send to computer through serial communication and after processing it is then fed to mobile via GSM.If any of the Greenhouse parameters exceeds the threshold value set by the user, necessary control action will takes place automatically.Temperature conditions can be manipulated by use of cooling fans. Humidity conditions can be manipulated by implementation of roof opening and closing.Moisture sensor can be manipulated by implementation of LED instead of a water sprayer.

The temperature sensor is used for sensing temperature. When temperature exceeds from a defined level or critical level, the system automatically turns on the fan and a message is also send to the owner or the operator with information of all parameters (Temperature, Humidity and Electrical appliance on off status)which are shown in figure. And when the temperature comes in normal range or comes below the defined level Fan turns off automatically. And when the temperature comes in normal range or comes below the defined level Fan turns off automatically. If the Humidity of the environment is below the defined levels, sprays are automatically turned on and if the humidity level exceeds from the defined level sprays are automatically turned off. But here in this project instead of a spray I have used CFL light to denote the spray.
The individual outputs from these sensors are in analog form. The sensed analog information is converted into digital values for further processing. Thus the digital values are processed by the Microcontroller and used to indicate the operating condition of the area to be monitored. The microcontroller will read the sensor periodically and updates the value of sensor. The monitoring node uses the zigbee module to transmit the sensed parameters. If any of the Greenhouse parameters exceeds the threshold value set by the user, necessary control action will takes place automatically. Also alert will be provided to the user through GSM module. The controlling action will takes place with the help of fan, water sprayer etc. If the Greenhouse parameter falls below the threshold value, the controllers will be turned off automatically.

III. HARDWARE SYSTEM DESIGN

A.ARDUINO

Arduino is an open-source electronics prototyping platform based on flexible, easy-to-use hardware and software. It's intended for artists, designers, hobbyists, and anyone interested in creating interactive objects or environments.Arduino can sense the environment by receiving input from a variety of sensors and can affect its surroundings by controlling lights, motors, and other actuators. The microcontroller on the board is programmed using the c++language .Arduino projects can be stand-alone or they can communicate with software running on a computer (e.g. Flash, Processing, MaxMSP).Arduino controls the device as:1.)If the values of temperature and humidity is greater than optimum, it opens the fan to decrease the temperature and humidity in the greenhouse, When the values of temperature and humidity is less than optimum, it opens the sprinkler to increase the temperature and humidity in the greenhouse until a suitable value is reached.2.)If the value of soil moisture is less than optimum, the value will open irrigation and when it is greater, irrigation will be closed.3.)if value of light is less than the optimum, the lamp turns on and closes after the period is finished (period is the time needed by the plain each day) and when the value is grater the lamp will be turned off. 4.)The GSM model sends an SMS to the user about the value that system measure.

B. ZIGBEE

Zigbee provide extensive hardware support for packet handling ,data buffering ,burst transmissions ,clear channel assessment, link quality indication and wake on radio. It has a high performance and easily to design product. It can be used in 2400-2483.5MHz ISM/SRD band systems, Consumer Electronics, Active RFID, Wireless game controllers, wireless KB/Mouse and others wireless systems. Its special features are as follows:

- Low current consumption
- Efficient SPI interface
- Easy for application
- Operating voltage:1.8V ~ 3.6V
- Available frequency at: 2.4 to 2.483GHz
- Programmable output power and high sensitivity

C. GSM

GSM is used here because of its improved battery life, efficient network design for less expensive system expansion, efficient use of spectrum, advanced features such as short messaging and caller ID, a wide variety of handsets and accessories, high stability mobile fax, Easy to use over air activation, and all account information is held in a smart card, which can be moved from handset to handset. A GSM modem is a wireless modem that works with a GSM wireless network.Like a GSM mobile phone, a GSM modem requires a SIM card from a M modem is a specialized type of modem which accepts a SIM card, and operates over a subscription to a mobile operator, just like a mobile phone. The baud rate is configurable from 9600 to 115200Kbps. The GSM module used in this project is SIM900 which offers all features mentioned above and serves as a medium between sink node and the user. Its operating voltage ranges from 4.2V to 12V.

D. SENSORS

The various sensors used in this project are described as follows:

1) DHT 11 MODULE

This is a multi functional sensor that gives you temperature and relative humidity information at the same

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time. It utilizes a DHT11 sensor that can meet measurement needs of general purposes. It provides reliable readings when environment humidity condition in between 20 percentage RH and 90 percentage RH, and temperature condition in between 0°C and 50°C, covering needs in most home and daily applications that don't contain extreme conditions.DHT11 Temperature and Humidity Sensor highlights a temperature and stickiness sensor complex with a calibrated digital signal input. By utilizing the selective computerized sign securing system and temperature and dampness sensing innovation, it ensures high reliability and excellent long-term stability.

2)LIGHT SENSOR

This Moisture Sensor can be utilized to recognize the dampness of soil or judge if there is water around the sensor, let the plants inside greenhouse connect for human help. They can be exceptionally to utilize, simply embed it into the dirt and after that read it. With help of this sensor, it will be feasible to make the plant remind: thirsty now, need some water.LDR is used in this project.

The Light Sensor is a passive devices that convert this "light energy" whether visible or in the infra-red parts of the spectrum into an electrical signal output. Light sensors are more commonly known as "Photoelectric Devices" or "Photo Sensors" because the convert light energy (photons) into electricity (electrons). For detecting light intensity LDR is used.

3) SOIL MOISTURE SENSOR

In this demonstration I have used a water pump and a soil moisture sensor, for detecting soil moisture. Two probes of soil-moisture-sensors are used and placed in soil. When soil-moisture-sensor does not sense moisture in soil then the system turns on the water pump until soil moisture sensor senses the moisture in soil. Sense level is adjustable with small potentiometer. It has both analog and digital outputs using a LM393 comparator chip. Operating voltage ranges from 3.3V-5V.

E.DC GEAR MOTOR

A geared DC Motor has a gear assembly attached to the motor. The speed of motor is counted in terms of rotations of the shaft per minute and is termed as RPM. The gear assembly helps in increasing the torque and reducing the speed. Using the correct combination of the gears in a gear motor, its speed can be reduced to any desirable figure. This concept where gears reduce the speed of the vehicle but increase its torque is known as gear reduction.

F.COOLING FAN

To maintain plant health during warm summer months, fans and air coolers should be used. It will be used in our project for cool climate inside the greenhouse. So we will use the fan that use in pc computer for mini model, Fans are available in many sizes and capacities. Typically square 120 mm and this fan cool vary good use in power supply and there many size for example (140 mm) and may we use it.

G. GSM MODULE

A GSM modem is a wireless modem that works with a GSM wireless network. A wireless modem behaves like a dial-up modem. The main difference between them is that a dial-up modem sends and receives data through a fixed telephone line while a wireless modem sends and receives data through radio waves. Like a GSM mobile phone, a GSM modem requires a SIM card from a wireless carrier in order to operate.Modem is a specialized type of modem which accepts a SIM card, and operates over a subscription to a mobile operator, just like a mobile phone. From the mobile operator perspective, a GSM modem looks just like a mobile phone;GSM modems can be a quick and efficient way to get started with SMS, because a special subscription to an SMS service provider is not required.In most parts of the world, GSM modems are a cost effective solution for receiving SMS messages, because the sender is paying for the message delivery.

IV. SOFTWARE SYSTEM DESIGN

A. Arduino 1.6.7 IDE

A number of things have to happen for our Arduino code to get onto the Arduino board. First, the Arduino environment performs some small transformations to make sure that the code is correct C or C++ (two common programming languages). It then gets passed to a compiler (AVR-GCC), which turns the human readable code into machine readable instructions (or object files). Then, your code gets combined with (linked against), the standard Arduino libraries that provide basic functions like digital Write() or Serial.print(). The result is a single Intel hex file, which contains the specific bytes that need to be written to the program memory of the chip on the Arduino board. This file is then uploaded to the board: transmitted over the USB or serial connection via the bootloader already on the chip or with external programming hardware.Figure 3.19 shows the initializing window of Arduino seen while we are opening the Arduino software.

B. DIPTRACE

Dip Trace (version: 2.4.0.2) EDA/CAD software for creating schematic diagrams and printed circuit boards. The developers provide multi-lingual interface and tutorials Dip-Trace has 4 modules: Schematic Capture Editor, PCB Layout Editor with built-in shape-based auto-router and 3D Preview and Export, Component Editor, and Pattern Editor. Basic Features includes 1.)Simple UI, 2.)Multi-sheet and hierarchical schematics, 3.)High-speed shape-based auto-router, 4.)Smart manual routing tools, 5.)Wide import / export capabilities, 6.)Advanced verification with real-time DRC, 7.)Real-time 3D PCB preview and STEP export, 8.)Manufacturing output

C. X-CTU SOFTWARE

Zigbee is a standard for low-power, short range wireless devices based on an IEEE 802 standard for personal area

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networks(PAN). Zigbee modules work in unlicensed ISM(Industrial Scientific Medical) band. Zigbee devices are capable of peer-to-peer, point-to-multipoint and mesh communication. They offer convenient low power wireless solutions for embedded systems where power consumption is a critical factor. A Zigbee network consists of three different types of ZigBee devices: coordinator, router, end-device. Each network has a 16 bit PAN ID. All devices in a Zigbee network is assigned a single PAN ID.

Device Types includes:

ZigBee coordinator (ZC): The most capable device, the coordinator forms the root of the network tree and might bridge to other networks. There must be one ZigBee coordinator in each network since it is the device that starts the network originally. The coordinator initiates a Personal Area Network(PAN) by selecting a RF channel and PAN ID. ZC also allows routers and end-devices to join the PAN. It is able to store information about the network, including acting as the Trust Center and repository for security keys.

ZigBee Router (ZR): As well as running an application function, a router can act as an intermediate router, passing on data from other devices. A router can start operation only when it has establishes connection with ZC

ZigBee End Device (ZED): Contains just enough functionality to talk to the parent node (either the coordinator or a router); it cannot relay data from other devices. This relationship allows the node to be asleep a significant amount of the time thereby giving long battery life. A ZED must join PAN like a router before sending any senor data. A ZED requires the least amount of memory, and therefore can be less expensive to manufacture than a ZR or ZC.

V. FLOWCHART REPRESENTATION

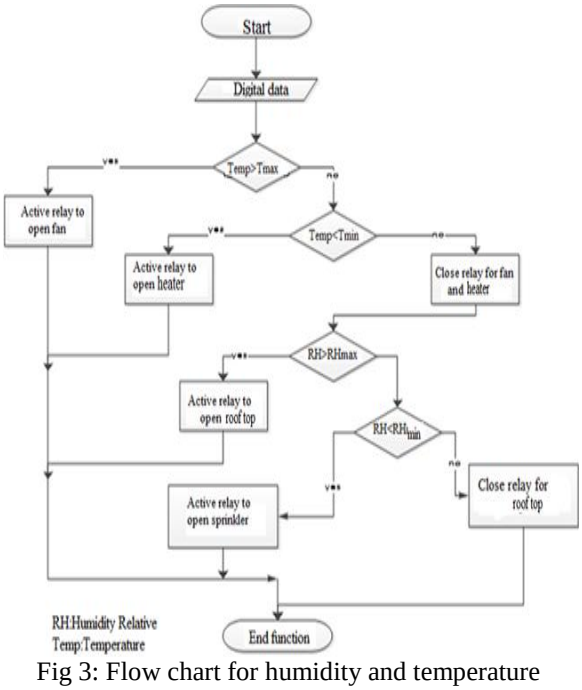

Fig 3: Flow chart for humidity and temperature

Figure3 shows how the temperature and humidity being automated using this smart technique. First of all we will take the maximum and minimum values for the humidity and temperature inside the green house.

By using those minimum and maximum values, fix the threshold. If the inside condition exceeds or deceeds the threshold, corresponding automation will happen.

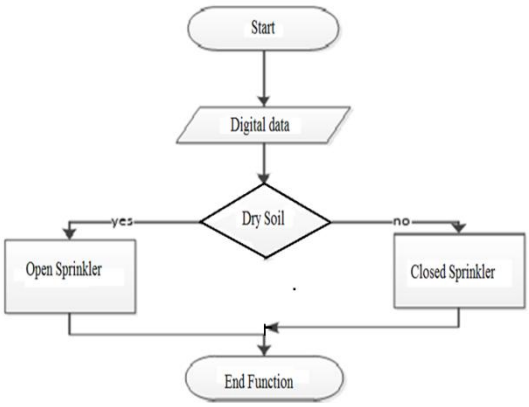

Fig 4: Flow chart for soil moisture

Figure 4 show the flow chart for the soil function sensor, program read the value of soil monitor sensor ,if the value of voltage out less than 1.9v active the pin that connect with valve of irrigation and when the value of voltage out greater than 1.9 v deactivate the pin that connect with valve of irrigation.

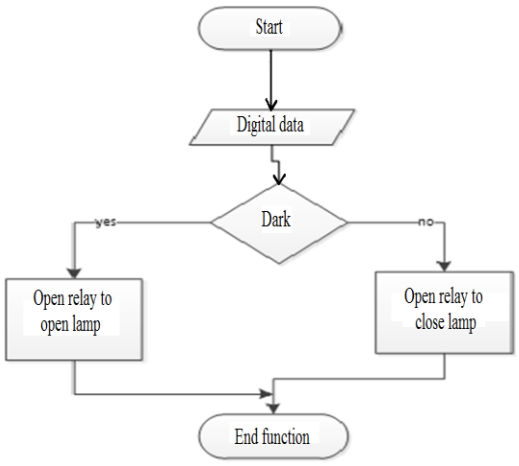

Fig 5: Flow chart for light sensor

VI. ADVANTAGES

Since the project is automated, labour charge can be saved. No additional programmer /burner hardware required for programming board. So,it's easy to compile the program. Low power consumption is an another important advantage. This proposed set-up of automated green house improves food production. If this is employed world wide, this will be a great victory for developing and developed countries.In some of the

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countries, used wired communication which faces with wiring problems, here its a solution for it by the usage of zigbee modules. By using zigbee modules the inefficiency occurred while the usage of wired connection can be avoided. And hence improves the overall efficiency of the green house system.

VII. CONCLUSION

This mini project offers a design of fully automated greenhouse management system. From the experiment it could be seen that it is fulfilling all major requirements related to greenhouse monitoring and controlling. The automatic greenhouse sensor design could help in increasing the productivity of plants. Automatic control over the devices like light, motor drives, fan provides a mechanism to alert farmers regarding the parameter changes in the greenhouse so that early precaution steps can be taken. If we are satisfying the needs of plants, its growth rate correspondingly gets improved. Thus by this construction, productivity of crops can be continuously increased so it can handle famine problem around the world. Thus we can say that the greenhouse monitoring system using GSM is far better than the same system using the different technologies.

VIII. FUTURE SCOPE

The system performance can be further expanded by increasing operating speed, memory capacity and instruction cycle period of microcontroller. Moreover, Time bound administration of crop yielding materials like fertilizers, pesticides and insecticides can be introduced. To operate multiple greenhouses concurrently, a multi-controller system can be developed.The system could be developed by different ways such as sending emails when an alarm happens , or using different devices such as PLCs. In addition to measure the conditions that have been mentioned in this mini project, other conditions may be included like shade and fire detection , PH value of soil, salianity, micro-nutrients in the soil etc..Management System (U-GHMS) based on USN (Ubiquitous Sensor Network) which can be real-time monitoring and controlling of Green house's facilities by collecting environment and soil information with environment and soil sensors, and CCTV camera. air enter the greenhouse by simply calling the arduino unit.

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