IOT BASED SOLAR WATER PUMP CONTROLLER

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ABSTRACT:

The solar pump operates on power generated using solar PV (photovoltaic) system. Solar energy is largely available source of energy in the world. With the advancement of technologies like Internet of Things (IoT), the solar energy can be used very efficiently. So, we proposed an IoT based solar water pump controller. This system consists of a microcontroller, moisture sensor, water sensor and wi-fi module. Solar tracking system is also included to observe maximum energy. The microcontroller send data to a central server, the data is stored and can be viewed from our mobile phone. Based on the readings the motor pump can be turned on or off. This minimizes the human effort in the remote places. The user can control all operations through his mobile device.

KEYWORDS—**Solar power plant, Energy generation, Water Pump, IOT**

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I. INTRODUCTION

A solar energy-powered water pump runs on the electricity that is generated by solar photovoltaic modules. Photovoltaic (PV) panels are used for agricultural operations, particularly in remote areas or places where alternative energy source is desired. The photovoltaic systems have the benefit of being scalable which ranges from few watts to hundreds of kilowatts. With proper designing these PV systems can result in significant long-term usage with minimal cost compared to conventional power systems. Storing the electricity in a battery in order to run the water pump when there is no sunlight add great value to the cost of the system. The storage solutions are expensive but they allow for greater utilization of the PV system. The solar powered water pumps can be controlled using IoT.

II. PROPOSED SYSTEM

The solar energy is always available and it is not going to be in shortage anytime. Hence the usage of solar energy will be improving day by day. With the advancement of technologies like IoT automation can be brought almost in every field. We also intend to implement IoT to the solar water pump in order to reduce the man power and make it easier for the user.

Using the Internet of Things Technology solar photovoltaic power generation can be monitored and used for various applications. In this paper the motor pump can be controlled and monitored through our mobile phone. It also calculates the moisture level in the land and can be viewed from our mobile phone. All these data will be uploaded to the cloud. The pump can be turned on using mobile phone. It also includes solar tracking to increase the power generated by photo voltaic cell according to the direction of sunlight. As an added feature the charge generated by the solar panel can also be viewed from our mobile phone and the motor can be operated either with the help of generated solar energy or electrical energy.

III. METHODOLOGY

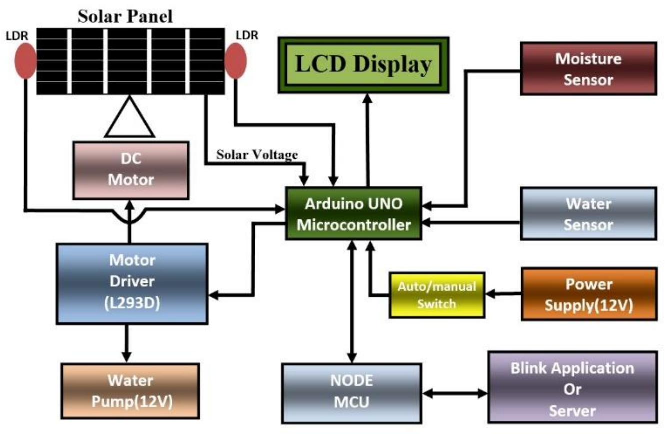


Fig 1: Block Diagram

The block diagram shows the overall working of the system. The required program for Arduino Uno and NodeMCU are created through software and are fed to the micro controllers using USB cable. Then the Arduino Uno and the sensors are connected, with this the process is made continuous. LCD display is to view the parameters acquired from the sensors. They are being interfaced with IOT using NodeMCU to mobile phones through Blynk server Application where the current status of water level and several other parameters can be viewed and thereby farmer can take further action.

IV. HARDWARE COMPONENTS

In our paper, IoT Based Solar Water Pump Controller, we have developed a setup for continuous process with IoT enabled solution. The following are the hardware components used,

1. Arduino Uno
2. Node MCU
3. LCD display

4. Water Level Sensor
5. Soil Humidity Sensor
6. LDR Sensor
7. Solar Panel
8. Motor Driver
9. DC Motor
10. DC Water Pump
11. Power Supply
12. Switch

1) ARDUINO UNO:

Arduino UNO is a micro controller which consists of 6 analog pins and 14 pins (Fig 3) which can either be digital input or digital output as shown in Fig 2. This arduino operates with 5V. Arduino helps in communicating with a computer, another arduino board or another micro controller. The pins Tx and Rx are meant for transmitting and receiving data of requirement which makes these 2 pins for lead role of serial communication.

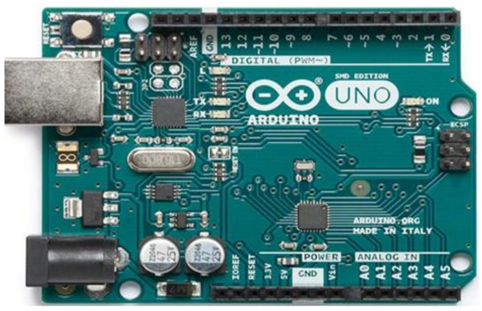


Fig 2: Arduino Uno Micro Controller

Arduino is an open-source electronics platform used for hardware and software interface. Arduino Uno board is able to read inputs – water level from a water level sensor, soil moisture level from soil humidity sensor, or a message and turn it into an output – turning on a motor, turning on an LED indicator, displaying it in LCD along with IoT interface. To do so the Arduino programming language and the Arduino Software (IDE) are used in computer.

(i) *CONFIGURATION:*

- Micro controller ATmega328
- Operating Voltage 5V
- Input Voltage(recommended) 7-12V
- Input Voltage(limits) 6-20V
- Digital I/O Pins 14
- Analog Input Pins 6
- DC Current per I/O Pin 40 mA
- DC Current for 3.3V pin 50 mA
- Flash Memory 32 KB(ATmega328)
- SRAM 2 KB (ATmega328)
- EEPROM 1 KB (ATmega328)
- Clock Speed 16 MHZ

(ii) *PIN DIAGRAM:*

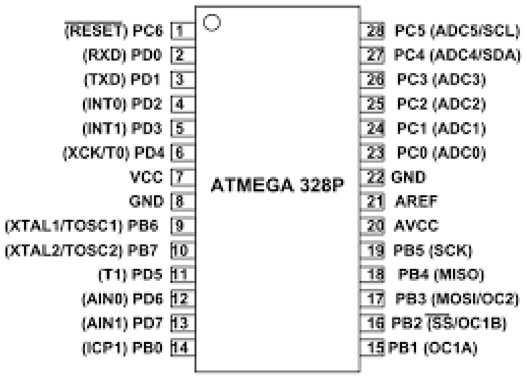
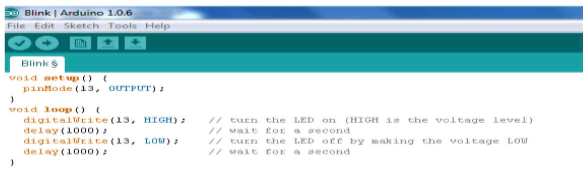


Fig 3: Arduino Uno Micro Controller Pin Diagram

(iii) *ARDUINO IDE:*

The Integrated Development Environment (IDE Fig 4) is a combination of editor, linker and a compiler which helps the developer to make their coding for their papers. Arduino IDE plays a major role in the open source platform for prototyping and easy to access of library functions. It is a user-friendly tool for beginners and it supports many programming languages like embedded C, Luna etc.



```
void setup() {
  pinMode(13, OUTPUT);
}
void loop() {
  digitalWrite(13, HIGH);   // turn the LED on (HIGH is the voltage level)
  delay(1000);              // wait for a second
  digitalWrite(13, LOW);    // turn the LED off by making the voltage LOW
  delay(1000);              // wait for a second
}
```

Fig 4: Arduino Uno IDE 1.0.6

2) NODE MCU:

Node MCU is an open-source IoT development kit that helps in designing a product especially using IoT with similar kind of coding's as that of Arduino Uno.

This module is similar to ESP8266 module which is a low-cost Wi-Fi module. But Node MCU chip is incorporating both a full TCP/IP stack and microcontroller capability as shown in Fig 5.

It is introduced by Espressif Systems. The ESP8266 NodeMCU is a complex device, which combines some features of the ordinary Arduino board with the possibility of connecting to the internet through Wi-Fi connectivity.

Fig 5: NodeMCU Micro Controller

NodeMCU can be programmed using Arduino software platform itself. Suitable configurations should be done in Arduino IDE before started coding for NodeMCU.

Board specifications should be chosen correctly for error free dumping and code compilation as shown in Fig 5.1.

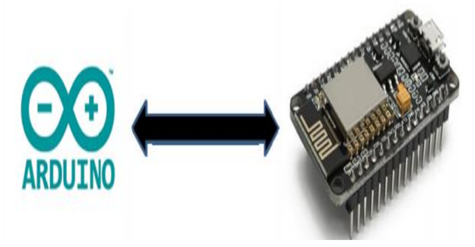


Fig 5.1: NodeMCU Micro Controller with Arduino

(i) *SMARTPHONE WITH BLYNK APPLICATION:*

Blynk is an Android application to control Arduino Unoover the Internet.It's a platform where we can build a graphic interface over internet for our paper. It is made simple by dragging and dropping the visual widgets as shown in Fig 6.

Blynk is not only specific to Arduino Uno board. Instead, it is supporting many hardwares of our choice. Our Arduino Uno is linked to the Internet over Wi-Fi embedded in this new ESP8266 chip. Blynk app will get your Uno board online.

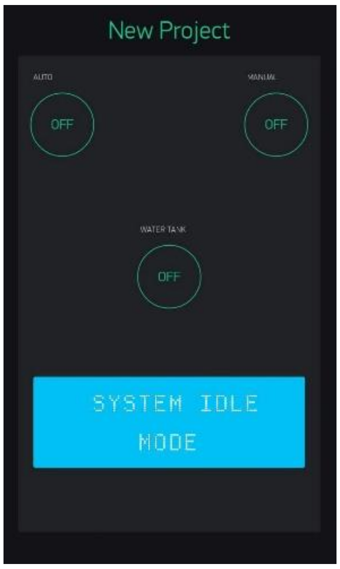


Fig 6: Blynk Application in SmartPhone

3) *LCD DISPLAY:*

16*2 LCD displays are mostly used as reliable output device. For any of the micro controller-based paper, it is not possible to use debugger every time. So, 16*2 LCD display can be used to test the output as shown in Fig 7.

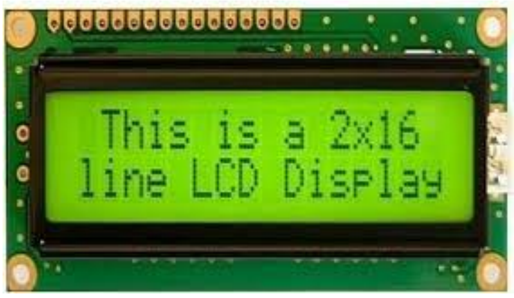


Fig 7: 16*2 LCD Display Module

LCD display will accept two types of signals from Arduino Uno such as data and control signal. These two signals are fetched by the LCD module from its RS pin.

Now the data can also be read from the LCD display, by pulling the R/W pin high. As soon as the E pin is enabled high, LCD display will read the data at the falling edge of the pulse and executes it. It is same for the transmission case also.

LCD display will take a time of 39-43µS to execute the given command. It is exceptional for clearing the previous display and to seek cursor to initial position it will take 1.53ms to 1.64ms.

4) *WATER LEVEL SENSOR:*

Level sensors are used to detect the level of water inside the bore well. Contact type sensor is used for detecting the level of water. Contact type water level sensor used is shown in Fig 8.

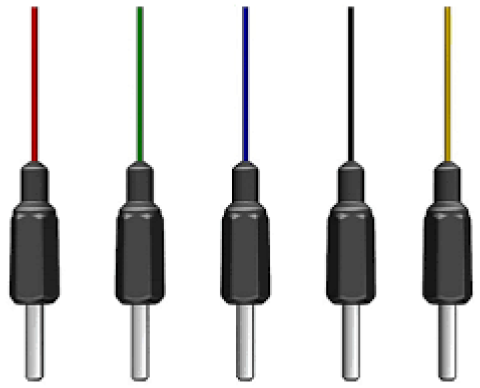


Fig 8: Water Level Sensor

This sensor is a corrosion free material and it comes with 2m cable wire for easy installation. Specifications of this sensor is as follows:

- Max Switch Current: 5A (DC)
- Max Switch Watt: 10W / VA
- Ideal Operating Ratings: Voltage: 2 to 12V DC Current: 5 to 50mA DC

5) *SOIL HUMIDITY SENSOR:*

The Moisture sensor is used to measure the water content(moisture) of soil. When the soil is having water shortage, the module output is at high level, else the output is at low level. This sensor intimates the user if the water level is low and also keeps track of the moisture content in the soil. Here the moisture sensor plays the major role in this whole process.

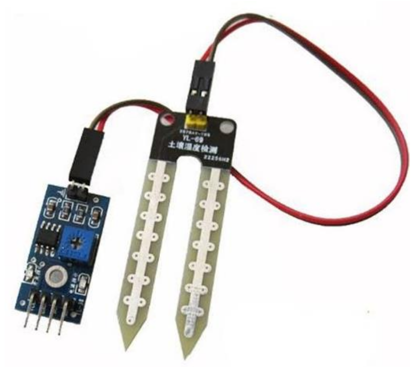


Fig 9: Soil Humidity Sensor

The specification of this sensor includes the following.

- The required voltage for working is 5V.
- The required current for working is <20mA.
- Type of interface is analog.
- The required working temperature of this sensor is 10°C~30°C.

6) *LDR SENSOR:*

LDR is the Light Dependent Resistor. Photo resistors, also referred to as light dependent resistors (LDR), are light sensitive devices most frequently want to indicate the presence or absence of sunshine, or to live the sunshine intensity. In the dark, their resistance is extremely high, sometimes up to 1MΩ, but when the LDR sensor is exposed to light, the resistance drops dramatically, even right down to a few ohms, depending on the light intensity. LDRs have a sensitivity that varies with the wavelength of the sunshine applied and are nonlinear devices.

In this paper LDR is used for solar panel tracking. The solar panel takes place with the help of DC motor.

Fig 10: LDR Sensor

7) *SOLAR PANEL:*

A solar panel comprises photovoltaic cells which are made of silicon or other semiconductor materials. When exposed to sunlight the photovoltaic cells in a solar panel receive energy which they absorb. They transfer the absorbed energy to the semiconductor which helps create an electric field which in turn delivers voltage and current. The power is delivered as per the equation P (power) = V (voltage) x I (current). The power generated is measured in watts (W).

Fig 11: Solar Panel

The electric field produced comprises almost constant voltage but current that varies with the amount of sunlight falling on the cells. So here, the energy generated by the solar panel is directly used to control the operation of the water pump, if the solar panel generate low power then there is an alternate electricity source which is used to operate water pump.

8) *MOTOR DRIVER:*

The motor driver used here is L293D. This motor driver is used to control the working speed and direction of two motors simultaneously. In this we use this motor driver to change the angle and direction of the motor to turn according to required direction. This motor driver is used to control DC motor and DC water pump.

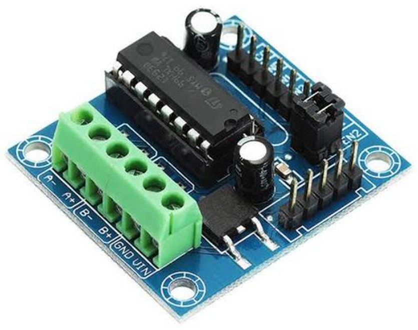


Fig 12: L293D Motor Driver Shield

The specification of L293D Motor Driver Shield:

- Operating Voltage :5V to 12V.
- Motorcontroller: L293D, Drives2 DC motors or 1 stepper motor.
- Max current: 600mA per channel.
- Peak Output Current :1.2 A.

9) *DC MOTOR :*

12V DC motor is used to rotate the solar panel based on the instruction given by the micro controller.

Fig 13: DC Motor

Dc motor is connected with motor driver L293D.It is driven by micro controller. It comes up with gear setting to slow down the speed of the motor.

10) *DC WATER PUMP:*

DC powered water submersible pump will operate in direct current to move water in a variety of ways. This pump will operate in 12 volts of DC power.

Fig 14: DC Water Pump

The DC motor is sealed in a plastic case attached to the impeller as shown in Fig 14. It is powered through a simple gear mechanism. Through a series number of pushes, the rotor continues to spin, driving the impeller and powering the pump and there by pumping out the water.

11) *POWER SUPPLY:*

This paper will require the operating voltage of 12V DC. It is powered with 12V DC adapter circuit. Adapter circuit comes with transformer and voltage regulators to provide constant DC output of 12V. It is sealed inside insulated material with external cable length of 2m as shown in Fig 15.

Fig 15: Power Supply

This adapter comes with the following specifications,

- Input Type: AC
- Input :100-240 VAC 50/60 Hz
- Output Type: DC
- Output: 12 Volts, 1 Amp

12) *SWITCH:*

Switch is used to break the circuit between power supply and the components used. In this paper Auto/Manual mode switch is used in order to operate the system in either automated mode or manual mode.

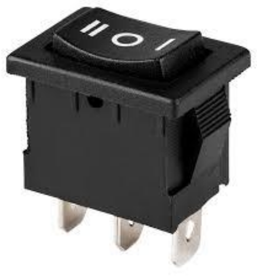


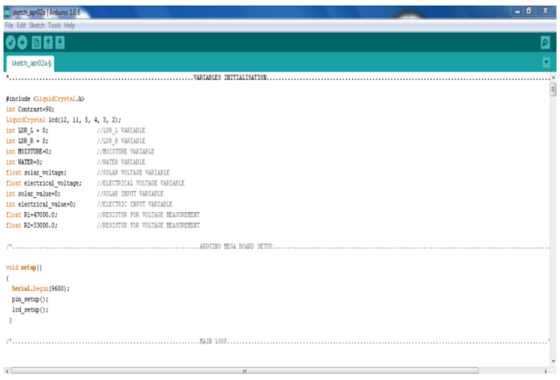
Fig 16: Auto/Manual Switch

The switch will break the circuit when it isin neutral position as shown in Fig 16. Further operation ofthe switch is similar to normal switches.This switch comes with the following specifications,

- Current rating: 10A @ 125 VAC, 6A @ 250 VAC
- Housing dimension: 18.4 mm L x 12.9 mm W x 13.8 mm D
- Contact: 1

V. DESIGN AND IMPLEMENTATION

The circuit setup along with the function of the process are shown in the Fig 17, Fig 18, Fig 19, Fig 20.



```
*.....................................................VARIABLES INITIALISATION.......................................................

#include <LiquidCrystal.h>
int Contrast=90;
LiquidCrystal lcd(12, 11, 5, 4, 3, 2);
int LDR_L = 0;               //LDR_L VARIABLE
int LDR_R = 0;               //LDR_R VARIABLE
int MOISTURE=0;              //MOISTURE VARIABLE
int WATER=0;                 //WATER VARIABLE
float solar_voltage;         //SOLAR VOLTAGE VARIABLE
float electrical_voltage;    //ELECTRICAL VOLTAGE VARIABLE
int solar_value=0;           //SOLAR INPUT VARIABLE
int electrical_value=0;      //ELECTRIC INPUT VARIABLE
float R1=47000.0;            //RESISTOR FOR VOLTAGE MEASUREMENT
float R2=33000.0;            //RESISTOR FOR VOLTAGE MEASUREMENT

/*.....................................................ARDUINO MEGA BOARD SETUP.......................................................

void setup()
{
  Serial.begin(9600);
  pin_setup();
  lcd_setup();
 }

/*.....................................................MAIN LOOP.......................................................*
```

Fig 17: Coding for Arduino Uno using arduino IDE software

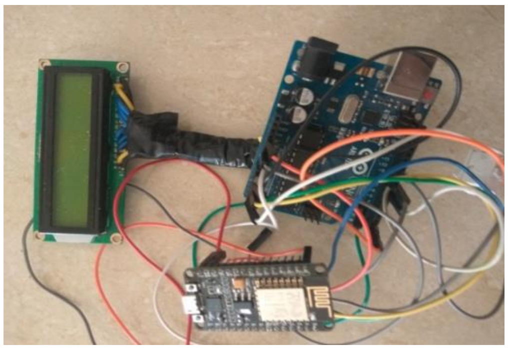


Fig 18: Hardware set up in the panel board

Fig 19: LCD display in the Panel board

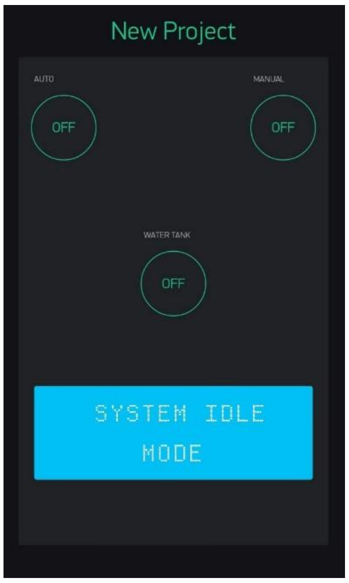


Fig 20: Blynk Application image in Mobile Phone

VI. CONCLUSION

The following results are been achieved through this work,

1. The moisture level of the land, the electricity generated from the solar cell and the status of the motor pump will be uploaded to the cloud.
2. The parameters can be viewed from cloud with the help of mobile phone.
3. The motor pump can be controlled using mobile phone.

VII. REFERENCE

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