SOLAR POWERED AUTOMATION IN IRRIGATION SYSTEM

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Abstract— Irrigation is the application of controlled amounts of water to plants at needed intervals, and measures the amount of water requirement for the plant. Transparent and flexible solar panels absorb sunlight as a source of energy to generate electricity. Each module is rated by its DC output power under STC, and typically ranges from 10W - 40W. A single solar panel can produce only a limited amount of power, most installations contain multiple modules. This paper includes completely automated process by using various sensors, which helps in monitoring and controlling of various parameters. Using these software's Arduino ATMega328 and GSM module we can control the sensors used in the system. Servo motor operations are performed for tilting of solar panels & to protect the crops during heavy rains.

Key Words—*Algorithm, Arduino, GSM, Solar panel, Solar tilting mechanism.*

Abbreviations and Acronyms:

GSM: Global System Mobile, **PWM:** Pulse Width Modulation**. TX:** Transmitter, **RX:** Receiver**, LED**: Light Emitting Diode.
STC: Standard system Condition, **ADC**: Analog to digital converter.

I. INTRODUCTION

In today's modest worldwide, India stay in second place in farming. But the need for food is not enough because of the population [1] is increasing day by day. So, in order we need to increase and progress the food production technology. Because agriculture is one of the main soul of Indian economy. In cultivation field, tremendous amount of water is needed. India's irrigation is mainly depending on ground water level. Due to the human activities, [2] rapid mechanization and climatic changes are raising the deficiency of rain and scarcity in water level. Irrigation is the method of the non-natural application of water to the land at a regular interval of time, that helps us to raise agricultural crops. Automatic irrigation system is used to control and display the irrigation process. The water surplus over the flooded soil is avoided, so depletion of water is minimized and the crop yield is raised by ensuring water supply when it is needed.

Irrigation is an artificial way of drenching the soil for the suitable growth of the plant. It [3] is primarily used in the dry zones and the places where the amount of rain is less. Irrigation also helps to defeat the weeds growing in the agricultural fields. The old methods used for irrigation was manual irrigation using buckets and watering cans, by using sprinkler irrigation, confined irrigation, drip irrigation etc. but by using these systems we can't expect the amount of water that a crop needs. Due to this water cataloging, will occur while using these techniques to water the crops. So, there is a need for the improvement on these existing techniques in direction to conserve the water. Hence, to prevent the [4] water which is being unused throughout irrigation, an automatic plant irrigation system has been established. This works by recognizing the moisture content of the soil and decides whether the pump should activate or not. The water supply desired for this irrigation can be from any source like pond, stream, well etc. This arrangement is not so expensive as we compare to other systems and is also time saving, as the whole thing done by the system is automatic. The Soil [5] monitoring system for accuracy agriculture is a new system that exchanges the current system for soil moisture, salinity and PH value testing. This format will have two parts: one mobile application which is used to be aware or give suggestions to the agriculturalists whether the soil moisture, salinity and PH value are low or high as related to standard values and used to manage the data about the process as full. The mobile [6] application is necessary to commune to a wifi shield. The serviceability provided by the wi-fi shield will be rooted into the application in order to help the manipulator to use the roles in the application in a flat manner. Meanwhile this is a data-centric system to store the data. For that, a file will be used.

Solar is a domestic [7], safer venture for our humanity. We can instantly reduce our power bills. The transparent and flexible solar panels are used for generation and protection purpose. By using these solar panels can be protected due to heavy rains.

Conservative solar panels, more definitely solar photovoltaic panels, absorb sunlight and convert it to photons into usable energy [8]. The trouble with making transparent solar panels is that sunlight passes through the clear material. This means that the process that produces the

energy in the solar cell cannot be started, because no light is captivated.

II. METHEDOLOGY

This paper entitles the sensing of soil moisture, rain, temperature, humidity, water level indicator and automatic plant watering system using Arduino UNO. This system reads the moisture content, rain, temperature, water level and humidity of the soil. Transparent and flexible solar panels are used for generation of power and also for protection of crops due to heavy rains by tilting mechanism of panel through DC servomotor. The status of the tank, motor, soil moisture, rain, temperature, humidity and water levels will be displayed on a 16 X 2 LCD display.

Set the preset value for soil moisture sensor, temperature sensor, humidity sensor, rain sensor and a water level indicator for paddy, wheat, sugarcane, maize, and groundnut. Soil moisture sensor will sense moisture content present in the soil, temperature sensor will sense the temperature of the atmosphere, humidity sensor will sense the humidity of various crops and level of water present is sensed by water level indicator and output of these sensors are given to the Arduino and values are displayed in 16X2 LCD display.

Before the Arduino gives command to the relay circuit, it sends alert signal to the farmers through GSM. By this, the process can be controlled automatically. Relay drives are used to operate and control the actions of water pump and DC servomotor. DC servomotor is used for operation of solar panels (tilting mechanism).

Infrared sensor (IR) is used to control the crops and fields from theft.

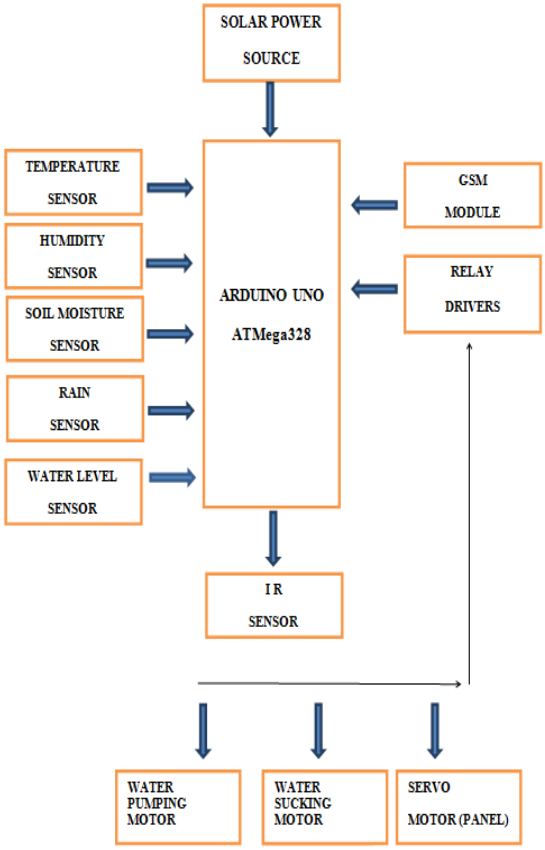

Fig. 1 Block diagram of solar powered automation in irrigation system

III. SYSTEM DESCRIPTION

a) ARDUINO UNO

The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, 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 a AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega8U2 programmed as a USB-to-serial converter.

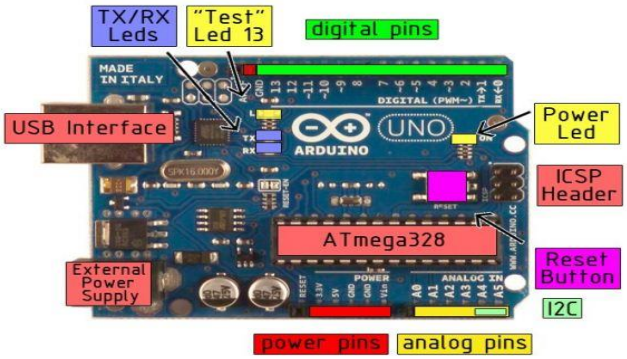

Fig. 2 Arduino Uno kit

b) GSM MODULE

In this paper, automation is interface with GSM Module to Arduino. There are different kinds of GSM modules available in market. We are using the most popular module based on Simcom SIM900 and Arduino UNO for this tutorial. Interfacing a GSM module to Arduino is simple. This need to make three connections between the GSM module and Arduino.

A GSM Module is basically a GSM Modem (like SIM 900) connected to a PCB with different types of output taken from the board – say TTL Output (for Arduino, 8051 and other microcontrollers) and RS232 Output to interface directly with a PC (personal computer). The board will also have pins or provisions to attach mic and speaker, to take out +5V or other values of power and ground connections. These types of provisions vary with different modules.

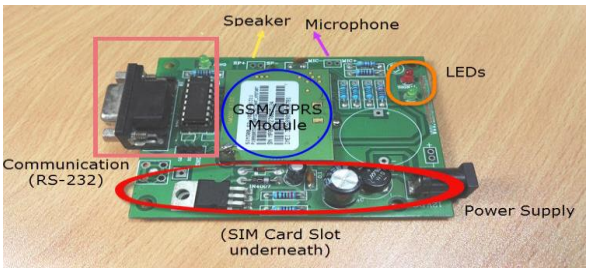

Fig. 3 GSM module

c) CONNECTING GSM MODULE TO ARDUINO

There are two ways of connecting GSM module to Arduino. In any case, the communication between Arduino and GSM module is serial. It supposed to use serial pins of Arduino (RX and TX). In this module, the connections of TX pin of GSM module to Rx pin of Arduino and Rx pin of GSM module to TX pin of Arduino are to be connected. GSM TX to Arduino RX and GSM RX to Arduino TX are connected**.** Now connect the ground pin of Arduino to ground pin of GSM module hence three connections are made and load control algorithm to communicate with GSM module.

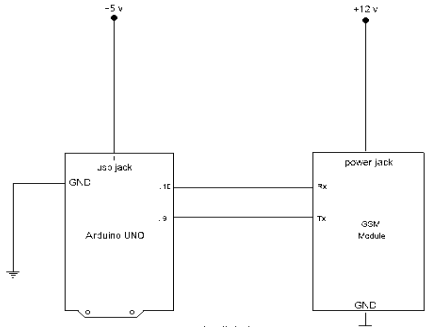

Fig. 4 Arduino to GSM interface

Table: 1 Water Requirement for different Crops

Crop	Water requirement (mm)
Rice	900-2500
Wheat	450-650
Sorghum	450-650
Maize	500-800
Sugarcane	1500-2500
Groundnut	500-700
Cotton	700-1300
Soybean	450-700
Tobacco	400-600
Tomato	600-800
Potato	500-700
Onion	350-550
Chilies	500
Sunflower	350-500
Castor	500
Bean	300-500
Cabbage	380-500
Pea	350-500
Banana	1200-2200
Citrus	900-1200
Pineapple	700-1000
Ragi	400-450
Grape	500-1200

IV. SYSTEM UNDER TEST

In this paper the monitoring and security control of automation in irrigation system was modeled and tested for different crops using control algorithm.

Fig. 5 Solar powered automation in irrigation system module.

The supply of water to the crops by a submersible pump and can be monitored and controlled by Arduino and GSM Module. The objective is to control the system from security violations through the proposed algorithm. The power supply can be used for automation by solar panels. If the security constraints are exceeding the acceptable limit, then the algorithm send the information to the operator (farmer) by sending signals through sensors placed in a field or through an SMS alert to a mobile and it decides the type of security violations and overcome the same. In this methodology, there are two types of problems are discussed as mentioned above. They are

1. Moisture content of crops and
2. Water level control.

The above two problems are found by the violation of security constraints, these security constraints are line voltage and voltage regulation of the distribution system. The voltage at the far end of the line will be reduced and the voltage regulation is poor during.

V. PROPOSED ALGORITHM

The control algorithm for solar powered automation in irrigation system is shown in fig 6 and working of algorithm is explained in following steps.

Step 1: Explore the Solar panels to atmosphere & generated power is given to the power kit.

Step2: Before the supply is given to the Arduino, set the preset value for soil moisture sensor, temperature sensor, humidity sensor and a water value indication for paddy, wheat and sugarcane.

Step 3: Switch on the Arduino and compare the values of obtained values with a preset value set in an Arduino. If both the values are same the condition satisfies and the signal goes to Arduino. If condition violates then there is two, chances (i) less than preset value (ii) more than preset value. The Arduino sends signal to a Relay circuit.

Step 4: Arduino send command to the relay circuit, it send a message of data is given to a customer through GSM Module.

Step 5: The relay will sense the above given conditions if it is less than preset value the relay sends a signal to a Motor and the Motor turns ON. If the water level is more than the preset value relay sends a signal to a motor and the motor turns OFF.

Step 6: Servo motor mechanism is performed for tilting of solar panels to protect the crops during heavy rains.

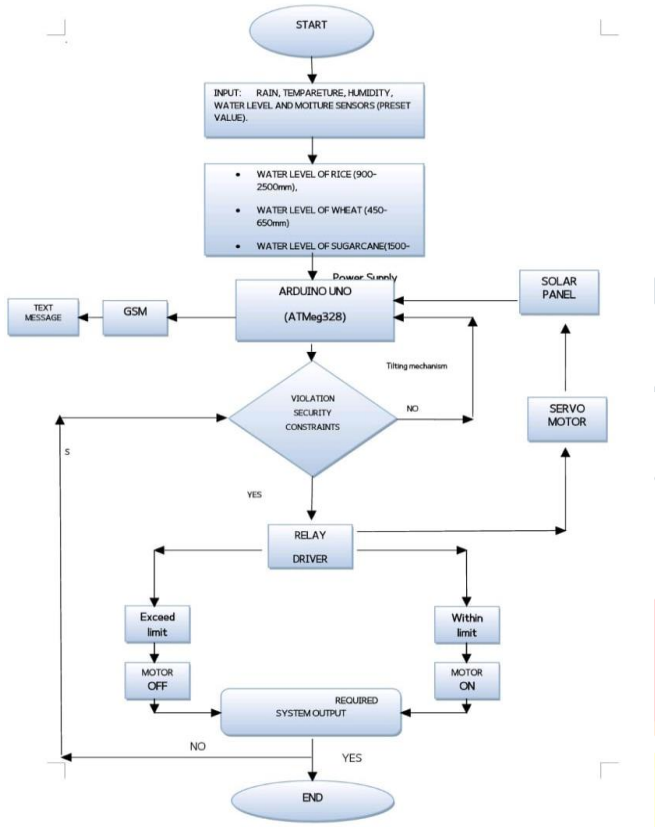

Fig. 6 Solar powered automation in irrigation system control algorithm

VI. RESULTS AND DISCUSSION

Various parameters are measured for improving the yield of the crops. The output of the solar panel is 12V, 1.2Amp, 10Watts.

i. The temperature sensor value is set to 40ºC
ii. The humidity sensor value is set to 35 ºC
iii. If the heavy rain occurs servomotor is ON and operates the solar panel to cover the crops and this protects from decomposition.
iv. The rain sensor value is set to 1023Ω which is very high.
v. The value of soil moisture sensor is set to zero, we get maximum value of 10-bit ADC, i.e. 1023. This, in turn gives 0% moisture.

Table: 2 Results obtained from test module

Parameters	Set values	Exceeding the limits	Within the limits
Temperature	40C°	Motor is ON Position	Motor is OFF Position
Humidity	35C°	Motor is ON Position	Motor is OFF Position
Rain Sensor	0 Ω	Servo motor ON	Servo motor OFF
Soil moisture	1023 Ω	Motor is OFF Position	Motor is ON Position
Water level indicator	Rice (900-2500mm) Wheat (450-650mm) Sugarcane(1500-2500mm)	Motor is OFF Position	Motor is ON Position

VII. CONCLUSION

This paper illustrates to build an algorithm for solar powered automation in irrigation system. The use of this technique will be able to contribute to the socio-economic development of the Nation. The utilization of solar panel is an advanced technology for generaion of electric power. This technique allows user to communicate with sensors from a long distance in no time which make the user more productive and to solve the problems occurring in irrigation system. The solar panel tilting mechanism is operated by servo motor control during heavy rains. The existing techniques improves the conservation of water in irrigation system. The system is completely automatic and reliable.

VIII. REFERENCES

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