Available online at www.elixirpublishers.com (Elixir International Journal)

Electrical Engineering

Elixir Elec. Engg 144 (2020) 54574-54577

ISSN: 2229-712X

IoT Based Farmland Powered Using Solar Energy

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ARTICLE INFO

Article history:
Received: 11 June 2020;
Received in revised form:
10 July 2020;
Accepted: 20 July 2020;

Keywords
Arduino,
Buzzer,
Soil Moisture Sensor,
Electrochemical Sensor,
Humidity Sensor,
Ultrasonic Sensor,
Turbidity Sensor,
PIR Sensor,
Temperature Sensor,
Relay,
Motor.

ABSTRACT

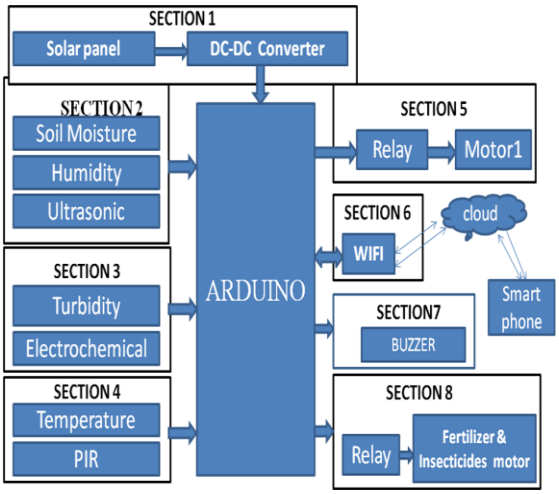
In the present scenario, availability of power and water are insufficient to satisfy the farmer's requirements. Traditionally implemented Techniques of irrigation are proving to be less futile as these are not good at multitasking different concerns which are combinations of availability of water, source of energy and timely soil profile analysis. With the merger of automation and the methods of irrigation used earlier. The scope to mitigate issues concerning water and power crisis, is huge. In this paper Internet of Things based solar powered smart irrigation system with monitoring and control features, is designed and implemented. The sensor enabled proposed model of smart irrigation system along with its Android application and ESP8266 as its main controllers. The farmland parameters can be monitored anywhere around the world with the help of IoT technology. The whole concept of this paper is implemented and then only the results are presented.

1. Introduction

Due to over population it occurs a deforestation this results in shortage of food, water and shelter in forest areas. So, Animals interference in residential areas is increasing day by day which affects human life and property causes human animal conflict but as per nature's rule every living creature on this earth has important role in eco-system. Agriculture is the backbone of the economy but because of animal interference in agricultural lands, there will be huge loss of crops. Elephants and other animals coming in to contact with humans, impact negatively in various means such as by depredation of crops, damaging grain stores, water supplies, houses and other assets, injuring and death of humans. Farmers in India face serious threats from pests, natural calamities &damage by animals resulting in lower yields Traditional methods followed by farmers are not that effective and it is not feasible to hire guards to keep an eye on crops and prevent wild animals. Since safety of both human and animal is equally vital.

2. Proposed System

In the proposed method, the entire process done by using microcontroller and sensors. We are using sensors for identify content of water present in the soil, moisture in the air ,detect the object, detect the water quality, detecting nitrogen, phosphorus, potassium ,detect sudden temperature rise in farm land and animal detection. This all information collects to the micro controller.



Block diagram

Explanation

Solar Panel is a Green and renewable one, used to power the whole device.

Soil moisture sensor-detects soil moisture. If it is not in limit then the motor pump will get turn on automatically.

PIR sensor- used to detect the intervention of animal/human using body temperature of animal/Human.

If intervention happened then buzzer will blow, so that the animals will get away.

Electrochemical sensor- used to detect nutrient and PH level of soil. If it is not in limit then the fertilizer spray pump will get turn on automatically.

Turbidity sensor- used to detect the purity of water. Water flow can also be controlled depending on the purity of water.

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Temperature sensor- used to detect fires in field. Water will be automatically sprayed after detection of fire.
Ultrasonic sensor- used to monitor the growth of the plant.
Humidity sensor- used to detect the moisture content of the air.
Microcontroller unit- Collects the information from these entire sensors and it is programmed to control the output devices like buzzer, water pump, and fertilizer sprayer pump.
Wi-Fi - used to transmit the information about the farmland parameters and receive the control signals from user Mobile phone.
Mobile Phone- used to monitor the farmland parameters and control output devices in Farmland by a signal from it.

3. Hardware Details

I. Solar Panel

Solar cells can be classified into first, second and third generation cells. The first generation cells also called conventional, traditional or wafer-based cells are made of crystalline silicon, the commercially predominant PV technology, that includes materials such as polysilicon and monocrystalline silicon. Dimension 780*670*30mm, Weight 0.10-4.90kg, Open Circuit Voltage 21.50-32.50v, Short Circuit Current 3.97 amps

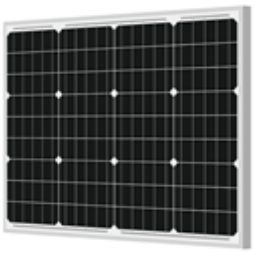

Figure.1 Solar panel

II. DC-DC CONVERTER

The buck–boost converter is a type of DC-to-DC converter that has an output voltage magnitude that is either greater than or less than the input voltage magnitude. It is equivalent to a fly back converter using a single inductor instead of a transformer.

Current Limit (Adj. or Fixed) LDO Regulator(s), On-Chip Light Load Mode Power Good Output Short Circuit Protection Shutdown, Enable, Standby Soft Start Synchronizable Under Voltage Protection, Brown-Out

Figure 2. DC-DC converter

III. Soil Moisture Sensor

Soil moisture sensors measure the volumetric water content in soil. ... Reflected microwave radiation is affected by the soil moisture and is used for remote sensing in hydrology and agriculture. Portable probe instruments can be used by farmers or gardeners.

Figure 3. Soil Moisture sensor

IV.Humidity Sensor

A humidity sensor (or hygrometer) 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. Relative humidity becomes an important factor when looking for comfort.

Figure 4. Humidity sensor

V. Ultrasonic Sensor

Ultrasonic sensors can measure the distance to a wide range of objects regardless of shape, color or surface texture. They are also able to measure an

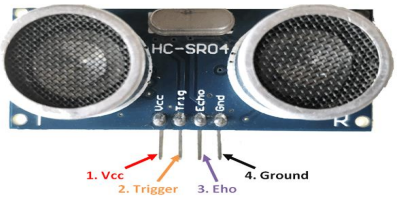

Figure 5. Ultrasonic sensor

VI. Turbidity

Turbidity sensors measure the amount of light that is scattered by the suspended solids in water. As the amount of total suspended solids (TSS) in water increases, the water's turbidity level (and cloudiness or haziness) increases.

Figure 6. Turbidity sensor

VII. Electrochemical

Electrochemical sensors are used for detecting oxygen and toxic gases. More specifically, they measure the concentration of a specific gas within an external circuit. This is done by method of oxidation or reduction reactions. These reactions generate the positive or negative current flow through said external circuit

Figure 7. Electrochemical sensor.

VIII.Temperature

A temperature sensor is a device, typically, a thermocouple or RTD, that provides for temperature measurement through an electrical signal.

Figure 8. Temperature sensor.

A thermocouple (T/C) is made from two dissimilar metals that generate electrical voltage in direct proportion to changes in temperature.

IX. Pir Sensor

A PIR or a Passive Infrared Sensor can be used to detect presence of human beings in its proximity. The output can be used to control the motion of door. ... A PIR sensor detects the infrared light radiated by a warm object.

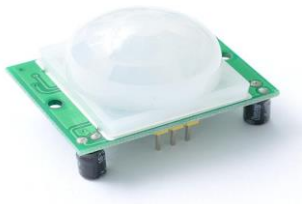

Figure 9. PIR sensor

X.Arduino

Arduino refers to an open-source electronics platform or board and the software used to program it. Arduino is designed to make electronics more accessible to artists, designers, hobbyists and anyone interested in creating interactive objects or environments.

Figure 10. Arduino

The **Arduino Uno** board is a microcontroller based on the ATmega328. It has 14 digital input/output pins in which 6 can be used as PWM outputs, a 16 MHz ceramic resonator, an ICSP header, a USB connection, 6 analog inputs, a power jack and a reset button. This contains all the required support needed for microcontroller.

XI. RELAY

A **relay** is an electromagnetic switch operated by a relatively small electric current that can turn on or off a much larger electric current. The heart of a **relay** is an electromagnet (a coil of wire that becomes a temporary magnet when electricity flows through it).

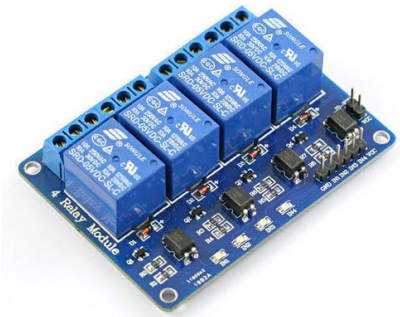

Figure 11: Relay

Relays control one electrical **circuit** by opening and closing contacts in another **circuit**. When a **relay** contact is Normally Closed (NC), there is a closed contact when the **relay** is not energized.

XII. Motor

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.

Figure 12. Motor

Solar-powered DC pumps use photovoltaic (PV) panels with solar cells that produce direct current when exposed to sunlight

XIII. Buzzer

A buzzer or beeper is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric. Typical uses of buzzers and beepers include alarm devices, timers, and confirmation of user input such as a mouse click or keystroke.

Figure 13. Buzzer

XIV. ESP8255 (Wi-Fi)

The ESP8266 WiFi Module is a self contained SOC with integrated TCP/IP protocol stack that can give any ARDUINO access to your WiFi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor.

Figure 14: ESP8266

Hardware Setup

The two terminals of solar panel is connected to dc-dc converter. Dc-Dc converter is used to provide constant power supply to the entire unit. The entire system consists of Arduino, sensors, Relay, motor and buzzer will get its power from dc-dc converter. The sensors connected to the GPIO pins of Arduino board are of analog sensor & digital sensor. Arduino board is programmed in such a manner that it controls the output device (Water pump & Sprayer pump & Buzzer) connected to it using relay unit. The ESP8266 is also connected to the Arduino board which will send farm land parameters to the website and it will also receive signal from the user at a mobile location.

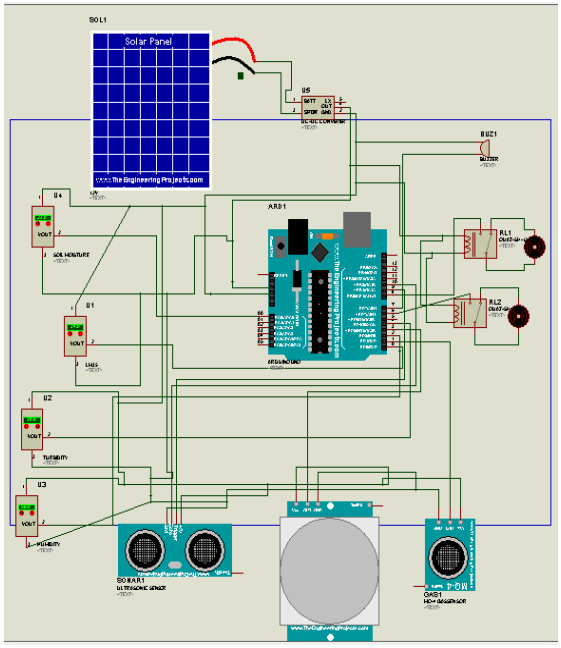

Figure 15. Circuit diagram.

The circuit diagram for the IoT Based Smart Farm land Powered Using Solar Energy is shown in the above figure.

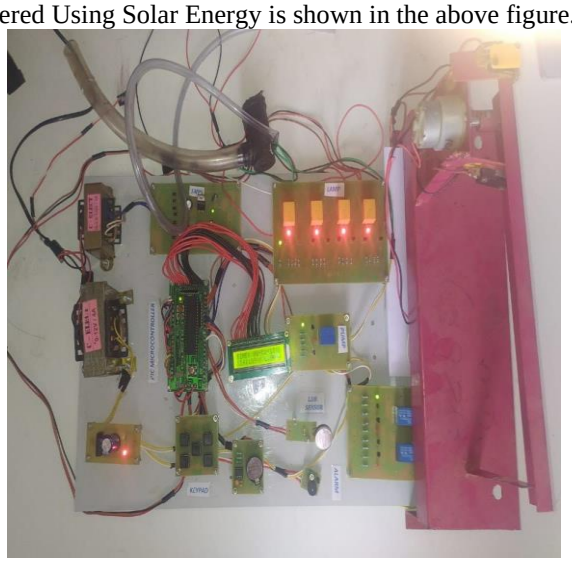

Figure 16. Prototype.

The prototype for the IoT Based Smart Farm land Powered Using Solar Energy is shown in the above figure.

Conclusion

IoT based Smart Farming improves the entire Agriculture system by monitoring the field in real-time. With the help of sensors and interconnectivity, the Internet of Things in Agriculture has not only saved the time of the farmers but has also reduced the extravagant use of resources such as Water and Electricity.

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