DESIGN AND FABRICATION OF SOLAR POWERED WATER PUMPING SYSTEM WITH AUTO TRACKING

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ABSTRACT

Solar energy is converted to mechanical energy by absorbing the solar radiation from the sunlight. In this paper we have introduced a solar photo voltaic cell for collecting the sun rays through the solar array and transforming this sun rays in to electricity to generate the electricity. The main aim of this project is to supply electricity through the sun rays and its for the purpose of irrigation in the rural areas where the electricity scare is expected. In our solar kit we have introduce an Automatic solar tracker which stimulates and increases the efficiency of the solar panel by keeping the solar panel which moves according to the direction of movement of sun rays. A solar PV cell is a electrical device that converts the energy of light directly to electricity by the photovoltaic effect. A photoelectric cell is defined as an device whose electrical characteristics like current, voltage, resistance, varies when exposed to light. Solar cells are the basement for any photovoltaic modules panels. Solar cells are used as a photo detector for detecting light near the visible range, or measuring light intensity..

Keyword: - *Solar panel, Microcontroller board (pic16f877a), Soil moisture sensor, Light dependent resistor sensor, battery, Pump.*

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1. INTRODUCTION:

Water pumping worldwide is generally dependent on conventional electricity or diesel generated electricity. Solar water pumping minimizes the dependence on diesel, gas or coal based electricity. The use of diesel or propane based water pumping systems require not only expensive fuels, but also create noise and air pollution. The overall upfront cost, operation and maintenance cost, and replacement of a diesel pump are 2–4 times higher than solar photovoltaic (PV) pump. Solar pumping systems are environment friendly and require low maintenance with no fuel cost . Keeping in view the shortage of grid electricity in rural and remote areas in most parts of world, PV pumping is one of the most promising applications of solar energy. The technology is similar to any other conventional water pumping system except that the power source is solar energy. PV water pumping is gaining importance in recent years due to non-availability of electricity and increase in diesel prices. The flow rate of pumped water is dependent on incident solar radiation and size of PV array. A properly designed PV system results in significant long-term cost savings as compared to conventional pumping systems. In addition, tanks can be used for water storage in place of requirement of batteries for electricity storage Agricultural production in developing countries is largely dependent on rains and is adversely affected by the non availability of water in summers. However, maximum solar radiation is available in summers as such more water can be pumped to meet increased water requirements. Urban water supply systems are also dependent on electricity to pump water in towns. There is a wide scope to utilize PV pumping systems for water supplies in rural, urban, community, industry and educational institutions.

2. LITERATURE REVIEW:

- [1] We observed that the photo voltaic working process of solar water pump and compared it with the diesel water pump

- [2] We observed that by using various sensors for the respective purposes we can able to reduce the manual work there by utilization of water can be properly done..
- [3] The comparison between the diesel using pump and solar pump is made such that the utilization of sun rays results in more economical benefit rather than the diesel one.
- [4] The economy and reliability of solar electric power made it an excellent choice for remote water pumping.
- [5] The implementation of the solar at the initial, costs high but the maintenance cost is low.

3. OBJECTIVE:

- Alternate energy source is utilized.
- Irrigation is made automated with the help of sensors.
- Fuel economy is obtained by using alternate energy source for the motors.
- It reduces the pollution.
- Maintenance is less.

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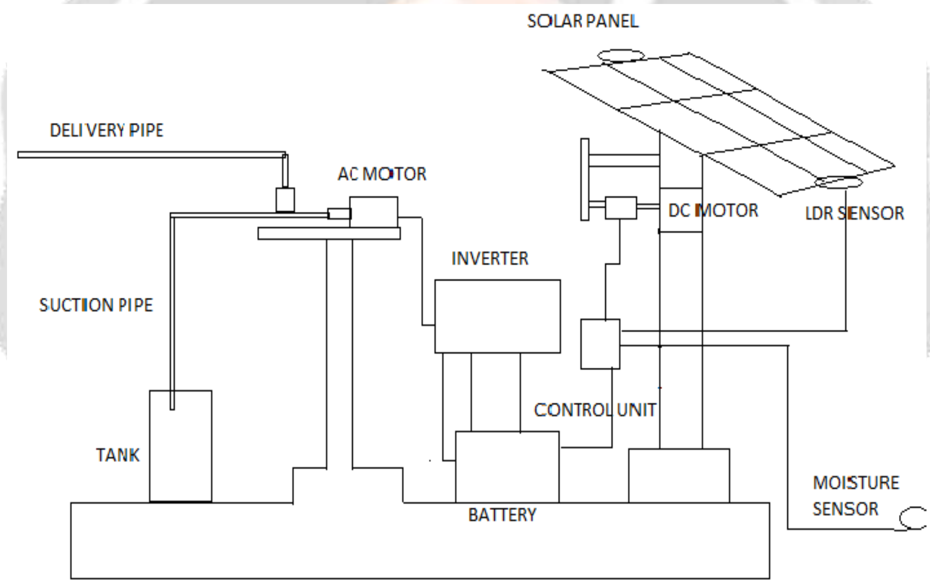
4. BLOCK DIAGRAM:



5. COMPONENTS USED:

5.1Solar Panel:

Photovoltaic solar panels absorb sunlight as a source of energy to generate electricity. A photovoltaic (PV) module is a packaged, connect assembly of typically 6x10 photovoltaic solar cells. Photovoltaic modules constitute the photovoltaic array of a photovoltaic system that generates and supplies solar electricity in commercial and residential applications. Each module is rated by its DC output power under standard test conditions (STC), and typically ranges from 100 to 365 Watts (W). The efficiency of a module determines the area of a module given the same rated output an 8% efficient 230 W module will have twice the area of a 16% efficient 230 W module. There are a few commercially available solar modules that exceed efficiency of 22% and reportedly also exceeding 24% A single solar module can produce only a limited amount of power; most installations contain multiple modules. A photovoltaic system typically includes an array of photovoltaic modules, an inverter, a battery pack for storage, interconnection wiring, and optionally a solar tracking mechanism..

5.2Micro Controller (PIC 16F877A):

A microcontroller (or MCU for microcontroller unit) is a small computer on a single integrated circuit. In modern terminology, it is similar to, but less sophisticated than, a system on a chip or SoC; an SoC may include a microcontroller as one of its components. A microcontroller contains one or more CPUs (processor cores) along with memory and programmable input/output peripherals. Program memory in the form of ferroelectric RAM, NOR flash or OTP ROM is also often included on chip, as well as a small amount of RAM. Microcontrollers are designed for embedded applications, in contrast to the microprocessors used in personal computers or other general purpose applications consisting of various discrete chips.

5.3 LDR Sensor:

A photoresistor (or light-dependent resistor, LDR, or photo-conductive cell) is a light-controlled variable resistor. The resistance of a photoresistor decreases with increasing incident light intensity; in other words, it exhibits photoconductivity. A photoresistor can be applied in light-sensitive detector circuits, and light-activated and dark-activated switching circuits. A photoresistor is made of a high resistance semiconductor. In the dark, a photoresistor can have a resistance as high as several megohms (MΩ), while in the light, a photoresistor can have a resistance as low as a few hundred ohms. .

5.4 Soil Moisture Sensor:

Soil moisture sensors measure the volumetric water content in soil. Since the direct gravimetric measurement of free soil moisture requires removing, drying, and weighting of a sample, soil moisture sensors measure the volumetric water content indirectly by using some other property of the soil, such as electrical resistance, dielectric constant, or interaction with neutrons, as a proxy for the moisture content. The relation between the measured property and soil moisture must be calibrated and may vary depending on environmental factors such as soil type, temperature, or electric conductivity. 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. Soil moisture sensors typically refer to sensors that estimate volumetric water content.

5.5 Pump:

A pump is a device that moves fluids (liquids or gases), or sometimes slurries, by mechanical action Mechanical pumps serve in a wide range of applications such as pumping water from wells, aquarium filtering, pond filtering and aeration, in the car industry for water-cooling and fuel injection, in the energy industry for pumping oil and natural gas or for operating cooling towers.

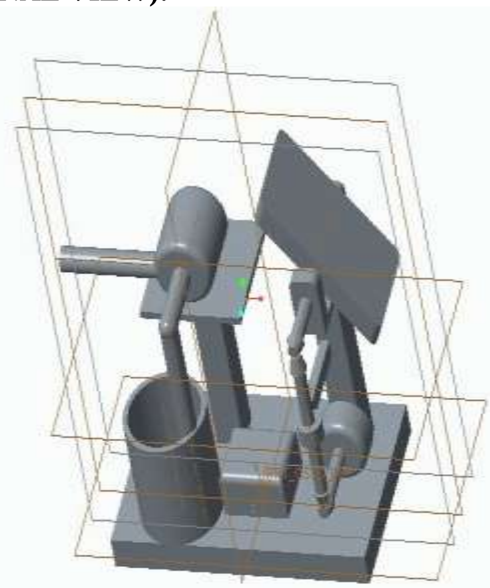
6. PROCESS INVOLVED:

The main process which is involved in our project is to make use of the solar power which is abundant in our region there by utilizing it for the purpose of irrigation. The main process we implemented here is that the energy is trapped according to the direction of the ray which incident on the panel with the help of the LDR sensor which makes the panel to move towards the direction of sun ray and the energy obtained through this is stored in the battery. Thus the automation of the water spraying is done with the help of sensors.

7. WORKING:

The sun rays from the sun light are received at an angle where we can get the maximum radiation, so the sun rays will get in to the interaction stage on the top most array in the panel which traps the photon energy from the sun lights and incident to the electron to interest towards the junction. This develops an open circuit voltage across the two terminals. The energy conversion process continues as long as light is incident on the active top surface of the cell. The power developed by these cells are collected and stored in a battery. There is a sensor placed to measure the moisture content and another sensor place along with the panel to trace the more sun ray falling angle. All are connected to a control unit. The power from the battery is sent to the invertor and then it gives power to the AC motor. It runs the pump coupled to it. The suction head is connected to the tank and discharge head is directed towards the field. The water from the well is pumped out and it is used for the domestic or agricultural purpose.

8. SETUP (3 DIMENSIONAL VIEW):



9. Codings For The Controllers:

```
#include<htc.h>
#define _XTAL_FREQ 20000000
__CONFIG(FOSC_HS & WDTE_OFF &  PWRTE_ON & CP_OFF & BOREN_ON & LVP_OFF & CPD_OFF);
#define lcd PORTB
#define rs RD6
#define en RD7


#define motor_f RC0
#define motor_r RC1
#define WATER RC2

unsigned char x,msg[90],lat[40],lon[40];
unsigned int i,k,n=1,ds=0;

void delay(unsigned int time);
void lcd_init();
void lcd_com(unsigned int com);
void lcd_data(unsigned char dat);
void lcd_str(unsigned char *dat);
unsigned int lock=0,n1,n2,n3,n4,d1,d2,d3,d4,p1,p2,p3,p4,h1,h2,h3,k;


char convert_deg(unsigned int a);
float decimal,mm,position;
unsigned int degree;
float lat1,lon1;

////UART
```

```
void UART_INIT();
void uart_sendstring(unsigned char *str);
void uart_sendchar(unsigned char a);

////   ADC
void ADC_Init();
unsigned int ADC_Read(unsigned char channel);
void val(unsigned int re);
void val1(unsigned int re);


unsigned int ADC_Read(unsigned char channel);
void ADC_Init();



void main()
{

TRISB=0X00;  //port b as output mode
PORTB=0X00;
TRISC=0x00;  //set column pin rc5,rc6 and rc7 as input mode  &&  other pins are output mode
TRISD=0X00;  //port d as output mode
PORTD=0X00;

motor_f=0;
motor_r=0;
WATER=0;

lcd_init();

ADC_Init();
lcd_str("    WELCOME");
delay(5000);
lcd_com(0x01);
lcd_com(0x80);
lcd_str("  SOLAR PLATE");
lcd_com(0xC0);
lcd_str("   ROTATION ");
delay(5000);

lcd_com(0x01);



while(1)
{
lcd_com(0x80);
lcd_str("L1=");
n1=ADC_Read(0);
val(n1);



lcd_com(0x88);
```

```
lcd_str("L2=");
n3=ADC_Read(2);
val(n3);

lcd_com(0xC0);
lcd_str("SOIL=");
n2=ADC_Read(1);
val(n2);


if(n1>950)
{
motor_r=1;
delay(320);
motor_r=0;
motor_f=0;

}

if(n3>950)
{
motor_f=1;
delay(320);
motor_r=0;
motor_f=0;

}
if(n2<400)
{
WATER=1;
delay(600);
WATER=0;
}



}
}


void ADC_Init()
{
 ADCON0 = 0x41;          //ADC Module Turned ON and Clock is selected
 ADCON1 = 0xC0;          //All pins as Analog Input
                         //With reference voltages VDD and VSS
}
unsigned int ADC_Read(unsigned char channel)
{
 if(channel > 7)                     //If Invalid channel selected
 return 0;
 ADCON0 &= 0xC5;                     //Clearing the Channel Selection Bits
 ADCON0 |= channel<<3;               //Setting the required Bits
 __delay_ms(10);                     //Acquisition time to charge hold capacitor
 GO_nDONE = 1;                       //Initializes A/D Conversion
 while(GO_nDONE);                    //Wait for A/D Conversion to complete
 return ((ADRESH<<8)+ADRESL);                  //Returns Result
```

```
}
void val(unsigned int re)
{
delay(500);
d1=(re/1000);
d2=((re-d1*1000)/100);
d3=((re-(d1*1000+d2*100))/10);
d4=(re-(d1*1000+d2*100+d3*10));
lcd_data(d1+0x30);
lcd_data(d2+0x30);
lcd_data(d3+0x30);
lcd_data(d4+0x30);
delay(50);
}


void lcd_init()
{
lcd_com(0x38);
lcd_com(0x0c);
lcd_com(0x06);
lcd_com(0x80);
lcd_com(0x01);
}
void lcd_com(unsigned int com)
{
lcd=com;
rs=0;
en=1;
delay(2);
en=0;
delay(2);
}
void lcd_data(unsigned char dat)
{
lcd=dat;
rs=1;
en=1;
delay(2);
en=0;
delay(2);
}
void lcd_str(unsigned char *dat)
{
while(*dat)
{
lcd_data(*dat++);
}
}


void delay(unsigned int time)  // Function for creating delay in milliseconds.
{
   unsigned i,j ;
   for(i=0;i<time;i++)    \
```

```
        for(j=0;j<250;j++);
}
```

10. CONCLUSIONS:

A review of current status of solar photovoltaic water pumping system technology research and applications is presented. The study focuses on update on solar water pumping technology, performance analysis studies carried out worldwide, optimum sizing techniques, degradation of PV generator supplying power to pump, economic evaluation, environmental aspects and recent advances in materials and efficiency improvement of photovoltaic technology and experience of using solar PV pumps worldwide.

11. FABRICATION IMAGES:

12. REFERENCES:

[1]. Md.Saifur Rahman "Design and fabrication of solar agricultural water pumping system and cost comparison with diesel pump"

[2]. Darshna.S, "Smart irrigation system"

[3]. Elham Mahmoud, "Renewable energy and sustainable developments in Egypt: photovoltaic water pumping in remote areas".

[4]. Kala Meah, Sadrul Ula, Steven Barrett, "Solar photovoltaic water pumping opportunities and challenge review"

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