SMART AUTOMATED DRIP IRRIGATION SYSTEM

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Abstract
Solar power can be a solution to the decreasing availability of energy resources. A wireless sensor network (WSN) to automatically irrigate the crops using soil moisture content values obtained from the soil moisture sensor is designed. The key objective of this paper is to provide a solar powered microcontroller based automated irrigation system. Minimization of human intervention in farm land irrigation can be done by using this automated technology. The use of moisture sensor and water level sensor all together sends the signals to microcontroller which further sends the various statuses as read by the sensors. Moisture level values read by the sensor are updated to server database through Wi-Fi module. The concept of solar drip irrigation system is simple but efficient, low cost solar powered pumping system, which provides the necessary pressurized water to a drip irrigation system. The function of solar panel is to charge the battery throughout the day when sunlight is available and the power for the pump is subsequently provided by battery.

Keywords: Sensors, Wireless, Irrigation, Solar power, ARDUINO UNO, WI-FI module.

INTRODUCTION

Agriculture sector is a major source of income in a country like India. India ranks second worldwide in farm output. Most of the power generation is carried out by conventional energy sources. Irrigation is an essential component of crop production in many areas of the world. Most of the irrigation systems are operated manually resulting in over irrigation and water wastage most of the times. Wireless sensors were used to monitor the environment and to automate the irrigation system, all powered using solar panel. The continual advancement in sensing and communication technologies has significantly brought down the cost of deployment and running of a feasible precision agriculture framework. An automated irrigation system uses solar panel which drives water pumps to pump water from water source [2]. India is country which focuses towards the modernization of the conventional agricultural practices for the better productivity. Despite of various disadvantage associated with the same, we are focusing upon solar power i.e. photovoltaicity for water pumping purposes [3]. Solar power is not only an answer to today's energy crisis but also an environmental friendly form of energy. Solar panels (an array of photovoltaic cells) are nowadays extensively used for running street lights, for powering water heaters and to meet domestic loads. The cost of solar panels has been constantly decreasing which encourages its usage in various sectors. Solar powered irrigation system can be a suitable alternative for farmers in the present state of energy crisis in India [4]. The problems related to higher agricultural productivity, poor performance and decreased availability of water for agriculture can be solved by using the proposed solar powered automated irrigation system [2]. Smart irrigation helps the efficient use of freshwater resources in agricultural areas which very important due to highly increasing demand for freshwater, optimal usage of water resources have been provided with greater extent by automation technology [3]. Drip irrigation is a method in which water drops right near the root zone of a plant in a dripping motion. If properly installed reduction in the loss of water through evaporation and runoff.

Drip irrigation is the most water efficient method of irrigation as it supports easy installation, efficient fertilization and saves water up to 80% [5]. It increases yields and allows for introduction of the new (potentially high-value) crops in regions where they could not be sustained by rainfall alone [4].

OBJECTIVE

- To measure field temperature periodically by deploying sensor nodes
- To transmit field data wirelessly for analysis
- To decide the need to provide irrigation to the crops based on soil moisture data
- To make use of solar power which could be generated even in remote areas

BLOCK DIAGRAM

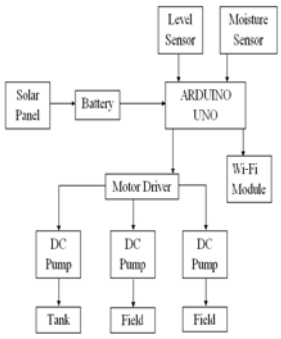

Fig.1. Block diagram of the WSN controlled drip irrigation system

Solar panel is used to provide supply to the whole system. Solar panel of 20V, 10W having output current of 0.5A is used. When the sunlight falls on the solar panel, it liberates the electrons within the material which then move to produce a DC current. This dc power is stored in the battery (12V, 1A) using 7815 voltage regulator to step down the voltage from 20V to 15V.The pump can operate even in the night time by discharging the battery. The other end of the battery is connected to the ARDUINO UNO.

The functional components in this system are moisture sensor and water pump. ARDUINO UNO a microcontroller board based on ATmega328 is programmed using the ARDUINO IDE software. ARDUINO controls both motor and moisture sensor.

The moisture sensor measures the level of moisture in the soil and sends the signal to the ARDUINO. If the measured level crosses the threshold value it is indicated as dry soil else it is indicated as wet soil. If the soil is dry, ARDUINO sends the signal to the motor indicating to water the plants until the desired moisture level is reached. The water level sensor is used to determine whether the water level in storage tank is sufficient or not for watering the fields. If water level falls below the certain threshold then the motor is ON else motor is OFF.WI-FI module ESP8266 is used to display continuously the value of moisture levels.

REQUIREMENTS

Solar Panel

Fig.2. Solar Panel

The basic element of a Photo-Voltaic system is the Photo-Voltaic cell also called as solar cell which captures the sun rays and converts that energy into electricity. A solar cell is generally made from silicon or any other semi-conductive materials that can convert solar energy into DC electricity through the Photo-Voltaic effect. When the sunlight falls on the solar cell, it may be reflected, absorbed, or passes right through. The absorbed light generates electricity. Solar cells do not use the sun's heat to produce electricity. They produce

electricity directly when sunlight interacts with semi-conductor materials in solar cells.

ARDUINO UNO

It is an open-source microcontroller compatible with developed platforms. The controller appears not to be expensive and uses low electrical power, 5.5 volts.

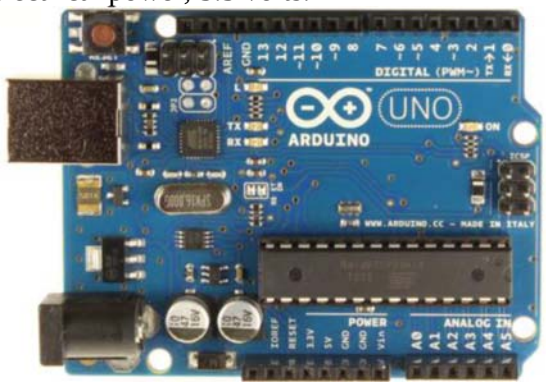

Fig.3. ARDUINO UNO

C and C++ were employed for this development. ARDUINO can connect to a computer via the Universal Serial Bus (USB) and perform with compatible connected accessories in both analog signal and digital signal. The ARDUINO is a microcontroller platform, mounted on a board that plugs easily into most computers. It allows the user to program the onboard Atmega chip to do various things with programming language, in programs called sketches.

Water pump

Fig.4. Submersible water pump

Pump is a device that moves fluid by mechanical action. Here the system uses a pump to meet the required pressure for the drip and it can be operated at low power compared to other irrigation pump.

Soil moisture sensor

Soil moisture sensor is used to sense the moisture content in the soil. The required value of moisture is fed prior to the microcontroller. Soil moisture sensor works on the principle of resistance.

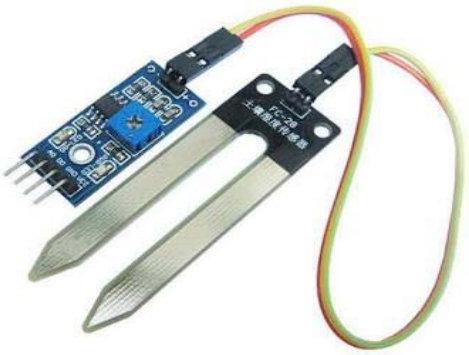

Fig.5. Moisture Sensor

When the soil is dry it gives high resistance for the connection of two electrodes, and when the moisture content in the soil increases the resistance given by the soil is less as water being good conductor of electricity conducts between the two electrodes. When the moisture level in the soil is below than the set value the pump gets on, and when the moisture content reaches the required level the power supply to the pump is cut-off. The moisture content required for different type of crops varies from crops to crops.

Battery

Fig.6. Battery

Batteries are connected in series to the panel and microcontroller to store and supply the electricity generated. The battery used in this system is 12V, 1A. It requires 18hrs for complete charging of this battery by the solar panel used for this system.

EXPECTED OUTCOME

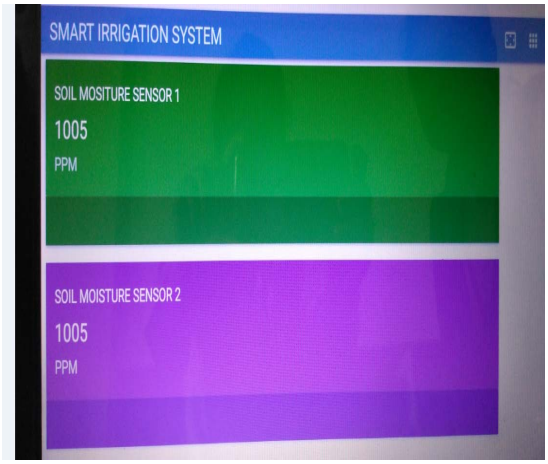

Fig.7. Wi-Fi module output

Fig.8. Whole system

ADVANTAGES

- Better water management
- Improvement in crop performance
- Long distance communication is possible
- Time saving
- Reduce use of non renewable resources
- Provide feedback on soil moisture level for correct scheduling of irrigation
- Switching of irrigation controller
- Detect leaching of nutrients
- Assess the effectiveness of rain water
- Fertilizer and nutrient loss is minimized
- Soil erosion is lessened

DISADVANTAGES

- Initial cost can be more than overhead systems.
- Drip irrigation can be unsatisfactory if herbicides or top dressed fertilizers need sprinkler irrigation for activation.
- Waste of water, time and harvest if not installed properly.
- Weak Wi-Fi signal lead to slow data transfer or dropped connections

CONCLUSION

Agriculture sector is the backbone of our country. By implementing the automatic irrigation system there are various benefits for the farmers. It optimizes the usage of water by reducing wastage and reduces the human intervention for farmers. The excess energy produced using solar panels can also be given to the grid which small modification in the system, which can be a source of the revenue of the farmers, thus encouraging farming in India and same time giving a solution for energy crises. Even though there is a high capital investment required for this system to be implemented, the overall benefits are high and in long run this system is economical.

The pump in water tank is utilized for the purpose of transferring of water to drip irrigation system. An installed capacity of 20W solar panels was designed to satisfy power requirement for the working of system. Battery and water tank are utilized for the purpose of storing energy obtained from solar panels and in the meanwhile the stability of the system is also increased.

The moisture sensors measure the moisture level (water content) of the different plants. If the moisture level is found to be below the desired level, the moisture sensor sends the signal to the ARDUINO board which triggers the Water Pump to turn ON and supply the water to respective plant. When the desired moisture level is reached, the system halts automatically and the Water Pump is turned OFF.

Environmental pollution is prevented with renewable energy and energy production from local resources is encouraged. An advantage of system is that system needs no maintenance. The use of this automated drip irrigation system

will be able to contribute to the socio-economic development.

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