"SOIL MOISTURE AND TEMPRATURE BASED AUTOMATED VERTICAL GARDENING CONTROL SYSTEM"

Prof. Priyen S. Patel[1], Suraj Yadav[2], Nishant Pandit[3], Rahul Verma[4,] Vikas Thakur[5]

[1] *Professor, Department of Electrical Engineering, Swarrnim startup and innovation university, Gujarat, India*

[2]*Student, Department of Electrical Engineering, Swarrnim startup and innovation university, Gujarat, India*

[3]*Student, Department of Electrical Engineering, Swarrnim startup and innovation university, Gujarat, India*

[4]*Student, Department of Electrical Engineering, Swarrnim startup and innovation university, Gujarat, India*

[5]*Student, Department of Electrical Engineering, Swarrnim startup and innovation university, Gujarat, India*

ABSTRACT

Urbanization which is one of the most serious problems in 21st Century causes many environmental problems such as concrete areas and population increase. Although the decreasing urban green areas cause many environmental problems, it provides a basis for developing vertical garden. The vertical gardens are defined as gardens that cover façade walls with using various plant species by systems. This paper primarily focuses on monitoring and controlling of Green wall environment parameters and automatically. The proposed system is based on various sensors such as moisture sensor and temperature sensor for continuous monitoring the various parameters responsible for plant growth. The present control system is designed using recent ARDUINO due to some important features such as sleep mode, 10- bit ADC, wide input voltage range and also higher memory capacity. A step-by-step approach to design the arduino-based system for monitor and control of the three essential parameters for vertically grown plant growth, i.e. Soil moisture and temperature has been followed. The measurement shows that the system performance is accurate and quite reliable.

Keyword: - *Vertical Gardening, Automatic watering, Capacitive soil moisture sensor, Temperature sensor, Arduino, solar charging controller and Renewable energy source*

1. Introduction

A green wall is a new and creative idea of growing greenery in an urban and indoor environment. Green walls consists special type of plant containers attached to wall structure at particular angle. Structures can be free standing or attached to wall. This advance greenery is eye catching, good looking and improves the look of once plain walls. Green walls are becoming more and more popular recently across the globe. These are widespread in Europe and also in other areas of higher temperatures. They can be made in the colder climates, with the proper plant variety. The system presented here maintains moisture in soil and controls the microclimatic parameters of a green wall environment. The system consists of sensors, ARDUINO, Relays, LCD display water pumps and Solar cells. The soil moisture sensors are deployed in the plant root zones. Aim of this system implementation is to demonstrate that the project can be used to save water, time and labor cost. When any of the environmental parameters cross a safety threshold value which we have to be maintained for plants growth, the sensors sense this change and send to controller at its input port through Arduino. Microcontroller then performs the necessary actions by actuating relays until the strayed-out factors have been brought back to its required advantageous level. For real time display of data received from various sensors and status of some other devices a Liquid crystal display (LCD) is also used. The system proposed here is an economical, low maintenance, runs on renewable

energy source and portable for green wall applications, especially in developing countries.

2 HARDWARE REQUIREMENTS

The basic components of our projects are Arduino UNO R3, solar panel, dc pump, capacitive soil moisture sensor, LM35 temperature sensor and SPDT relay.

2.1 LM35 Temperature Sensor

The temperature sensor used in this project is thermistor. It is basically thermal resistor which changes its resistance with change in temperature. The sensor circuitry is not subjected to oxidation normally It is sealed. It can measure temperature accurately. It also has low self–heating property and does not exceed more than 0.1oC temperature rise in still air. Its operating temperature limit is from -55°C to 150°C.

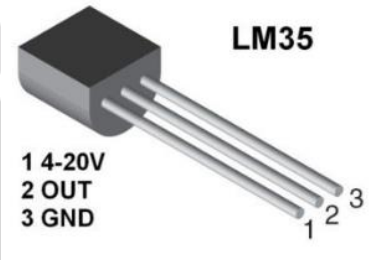

Figure -1: LM35 Temperature sensor

2.2 Capacitive soil moisture sensor

This moisture sensor consists of 2 copper conductors that are located at small distance from each other. For demonstration purpose, water pump is used and three soil moisture sensors for detecting soil moisture sensor. Both probes of soil-moisture-sensors are placed in soil. When no moisture is sensed by soil-moisture sensor in soil then the system turns on the motor or water pump until sensor senses the moisture in soil. Small potentiometer adjusts the Sense level. Its operating voltage ranges from 3.3V-5V.

Figure-2: Capacitive soil moisture sensor

2.3 Arduino UNO R3

This Arduino board has 14-digital I/O pins, a power jack, analog i/ps-6, ceramic resonator-A16 MHz, a USB connection, an RST button, and an ICSP header. All these can support the microcontroller for further operation by connecting this board to the computer. The power supply of this board can be done with the help of an AC to DC adapter, a USB cable, otherwise a battery.

Figure-3: Arduino UNO R3

2.4 Relay 12V DC

Relay is an electromagnetic device which is used to isolate two circuits electrically and connect them magnetically. They are very useful devices and allow one circuit to switch another one while they are completely separate. They are often used to interface an electronic circuit (working at a low voltage) to an electrical circuit which works at very high voltage. For example, a relay can make a 5V DC battery circuit to switch a 230V AC mains circuit. Thus a small sensor circuit can drive, say, a fan or an electric bulb.

Figure-4: SPDT Relay

2.5 DC Pump

DC powered pumps use direct current from motor, battery, or solar power to move fluid in a variety of ways. Motorized pumps typically operate on 6, 12, 24, or 32 volts of DC power. Solar-powered DC pumps use photovoltaic (PV) panels with solar cells that produce direct current when exposed to sunlight.

Figure-5: DC water pump

2.6 Solar charging controller

A charge controller is an important component in a battery based solar system and are not used in straight grid tie systems. The primary role is to manage charging the battery bank, prevent it from overcharging and many control the rate of the current and voltage at which it charges.

Figure-6: Solar charging controller

3. OBJECTIVES

In non conventional energy era, solar energy is one of the most effective energy sources , so solar cells are used to power our circuit .The main objective of this project was to design a greenwall monitoring system that is be highly reliable, cheaper in cost and efficient for growing the plants. Our project mainly focuses on the control of parameters such as-temperature and soil moisture. The block diagram of the green wall monitoring system has been shown in Figure 6.

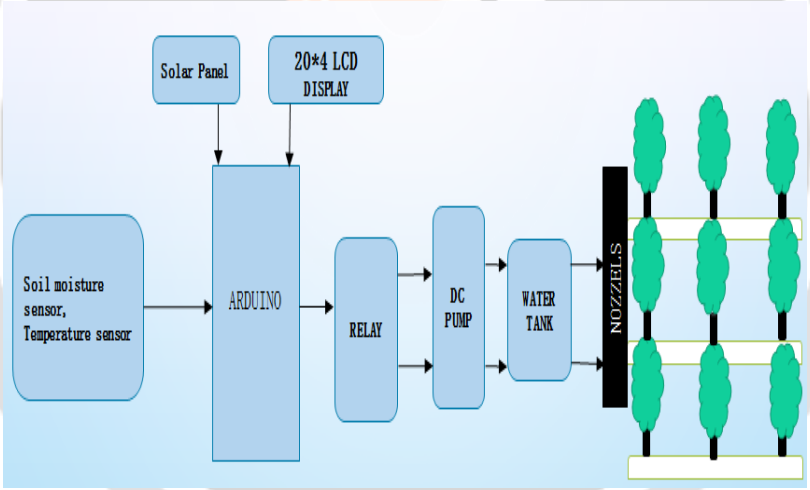

Figure-7: Block diagram of system

4. Methodology

System is switched on by solar panel or 9-volt dc battery and a Dc supply by solar panel to the pump. Solar panel provides the 7 to 9-volt supply to the Arduino. Sensor is connected to Arduino its getting power though the Arduino. Sensors output is given to ADC which provides digital signal at input port of microcontroller. Then controller generates necessary control signals to switch the Relay to operate the pump. The thermistor is used for sensing temperature. When temperature exceeds from a predefined level or critical level, then the system automatically switches on the sprinkles and also displays information of all parameters (Temperature, soil sensor and Electrical appliance on/off position) on LCD. And when the temperature falls below in normal range or comes to the predefined level pump will turns off automatically. Moisture sensor is used for sensing moisture in soil. When moisture comes down from a defined level, controller turns on the water pumps automatically to maintain moisture level in soil and made off in presence of moisture. The individual outputs from the sensor are in the analog form. Sensed analog signal is for further processing. Thus, the analog values are given to the Arduino to

indicate status of devices on LCD. The Arduino will read the sensor periodically and updates the value of sensor. If any of the Green wall parameters exceeds the threshold value set by the user, necessary control action will take place automatically. If the Green wall parameter falls below the threshold value, the controller will be turned off the device.

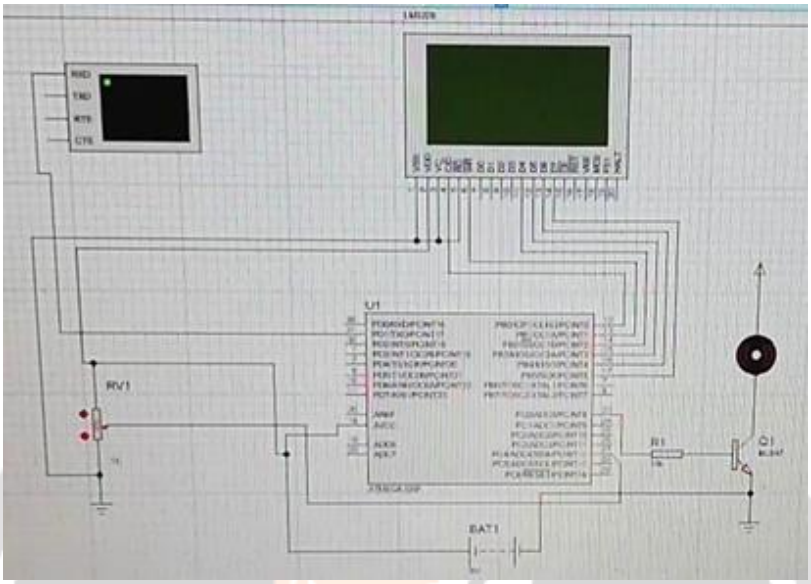

Figure-8: Simulation in proteus with atmega-328

The Proteus Design Suite is a proprietary software tool suite used primarily for electronic design automation. The software is used mainly by electronic design engineers and technicians to create schematics and electronic prints for manufacturing printed circuit boards.

In above simulation there is a sensor work as soil sensor which will give us an output of analog signal. This sensor is set on value of 51%. If the value is above the 51% the condition will be normal, which means soil has enough water for plants, so the motor doesn't work. But when the value of sensor goes below the 51% immediately the motor will start working by itself, and the display will keep showing the soil moisture level respective to sensor's output.

Efficient results have been obtained from the following project. Table 1 shows the recorded data in several days. The sensor that we are using are giving good results and performing to the expectations.

Table-1: Recorded Data

Soil moisture level	Relay	Water Pump ON/OFF
100%	Turns off	OFF
67%	Turns Off	OFF
48%	Turns On	ON
33%	Turns On	ON

5. Hardware arrangement

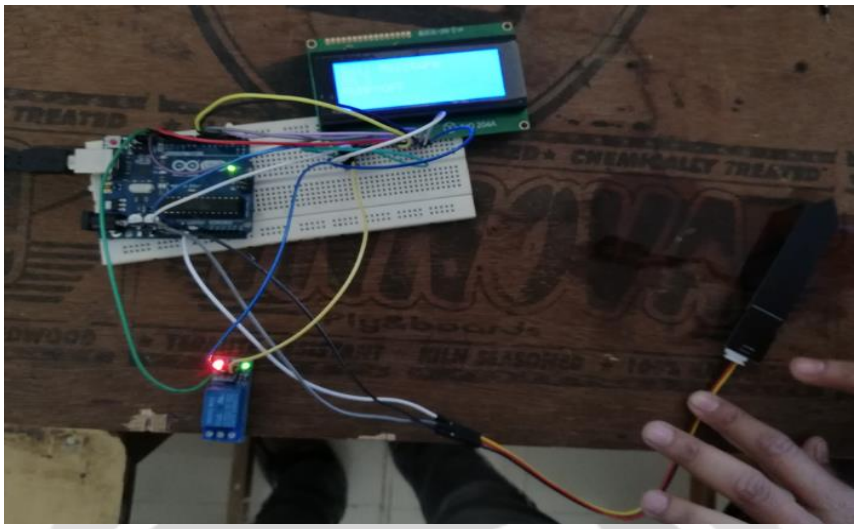

Figure-9: Hardware Arrangement

The same as interface in simulation Here we have connected soil moisture sensor and LCD display and arduino with the help of bread board. There are two different pots one with dry soil and another one with wet soil. As we put moisture sensor in wet soil, sensor passes the signal to the arduino that soil is wet so the pump should not be start. The moisture level shows on the LCD display. As we put moisture sensor in the dry soil, sensor detects it and passes the signal to the arduino that pump should be ON. As the soil getting wet by supplying the water the corresponding moisture level displays on the LCD display in percentage.

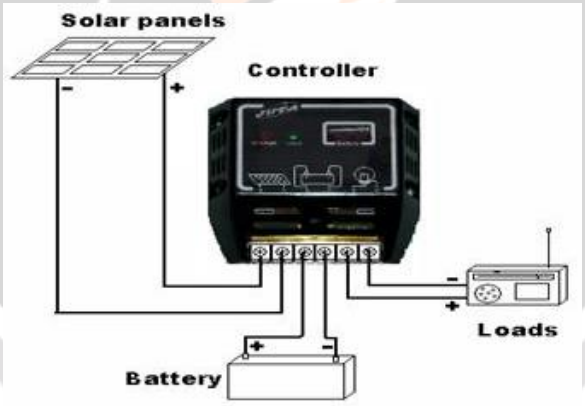

Figure-10: Solar charging controller connction

The most essential charge controller basically controls the device voltage and opens the circuit, halting the charging, when the battery voltage ascents to a certain level. More charge controllers utilized a mechanical relay to open or shut the circuit, halting or beginning power heading off to the electric storage devices. Generally, solar power systems utilize 12V of batteries. Solar panels can convey much more voltage than is obliged to charge the battery. The charge voltage could be kept at the best level while the time needed to completely charge the electric storage devices is lessened. This permits the solar systems to work optimally constantly. By running higher voltage in the wires from the solar panels to the charge controller, power dissipation in the wires is diminished fundamentally. The solar charge controllers can also control the reverse power flow. The charge controllers can distinguish when no power is originating from the solar panels and open the circuit separating the solar panels from the battery devices and halting the reverse current flow.

6. FUTURE SCOPES

- This system can be connected to the communication devises like cellular phone, modems, or satellite terminals for the remote collection of the recorded data.
- This system can be improved with the use of data logger and graphical LCD panel showing the sensor data after a period of time.
- Adding a Fertilizer sensor and automatic control on it will be a good improvement in this system.

7. CONCLUTION

A step-by-step approach to design the Arduino based system for monitor and control of the two essential parameters for vertically grown plant growth, i.e. Soil moisture, and temperature, has been followed. The measurement shows that the system performance is accurate and quite reliable. The designed system has successfully overcome the drawbacks of the previous system by reducing maintenance, complexity and the power consumption, at the same time providing very precisely management of providing the waters. Less amount of water is used due to controlled irrigation and it helps to save water and time. Use of multiple sensors reduces quantity of dead plants and increases quality and productivity of plants. Well developed and good quality plants results a beautiful living green wall. Thus, the system is efficient and compatible to change the environment.

8. REFERENCES

[1]. Hindle, Richard L. "Reconstructing the 'Vegetation-Bearing Architectonic Structure and System (1938)'". Graham Foundation. An archived from the original on January 25, 2013. Retrieved February 20, 2013.

[2]. Hindle, Richard L. (June 2012). "A vertical garden: origins of the Vegetation-B earing Architectonic Structure and System (1938)". Studies in the History of Gardens&Designed Landscapes.32 (2):99–110. d oi:10.1080/14601176.2011.653535. Archived from the original on 2019-06-26. Retrieved 2019-06-26.

[3]. "Vertical gardens a green solution for urban setting". The Times of India. Bennett, Coleman & Co., Ltd. Feb 14, 2013. Archived from the original on May 6, 2013. Retrieved February 20, 2013.

[4]."Welcome to Vertical Garden Patrick Blanc – Vertical Garden Patrick B lanc". www.verticalgardenpatrickblanc.com. Archived from the original on 2017- 01-06. Retrieved 2017-01-06.

[5]. "The International Greenroof&Greenwall Projects Database!" greenroofs.com. Greenroofs.com, LLC. Archived from the original on 18 October 2013. Retrieved 17 October 2013. select 'green wall' as type and 'living wall' under'greenroof type'