IOSR Journal of Engineering (IOSR JEN) **www.iosrjen.org**
ISSN (e): 2250-3021, ISSN (p): 2278-8719
PP 50-54

Solar based Automatic Crop Irrigation System- An Approach Towards Smart Watering

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Abstract *- Agriculture sector amounts to 85% of water consumption. Irrigation is an important factor in agriculture which allows the farmer to improve the cultivation in a way the plants need. Techniques like drip irrigation system, sprinkler systems, automated irrigation systems, network based systems which work on automation of irrigation. Efficient system is proposed to minimize the water wastage with the help of renewable energy. In our project the main function is performed by the Arduino Mega 2560 which acts as the controller. Input is given to the microcontroller by measuring the moisture level. Analyzing the data provided, the motor pump is turned ON and turned OFF based on the values. Additionally we measure Fertilizer value, temperature level and humidity level. The plant is monitored through the Adafruit website. Eventually, the details of sensors and motor condition are displayed in the OLED.*

Keywords *- Arduino Mega 2560, soil moisture sensor, Humidity sensor, NPK sensor, ESP8266 Wi-Fi Module, IOT Modem, DC Motor.*

I. Introduction

India has a population of more than a billion and its requirement for water increases each year as the demand for food increases; hence management of water resources to sustain this massive population is of high importance. Agriculture plays the important role in the economy and development of India. Increasing demand and decrease in supply of food necessities, it's important to rapid improvement in production of food technology. Agriculture is an important factor in human societies to growing and dynamic demand in food production. Due to lack of water and scarcity of land water result the decreasing volume of water on earth, the farmer use irrigation. In Irrigation system, depending upon the soil type, water is provided to plant. The important factors in agriculture are, getting information of about the fertility of soil and measuring moisture content in soil.

II. Literature Survey

The author [1] has proposed a system with various sensors like water flow sensor, temperature sensor and soil moisture sensor. Data's are transmitted to Arduino which is linked to an interactive website. While in [2], the system is designed with ATmega328 and it is programmed to water the plants twice a day till it reaches the threshold value. The notifications are given through mobile application. In [3] the author described a system with soil moisture sensor, water level sensor and an LCD display to show the moisture conditions of soil and water pump. It [4] is programmed with Arduino UNO to sense only the moisture content of the soil for a period of time and water the plants with a pump. The paper [5] develops a small embedded system which has PIC18F4550 microcontroller interfaced with GSM module. It allows the farmer to manually operate and monitor the irrigation pump. This author [6] proposed a system, where Raspberry Pi is used as a Coordinator node and Arduino as end node device. Based on the sensor values, the pump is turned ON and the status of the field is monitored in webpage. A PIR sensor and a buzzer are used to protect the crop from the cattle entering the field. In [7] different crops require different soil moisture for optimum crop yield. Advance Robots are implemented in [8] embedded with ultrasonic sensors, IR sensors and actuators which can be used for irrigation operation of agriculture. The paper [9] utilizes PH sensors, water flow sensors, temperature sensor and soil moisture sensor which measures and sends the values to Arduino Mega which drives the servo motor. Star Zigbee topology serves as the backbone in [10] for communication between Raspberry pi and end devices. The system in [11] has a sensor to measure the moisture of the soil and switches relay which controls solenoid valve according to the need. In [12] Arduino is linked wirelessly via the HC-05 module to an Android smart phone, it senses all the data and transmits it through Bluetooth. Using IOT the author in [13] demonstrates a system which senses all the values and transmits it through the GSM Module. The farmers monitor the parameters in [14]

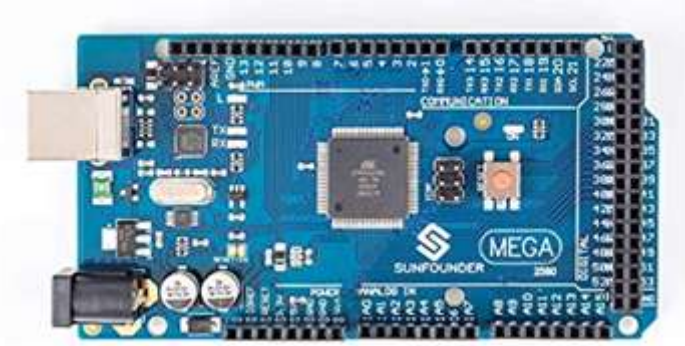
through the mobile app which is integrated with the cloud storage. Here in [15] data's are wirelessly transferred to Raspberry Pi through XBee.

III. Proposed Method

In our project, ATmega16u2 (Arduino Mega 2560) based microcontroller is used. Soil moisture sensor relative humidity sensor and NPK sensor are used. The motor is supplied by 12V and the Arduino by 5V through the adapter. Through the Wi-Fi module the details of the sensor and the operation of the motor pump is known to the user via OLED Display. The various components used are given below with brief description.

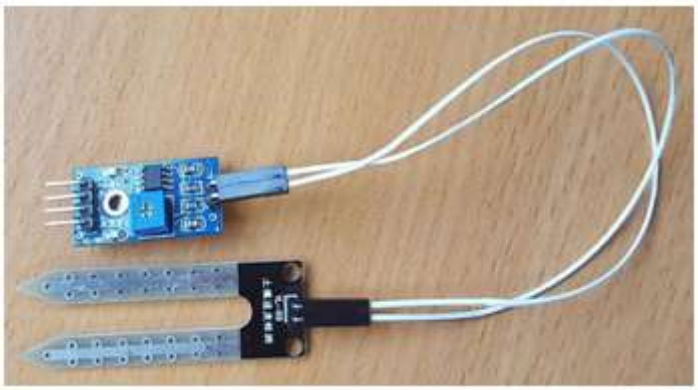
1.1 Arduino Mega 2560

The Arduino Mega 2560 is a microcontroller board based on the Atmega2560. It has 54 digital input/output pins (of which 15 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. A maximum of 40mA is the value that must not be exceeded on any I/O pin to avoid permanent damage to the microcontroller.



1.2 Soil Moisture Sensor

This moisture sensor can read the amount of moisture present in the soil surrounding it. It's a low tech sensor, but ideal for monitoring an urban garden, or your pet plant's water level. This is a must have tool for a connected garden. This sensor uses the two probes to pass current through the soil, and then it reads that resistance to get the moisture level. More water makes the soil conduct electricity more easily (less resistance), while dry soil conducts electricity poorly (more resistance). It will be helpful to remind you to water your indoor plants or to monitor the soil moisture in your garden.

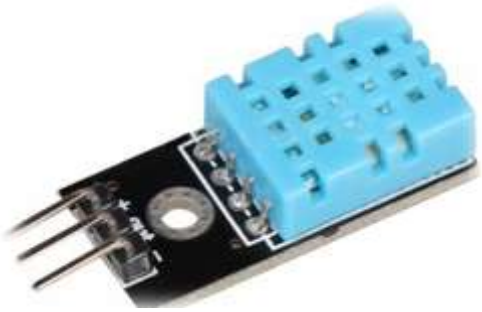


1.3 Humidity Sensor

A humidity sensor senses, measures and reports both moisture and air temperature. The ratio of moisture in the air to the highest amount of moisture at a particular air temperature is called relative humidity. A humidity sensor (or hygrometer) senses, measures and reports the relative humidity in the air and sends out a digital signal on the data pin. It therefore measures both moisture and air temperature. Relative humidity is the ratio of actual moisture in the air to the highest amount of moisture that can be held at that air temperature.

1.4 NPK Sensor

An optical transducer is developed to measure and to detect the presence of Nitrogen(N). Phosphorus(P), Potassium(K) of the soil. Detection of NPK nutrients of the soil, can improve the quality of the soil . Also reduces the undesired use of fertilizers to be added to the soil.



1.5 Water Pump

A submersible pump (or sub pump, electric submersible pump) (figure3.8) is a device which has a hermetically sealed motor close-coupled to the pump body. The whole assembly is submerged in the fluid to be pumped. The main advantage of this type of pump is that it prevents pump cavitations', a problem associated with a high elevation difference pump and the fluid surface. Small DC Submersible water pumps push fluid to the surface as opposed to jet pumps having to pull fluids. Submersibles are more efficient than jet pumps. It is usually operated between 3v to 12v.

1.6 ESP8266 Wifi Module

The ESP8266 highly integrated chip, including antenna switch balun, power management converter, so with minimal external circuitry, and includes front-end module, including the entire solution designed to minimize the space occupied by PCB. The system is equipped with ESP8266 manifested leading features are: energy saving VoIP quickly switch between the sleep / wake patterns, with low-power operation adaptive radio bias, front-end signal processing functions, troubleshooting and radio systems coexist characteristics eliminate cellular / Bluetooth / DDR / LVDS / LCD interference.

1.7 IOT

Internet of Things or IOT is an architecture that comprises specialized hardware boards, Software systems, web APIs, protocols which together creates a seamless environment which allows smart embedded devices to be connected to internet such that sensory data can be accessed and control system can be triggered

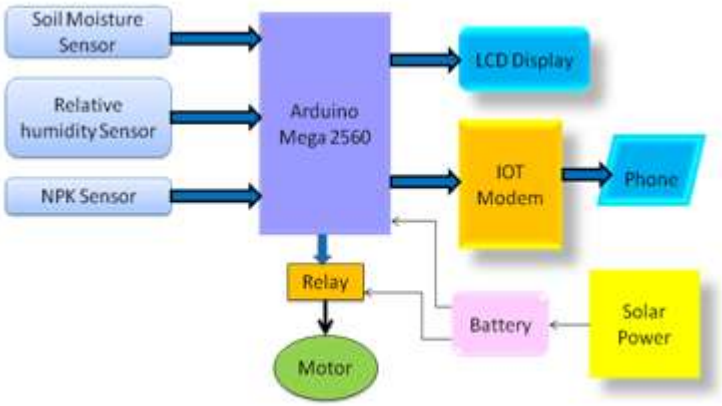
over internet. Also devices could be connected to internet using various means like Wi-Fi, Ethernet and so on. Furthermore devices may not need to be connected to internet independently. Rather a cluster of devices could be created (for example a sensor network) and the base station.

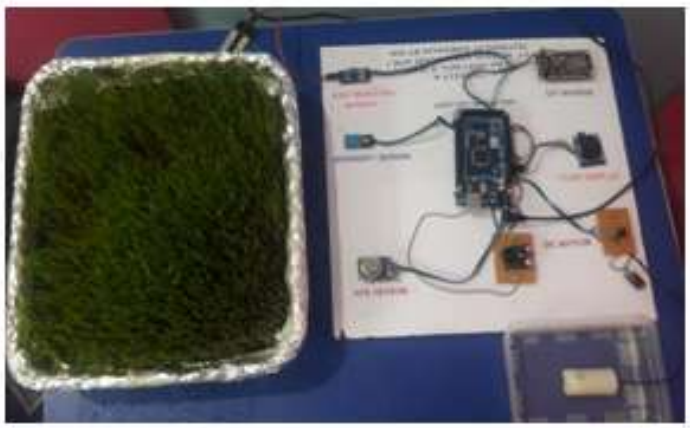
1.8 OLED Display

The organic light-emitting diode (OLED) display is a mono colour; 0.96-inch display with 128×64 pixels. It doesn't require backlight, which results in a very nice contrast in dark environments. Additionally, its pixels consume energy only when they are ON, so the OLED display consumes less power when compared with other displays.

IV. Methodology

The sensors which are connected to the Digital pins of Arduino microcontroller and they are given 5V supply. They continuously send data to the Arduino, where the data received is compared with the threshold values of each sensor. The Arduino sends command to the motor relay as 1(Motor ON) and 0(Motor OFF). Simultaneously, these data are displayed in the LCD. IOT modem Receives from Arduino and transmits the details through a website.





V. Conclusion

The agriculture field is being monitored and controlled by My MQTT Web app at user end. The ESP8266 is the device at field end which receives the messages from broker network and manipulates it and will perform the function mentioned in message. After it will send the messages to broker network and intern it will be published to the Client (user end). The ESP8266 is the best device for IOT projects. Since it is small, compact, lightweight, easily programmable, and easily installable and has enough GPIO pins to use them.

VI. Future scope

In order to overcome power cut, a renewable energy source such as solar can be used to give Power supply to this system. This Project can further be made as a Robot which has wheels for moving and additional features such as pesticide spraying, Temperature sensor to enhance the plants growth and reduce the human interference.

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