JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

GREENHOUSE AUTOMATION USING SOLAR ENERGY

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Abstract *— A greenhouse is a building in which plants are grown for commercial or research purposes. These structures range in size from small sheds to very large buildings, with different types of covering materials, such as a glass or plastic roof and frequently glass or plastic walls. But, nowadays, the rising demands for crop production and quality have significantly increased the utilization of high quality and productivity of greenhouse.This project demonstrates the design and implementation of a various sensors for greenhouse environment monitoring and controlling.The PIC16F877A microcontroller is used as the controller for this project which 40 pin IC with 7 analog pins. Among these 7 analog pins, 5 pins are connected with sensors (Soil moisture sensor,pH sensor,Temperature sensor, Humidity sensor,PIR sensor). In this there are two modes of working namely IOT mode and pH mode.The Blynk app is used in IOT mode to control parameters. Solar power is used to run this whole process. Solar battery of 7.2Ah 12V is used to store solar power. Charging circuit is designed separately to charge this solar battery. Once the battery gets fully charged it is connected to run this project*

Keywords -- PIC16F877A,Blynk app, solar battery, sensors

I. INTRODUCTION

One of the most indispensable needs of life is food and its worldwide availability endorsement has made agriculture an essential sector in recent years. As the technology evolved, the need to maintain a good and suitable climate in the greenhouse became imperative to ensure that the indoor plants are more productive hence the agriculture sector was not left behind. That notwithstanding, the introduction and deployment of IoT technology in agriculture solves many problems and increases crop production. This paper focuses mainly on the deployment of the Internet of Things (IoT) in acquiring realtime data of environmental parameters in the greenhouse.The PIC16F877A microcontroller is used as the controller for this project which 40 pin IC with 7 analog pins. Among these 7 analog pins, 5 pins are connected with sensors (Soil moisture sensor,pH sensor,Temperature sensor, Humidity sensor,PIR sensor).

The Greenhouse system enclosure allows the management and control of the crop ecosystem resulting in increased crop production, longer production time, enhanced product quality, and less defensive chemicals. To achieve this, the agriculture industry is bound to adopt the Internet of Things because its introduction in the agricultural sector can solve many problems for farmers. According to recent statistics, IoT systems installation in the agriculture sector is rising at a compound annual growth rate of 20 percent (20% CAGR). It is estimated that the number of connected devices is growing from 13 million to 225 million in the period of 10 years (2014-2024). With the current development worldwide, a lot of agricultural lands have been used in other non-agricultural areas, such as buildings, industrial sites, and other infrastructures, which will undoubtedly lower the agricultural production and have negative impacts on environments and economy in general. With this problem, the need of developing new technologies to close and cover this gap is increasing day-to-day. One solution that the community can implement is to create an agricultural system with limited land availability commonly called urban farming or urban agriculture.

Researchers in the IoT domain must also consider the cloud platform that manages information and various IoT protocols such as MQTT, CoAP, and AMQP that are used to communicate and transmit data to the cloud as well as to the end-user in order to keep farmers informed about crop conditions from a remote location. It is expected that the technology will be evaluated further in long-term crop cycles in order to optimize activities and adapt to decision support capability, which will be provided to human operators as management solutions

II. PROJECT OVERVIEW

There are many parts in the system, the first part contains a combination of sensors, Soil moisture sensor, Temperature sensor, Humidity sensor, PIR sensor, pH sensor. The next half of the project is whole about producing solar power and running the project using that power. The code is dumped to the PIC16F877A and the sensor readings are displayed in LCD display and in Blynk app. Based on the user's requirement mode is selected and based on the mode manual or automatic process is followed.

HARDWARE COMPONENTS	SOFTWARE COMPONENTS
PIC16F877A microcontroller	Blynk app
Soil moisture sensor	MPLAB IDE version 8.30
Temperature sensor	
Humidity sensor	
pH sensor	
PIR sensor	
DC Pump	
DC Light	
DC Fan	
DC Motor	
UV light	
Relay	
Solar panel	
Solar battery	

III. PROPOSED WORK

The PIC16F877A microcontroller is used as the controller for this project which 40 pin IC with 7 analog pins. Among these 7 analog pins, 5 pins are connected with sensors (Soil moisture sensor, pH sensor, Temperature sensor, Humidity sensor, PIR sensor).In this there are two modes of working namely IOT mode and pH mode. In IOT mode all the parameters are controlled manually through the blynk app. All the three parameter values are displayed both in the LCD display and in blynk app. In the LCD display the IOT mode is displayed as **'I'** and this was to make user clear that the project was working in IOT mode. The pH sensor doesn't work in this mode as there is only one receiver in the pic microcontroller either pH sensor signal or IOT signal can be received.Once this mode gets on, the values of the parameters are displayed in the IOT device (blynk app) if there is any need for water, air or light the user can manually ON them through the pushbutton in the app, once the user is satisfied, pushbutton can be turned of manually by the user. The pump and the UV light is interconnected, whenever the pump is turned ON ,UV light also gets turned ON this was to avoid the formation of algae in the water. In pH mode, the parameters are only displayed in LCD display. In case of pH mode the blynk app is not connected. In pH mode, there occurs a looping concept (i) whenever the temperature goes above 41degree Celsius (ii) whenever the humidity drops down (iii) whenever the level of water content goes down. Under these cases the pump automatically gets on to satisfy all these parameters. All the three cases occurs at the same time as they are placed on the same environmental conditions. Here the PIR sensor was also included to detect the presence of human. whenever the PIR sensor detects the presence of human, the motor gets ON and the door gets opened automatically. In the LCD display this mode is displayed as **'s'** mode. This mode is automatic mode hence it can be used even in the absence of human or mobile. Solar power is used to run this whole process. Solar battery of 7.2Ah 12V is used to store solar power. Charging circuit is designed separately to charge this solar battery. Once the battery gets fully charged it is connected to run this project.

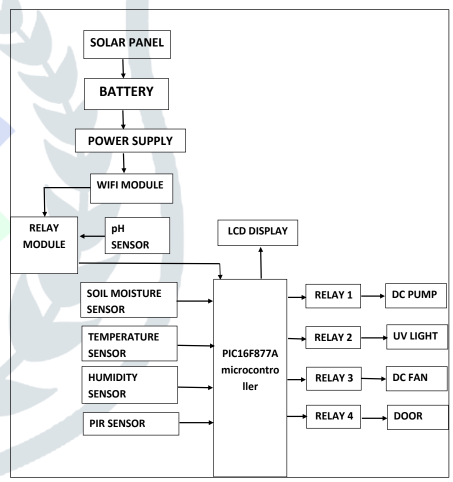

Figure 1: Block diagram of the proposed system

(i) Hardware Implementation:

a) RELAY UNIT:

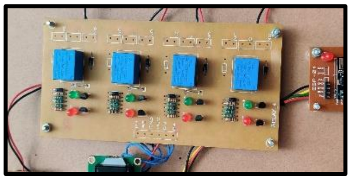

Figure 2: Relay unit

It is 4 channel relay unit. This relay unit has three 10K resistor to control BC547 transistor, two 1K resistor to control LED and 2 Diode to avoid ripple. The 4 Channel Relay Module is a convenient board which can be used to control high voltage, high current load such as motor, solenoid valves, lamps and AC load. It is designed to interface with microcontroller such as Arduino, PIC and etc

b) POWER SUPPLY CIRCUIT:

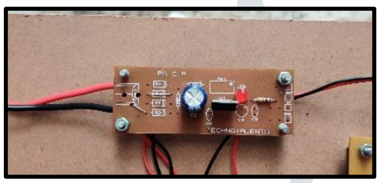

Figure 3: Power supply unit

This circuit is connected with 7.2 Ah battery. This battery is charged using solar panel once the battery is completely charged the battery is used in the process. there is need for 5V power the IC7805 voltage regulator is used and 1000microfarad capacitors are used for DC voltage filtering process.

c) MODE SWITCH:

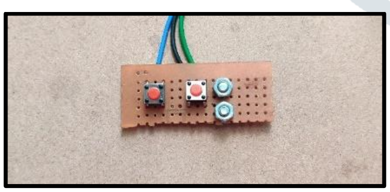

Figure 4: Mode switching button

In this there are two modes of working namely IOT mode and pH mode.In IOT mode all the parameters are controlled manually through the blynk app. All the three parameter values are displayed both in the LCD display and in blynk app. In the LCD display the IOT mode is displayed as **'I'** and pH mode is displayed as **'S'**

d) SOLAR POWER PRODUCTION:

Figure 5: solar panel

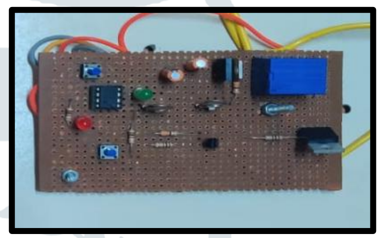

Figure 6: Solar power circuit

These are the solar panels that capture energy from sunlight. The photons in sunlight knock electrons in the solar panel out their orbits, and when connected as part of a closed loop, the electrons flow; the base definition of an electric current. Each 225W panel used in the system is rated for 30 V at 7.7 A, and has a 21% power density). All efforts go toward keeping the battery charged; it is the nucleus of the entire system. The batteries in the bank are connected in parallel to maximize the lifetime of a charge as well as keep the voltage at a minimum

(ii) Software Implementation:

BLYNK APP:

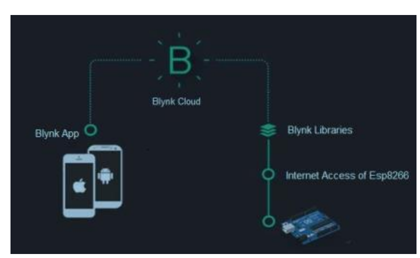

Figure 7: Blynk App

Blynk is a new platform that allows you to quickly build interfaces for controlling and monitoring your hardware projects from your iOS and Android device. After downloading the Blynk app, you can create a project dashboard and arrange buttons, sliders, graphs, and other widgets onto the screen. Blynk was designed for the Internet of Things. It can control hardware remotely, it can display sensor data, it can store data, vizualize it and do many other cool things.

There are three major components in the platform:

- **Blynk App** - allows to you create amazing interfaces for your projects using various widgets we provide.
- **Blynk Server** - responsible for all the communications between the smartphone and hardware. You can use our Blynk Cloud or run your private Blynk server locally. It's open-source, could easily handle thousands of devices and can even be launched on a Raspberry Pi.
- **Blynk Libraries** - for all the popular hardware platforms - enable communication with the server and process all the incoming and outcoming commands.

IV. RESULT

After processing these particular procedure output can be analysed. In IoT mode the values are displayed in both blynk app as shown in Figure 8 and in LCD display as shown in the Figure 9.In blynk app the parameters can be manually controlled by using the push button. In case of automatic mode the values are only displayed in the LCD display.

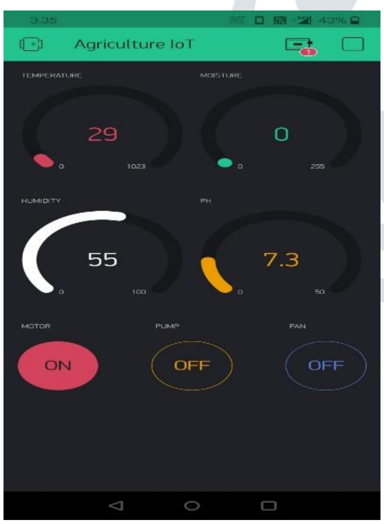

Figure 8:Output readings in blynk app

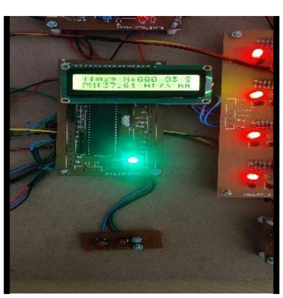

Figure 9: Output readings in LCD display

Hardware components as discussed are assembled as shown in figure 10. Programmable code is embedded into the controller and accordingly the sensor outputs are read and displayed.

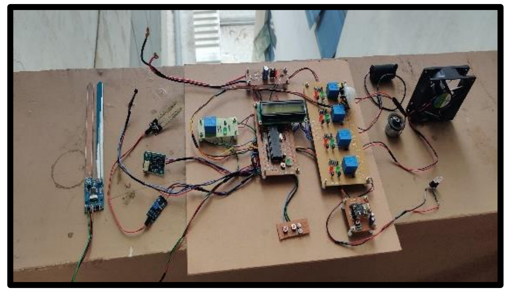

Figure 10: Hardware Output

V. CONCLUSION & FUTURE SCOPE

Development of automatic greenhouse monitoring and controlling system using sensors and solar power is completed effectively. The system has been tested under simulated environment successfully and depicted the capability of monitoring and controlling the intensity of the light, humidity of the air and inside temperature and moisture level of the soil. The values of various parameters like temperature, humidity, soil moisture, and light intensity are measured successfully and the measured values are displayed on LCD that is attached with the system and on the Blynk app. The communication between PIC16F877A microcontroller and various sensors is done accurately with no interference observed.

In future, the performance of the system can be further improved in terms of the operating speed, memory capacity, and instruction cycle period of the microcontroller by using other controllers. The number of channels can be increased to interface more number of sensors which is possible by using advanced versions of microcontrollers. The system can be modified with the use of a data logger and a graphical LCD panel showing the measured sensor data over a period of time. This system can be connected to communication devices such as modems, cellular phones or satellite terminal to enable the remote collection of recorded data or alarming of certain parameters.

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