

# SOLAR TRACKER APPLICATION WITH JAL PROGRAMMED PIC CONTROLLER

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## **ABSTRACT**

*Due to the growing population and technological applications, demand of energy is increasing rapidly every day. The most common source of energy used to meet this demand is the fossil fuel. However, since the source of fossil fuels are about to be exhausted and they have harmful effects on environment, alternative sources of energy are needed. When all of those taken into account, clean sources of energy which may be found everywhere come up as a solution to this problem. Solar, wind and wave energy are the most important ones of those.*

**Keywords:** PIC Control via JAL, Solar Tracking, Servo Motors

## **1. Introduction**



Picture 1 Photovoltaic cells.

Photovoltaic cells turn the solar energy into the electrical energy directly. The use and the transmission of the electrical energy is an easy and clean type of energy. The factor which affects the performance of the PV solar cells is the value of solar radiation which changes according to the factor zenith angle. The more those cells get the sunshine with a

right angle, the more effective they are. It may be stated that in the intensive light environment which is provided by the coaxial solar tracker system which we have used in our study, observing the increase of the solar cells in the production of the electricity, the number of solar cells which have a very high cost will lower and be saved for the energy needed.

## **2. The Level Reached in the World Technology**

Being parallel with the developments in PV technology in the last 20 years and the growing PV market costs tend to decrease. According to the International Energy Agency report which includes 17 countries, in the period between 1990 and 1995 180 MW power level has been reached from the 53 MW power level with an increase of 25% each year. The uses of solar energy may change according to the special aims. Solar energy is used:

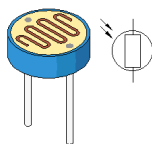
- ✓ in residences and offices
- ✓ in the countryside and agricultural technology
- ✓ in industry
- ✓ in transportation vehicles
- ✓ in communication vehicles' (radio, TV) signalization and automation
- ✓ in meeting the need of energy in the extensive production of energy and in military areas for special objectives

## **3. Accumulation and storage of the Solar Energy**

Solar cells, which accumulate the solar energy electronically (photovoltaic), transforms the photons of the photo energy into the electric energy in terms of the photo electricity. Electrical storage is done with the batteries. To accomplish this, lead-acid accumulators, nickel cadmium batteries and sodium sulfur batteries are used. With the serial coupling of these batteries and the use of the 220 Volt transformers and charge units; 2-10kWh energy, which is the average daily consumption of a house, can be stored by 5 or 10 accumulators and the need for energy can be met when the weather is cloudy or at night.

## **4. Design of the Application System**

Solar tracker systems are the systems which reflect the sunshine with the best right angle to the surface of the photovoltaic cells on it. Electronic circuit finds the Sun by searching for it in two axes. It moves with the help of two sensors, which stand in the upright position to one another moving around the vertical axis, until they have the equal force of light on them. With the same principle, incoming information to the controller with the help of the sensors on the horizontal axis is processed and signals are sent to the related motor simultaneously.



Picture 2 The view of the LDR sensor

The dimensions of the platforms the motor and the Photovoltaic cells stand are 1550mm x 1550 mm. The diameter of the spindle which the cells are connected to is 10mm long. Solar tracker system is motivated by two futaba s3003 model servo motors. Four LDRs positioned upright are used. Four 1,5 Volt 0,0025 Ampere solar batteries are used as Photovoltaic cells. A PIC 16F877 micro controller is preferred for the controller circuit. The reason why this micro controller is preferred is that it has a 10 bite (adc) analog/digital transformer to transform the analog information coming from the sensors to the digital. In order to program the micro controller JAL compiler is used.

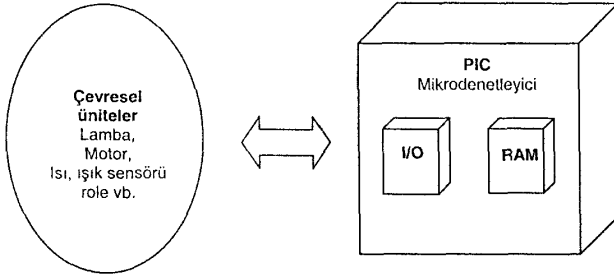
Application system includes those parts below:

- 1) Four PV solar cells
- 2) Four LDRs
- 3) PIC16F877 Micro Controller
- 4) Two Futaba s3003 servo motors
- 5) Four 100k potentiometers
- 6) LM 7805 voltage regulator
- 7) Two 15pF and one 470nF capacitor
- 8) 4 MHz crystal
- 9) 10k resistor
- 10) breadboard
- 11) Three 1550mm x 1550 mm plastic platforms
- 12) Two 10mm diameter and 10 cm long metal spindle
- 13) Two 10 mm diameter ball race

## 5. What is a Micro Controller ?

A microcontroller is a chip which includes one of a computer's basic component namely RAM I/O unit. Microcontrollers, which have been designed to use in applications requiring computer technology, are considerably cheaper and simpler compared to the microprocessors. Recent microcontrollers are used in various areas such as automobiles, cameras, mobile phones, fax-modem devices, photocopy, radio, TV and some toys.

Recent microcontrollers are being produced by many chip manufacturers. Each firm gives different names to the chips they produce. For instance, whereas Microchip calls its products PIC, 8051 which was produced by Intel and launched to the market in the early 80s is also sometimes called MCS-51.



Picture 3. Structure of Micro Controller

## 6. The Definition of JAL

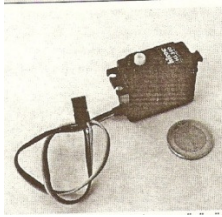
JAL is a high level clear source code compiler designed free of charge for the micro controllers of Microchip and Unicom firms. JAL can be downloaded from the internet easily since it is free of charge. They may create new programs with the help of the source codes of JAL or the source codes of the JAL may be improved. JAL, which is based on the language of PASCAL or C, uses a very simple and clear technique of programming language. Thus, people who have been using PASCAL or C before will easily adapt to JAL. The beginners also will not have any difficulties thanks to the easy programming language.

If the advantages of using JAL in PIC programming should be summarized:

- Free of charge
- Easily downloadable from the internet
- Clear source code
- Usable for the most popular types of PIC
- Convenient for popular operating systems such as Windows, DOS, Linux
- Easy programming language
- Determined compiler
- Open to constant improvement are some of the reasons why it is used in programming of the JAL micro controllers.

## 7. RC Servo Motor

RC Servo Motor is one of the kinds of motors used in the applications such as model planes, cars, boats or small powered robots. Inside the RC servo motor there is a DC motor, a code decipher, an electronic circuit, and plastic or metal gears used to increase the motor power. Since RC servo has its own electronic driver inside, it can be driven directly by PIC.



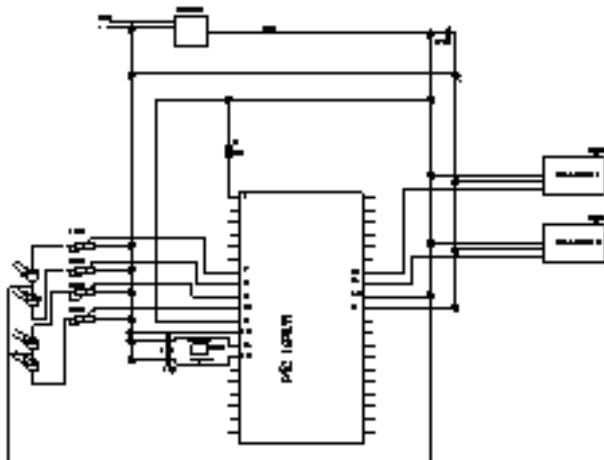
Picture 4. The view of the Servo Motor

## 8. Production of the Solar Tracker System



Picture 5. An overview of the solar tracker system.

## 9. Circuit Schema



Picture 6. Circuit schema

## 10. JAL codes of the solar tracker

```
İnċlude 16f877_4
İnċlude jlib
İnċlude adc
İnċlude rc_cont_servo
--x ler 0 ile 255 arasında deęer almaktadır.
Var byte x0 , x1 , x2 , x3
Srv1 = 130
Srv2 = 130
Forever loop
```

```
Adc_8 ( 0,4,x0 )
Adc_8 ( 0,5,x1 )
Adc_8 ( 0,6,x2 )
Adc_8 ( 0,7,x3 )
İf ( x0 > x1 ) then srv1 = srv1 +50 end if
İf ( x1 > x0 ) then srv1 = srv1 -50 end if
İf ( x2 > x3 ) then srv2 = srv2 +50 end if
İf ( x3 > x2 ) then srv2 = srv2 -50 end if
Rc_servo_2
End loop
```

## 11. Conclusion

There is a growing tendency of using the renewable energy sources in the world. Especially, places where there is no city grid or there is a high cost of supplying a grid, on the high mountains where energy is needed for a TV transmitter, link, etc, for street lamps which are intended not to be affected by the power outage solar energy may be used efficiently.

New studies to get the maximum benefit from the renewable energy sources are being carried out constantly. Solar tracking systems are being used in various application areas in the world to get the maximum benefit from the solar panels.

Solar tracker systems increase the amount of energy by making the sunlight come to the photovoltaic area with a direct angle. With the help of those systems, energy produced from the solar panels can be increased 30%-37%.

Solar tracking system used in this study locates the Sun by comparing the signals sent from the four LDR (photo resistor) as sensors and it helps the photovoltaic cells to turn towards the Sun by sending signals to the related motor.

## 12. References

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