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Solar Power based Automated Irrigation System

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Abstract: Automatic solar power irrigation system, an advanced form of solar irrigation system consists of an automatic control to ON and OFF the control valves which aids the farmers by governing the supply of water to the irrigation lands. It also sustains the moisture level of soil that results in better yield. This proposed system employs soil sensor to detect the water quantity present in agricultural field. This system is based on Audrino, and aims at reducing the water usage. In regular practice, Watering of crops is the most significant practice and arduous task. Irrespective of the climatic conditions, the proposed system would be able to control the water that reaches the farm plants. This system could be effectively used to water the plants based on the demand. Installation of automatic plant watering system requires combination of sprinkler systems, pipes and nozzles.

Keywords: Solar Panel, Sensors, gardening setup, Arduino

I. INTRODUCTION

Agriculture is the basis of livelihood and has incredible effect on the economy of India. In dry territories or in areas of inadequate shower, irrigation becomes more difficult task. So, irrigation of dry lands requires more attention and automation would be the best solution.

Alarming rise in the cost of energy and declining water sources demands the need of better water management. Management of irrigation is a complicated verdict to presume the amount of water to be supplied to the crop fields to end up in better yield. The distant irrigation lands draws less attention of farmers due to lack of regular visits. So a remote monitoring automated irrigation system consisting of controllers with ON and OFF control valves helps farmers in management of irrigation better. The system utilizes the emerging and open source platform, Arduino.

Burney J et.al (2009) developed an idea of drip irrigation system harvesting energy from solar power. Shah T et.al (2012) made an analysis on Economy of India's ground water and irrigation with Solar pumps. Campania PE et.al (2015) examined the optimizing technology of photovoltaic pumping systems. Shah T et.al (2016) worked on raising of remunerative crops with ease of Solar power

II. ARDUINO

2.1 Arduino Uno Board

The Arduino Uno is a microcontroller board based on the ATmega328. It comprises of 14 digital Input /Output pins out of which 6 shall be used for Pulse Width Modulation outputs, 6 analog inputs, 16MHz ceramic resonator, USB connection & power jack, an ICSP header and a reset button. It consists of all components needed to support the microcontroller. The unique characteristic of this board is it does not require FTDI USB-to-serial driver chip. It employs Atmega16U2 programme as a USB-to-serial converter.

Fig 2.1 Arduino

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2.2Interfacing of LCD with Arduino uno

Liquid Crystal Display modules are very essential component in embedded system and knowledge on their interfacing is mandatory for designing a good system. 16x2 Liquid Crystal Display is used to interface with Arduino Uno.

Arduino based embedded system designs imbibe the LCD modules as the main part and knowledge on interfacing of the both is highly essential. 16×2 LCD is employed to interface the Arduino and LCD module named JHD162A is used in the proposed system. This module is made from Hitachi, it consists of 4 bit mode or 8 bit mode.

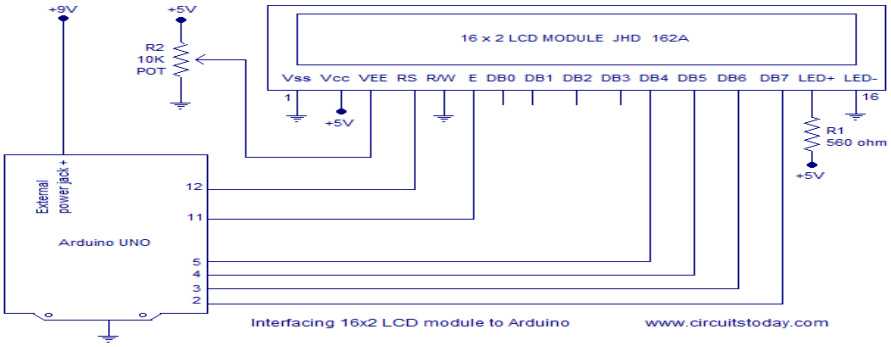

Fig 2.2 Arduino to 16×2 LCD Modules

III. HARDWARE DESCRIPTION

This module of soil moisture sensor comprises two output pins, one digital and other analog. Output obtained from the moisture sensors are compared with set value by using of comparator. The output combination depends on the digital pin either low or high, to decide the soil condition. The dry or wet condition is adjusted by the programming part. Figure 3 illustrates that a sensor pin is connected to any one of the analog pins of Arduino and 1 KΩ resistor is used to pull up the line. Analog pins of Arduino controller can also act as digital inputs. The output of the Soil moisture sensor determines the status of the tank. LCD display is connected to the Arduino controller to show the moisture level status respectively and also the 4th pin links to motor driver which in turn drives the 12 V DC motor.

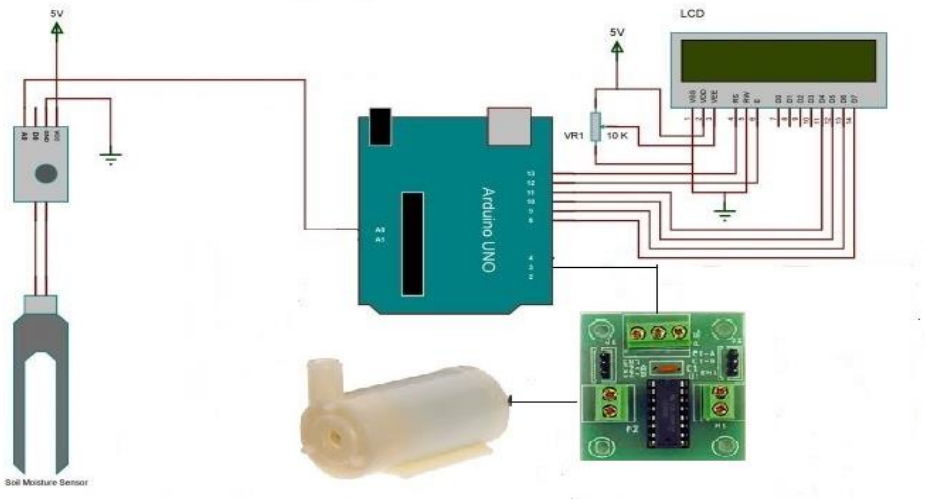

Fig 3. Circuit Diagram

3.1 Soil based Moisture Sensor

In soil moisture sensor status could be resolute by direct & indirect methods. Soil moisture sensor are not commonly used for irrigation scheduling. These sensors are installed at predefined places in farms for measurement of moisture over a specific time period. The sensors need close attention in soil as they are to be installed in soil matrix.

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Soil moisture is an very needed component in the atmospheric water cycle, used in agricultural scale and large-scale modeling of land or atmosphere interaction. Vegetation and crops are always depended more on their moisture exists at root level on the incident. The Water based budgeting in irrigation system planning, as well as the actual scheduling of irrigation action, need of local soil moisture information. The temperature of soil wetness helps to estimate the risk of low-lying areas, or instance of fog.

The relationship between content and potential is not common and is dependent on features of local soil like soil density and soil texture. The soil water content is identified by using gravimetric method. Owing to the fact by this method is based on direct measurements; it is the standard by which all other methods are compared. As gravimetric method is a destructive type, repeatability highly impossible.

The direct gravimetric measurement is a tedious process which involves measurement of soil moisture by removing, withering and weighing of samples, whereas soil moisture sensors use property like electrical resistance or dielectric constant. The measured value and moisture content of soil relationship is measured and calibrated which is highly affected by environmental factors. The soil based moisture sensor is used to estimate the volumetric content of water and also measures the potential of the water content.

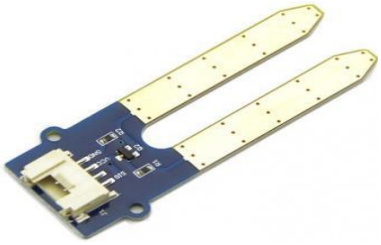

Fig 3.1 soil moisture sensors

3.2Solar panel

Solar panel boards assimilate sunlight and convert it to generate electricity/heat. A photovoltaic setup is a package consisting of 6x10 solar PV cells. The main principle of working is photovoltaic effect. The construction of module employs wafer-based crystalline silicon or thin film cells. The individual cells may be electrically connected in series or parallel with one another.Some special solar PV modules include concentrators in which light is focused by lenses or mirrors onto smaller cells. This enables the use of cells with a high cost per unit area (such as gallium arsenide) in a cost-effective way.Solar panels comprises of metal frames with racking components, brackets, reflectors and troughs in order to better support the panel structure.

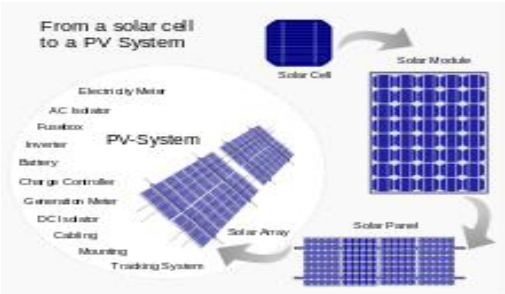

Fig 3.2 solar panel

3.3 Prototype Module

This module consists of Arduino, Solar Panel, Interfacing of LCD and External power source. The moisture level sensor is interfaced with the Arduino UNO processor to determine the soil moisture level – Wet/Dry. The solar panel is the power generating source through the absorption of energy from the sunlight. Arduino is activated by external power source. The LCD display highlights the temperature and moisture level of soil. The pump is used to supply the water during the wet and dry condition based on the signal sent from Arduino.

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Fig 3.4 Prototype

IV. RESULTS AND DISCUSSION

"Solar Powered Automatic Irrigation System" has been designed and was tested successfully. Every component of the proposed system has been identified and assembled carefully to work automatically. The moisture sensors have been chosen to measure the moisture content of different plants. If the moisture level is found to be below the desired level, the moisture sensor sends the signal to the Arduino board to turn ON Water Pump and supply the water to respective plant using the Rotating Platform/Sprinkler. When the desired moisture level is reached, the Water Pump is sent off signal to turn it OFF. Thus, the working of the proposed system has been tested thoroughly and ensured the desired functioning. The real parameters are recorded with the designed system and tabulated as follows:

Solar output voltage	12V
Battery charging time	7hours
Battery discharging time	4.2hours
Battery voltage	12V
Battery Amps	7AH
Arduino input	5V
Soil in Dry condition	Pump ON
Soil in wet condition	Pump OFF

Table 4. Obtained Results

V. FUTURE ENHANCEMENT

Our proposed system can be further enhanced by inclusion of Web scaper which predicts the weather and irrigate the plants/crops accordingly. On raining forecast, less amount of water is supplied for the plants. Automatic carrying of plants will be done. Plantation will be successful in low water quantities. Environment balancing like tree plantation & saving trees kind of activities will become come easy once implemented. It is possible to pumping the water by solar energy. It is possible to connect Moisture sensor to sense Moisture.

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