Microcontroller-based Solar power AC motor speed control system

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Abstract: *The Solar energy is the most important renewable energy in the basic energy, biomass, wind energy, ocean energy, water and so on from the solar energy, broadly speaking, the solar energy above all kinds of renewable energy. Solar energy is a kind of renewable energy, it refers to the direct conversion and utilization of solar energy. Solar thermal power generation using solar energy heat generation technology which converts solar radiation energy into heat energy by a conversion device and uses thermal energy to generate electricity is also a technical field of the present invention. The conversion of solar radiation energy into electric energy utilization solar photovoltaic power generation technology, photoelectric conversion device is usually the use of semiconductor devices photoelectric effect principle of photoelectric conversion, also known as solar photovoltaic technology. The report aims to provide a better understanding of the feasibility and importance of solar charging and to contribute to the protection of the planet. This report hopes to teach more people understand the basis of solar charging, which can increase people's interest in solar charging, In addition, the report will cover more solar charging process and knowledge. Final solar energy contribution is absolutely no risk of nuclear leakage to protect people's lives and can provide power generation, while solar energy is a clean energy can reduce environmental pollution and solar energy is everywhere, do not need to transport, save human resource.*

Keywords: *Solar energy, solar photovoltaic power, solar charging process, photoelectric effect, save human resource;*

I. Introduction

Needless to say, energy crisis is a growing awareness around the world thanks to the high demand and usage of limited energy resources. Developing renewable energy is the sole key to tackle the problem. One of the green energies, solar energy, has been widely used in society both domestically and commercially. That is the reason why it is chosen for the project.

However, one of the disadvantages of solar energy is that the collection of solar energy is limited to places that have long sunshine duration [1]. To solve this, a sunshine detector is incorporated in our design to optimize this limitation.

Our system can change solar energy into electrical energy and store up by a battery charger. The energy generated would be used to drive a viable speed motor. The motor can be applied on lifting system, ventilation system, water driving pumps and railway system, etc. All in all, not only our design can help to improve the sunshine collection more effectively, but also can implement in wide usage in our daily life.

The basic structure of solar cells is the use of P-type and N-type semiconductor bonding formed, this structure is called a PN junction.

When the sun shines on ordinary semiconductors (such as silicon), electron and hole pairs are created, but they quickly combine and convert energy into photons or phonons (heat), photons and energy, and sound The subcategories are related to momentum. So the lifetime of electrons and holes is very short; in the P-type, due to a higher hole density, light-generated holes have a longer life, the same token, in N-type semiconductors, electrons have longer Of life.

At PN junctions, the diffusion due to the difference in effective carrier concentration creates a built-in electric field from N to P, so that when the photon is absorbed by the semiconductor at the junction, the electrons produced will be affected by the electric field And move to the N-type semiconductor, the hole is moved to the P-type semiconductor, so it can accumulate on both sides of the charge, if the wire connection, you can generate current, and the challenge of solar cells is how to generate electricity The hole pair collects it before recombining it.

II.   Project Description

The solar charger has three types of functions, which are sunshine track, battery charger and variable-frequency motor. For the sunshine track function, it is controlled by 8051 microcontroller system .The hardware tracks daylight by 4 daylight sensors, and then it calculates the most brightness point by the solar panel. Finally the panel adjusts the direction to collect solar power effectively for the battery charger.

For the battery charger, it supplies power to the motor. A boost converter is connected to the battery charger. It steps up the voltage in order to charge up the battery. For the variable frequency motor, a DC/AC converter is connected to it and used to transform direct current power to accumulating power for the motor. The motor frequency speed is detected by a frequency sensor and signals are then transmitted to 8051 microcontroller to monitor the speed of motor. Also, the motor speed can be controlled by the microcontroller.

Photoresistor After exposure to light, the brightness is higher, the smaller the resistance, and then and 25K, 50K partial pressure after an adjustable resistor, to give a total of four light voltage direction, then by ADC0838 after the voltage value converted into digital values, transferred to 8051 were compared, and then the drive motor turning a brighter direction. The servo motor is substantially locatable motor. When the servo motor receives a position command, it will move to the specified location. Therefore, the robot model is also commonly used as a controllable movement joints Miniature servo motor has the following advantages: high torque, simple control, flexible assembly, the relative economic In this project, the design of the three major factors of the system (Tracking systems, Battery charge systems and AC motor systems).

Solar tracking systems: we will use four photoresistor install to solar panel to detect four direction of sunlight, Also the ADC will get Analog value change to digital data, across by 8051 to servo motor, then the solar panel will turn to correct direction. The whole system is divided into automatic and manual, automatic system we use Microcontroller 8051 to monitor our systems to ensure that there is no monitoring of the entire system will automatically operate under, the manual mode will be carried out in the control center, to ensure that every device in the automatic failure manual operation can also use.

The solar tracking circuit of the topic, after analysis, agreed that there is feasibility, and proceed to plan how the hardware circuit should be designed, how to combine with the software, hope to achieve the effect of the virtual solar panels with light exposure by light Different angles, automatic sensing light source, to promote XY axis DC motor for rotation control, so that the simulation of the energy storage plate can be turned towards the light angle. Using 89S51 as the hardware core, the use of Flash ROM, with 4KB ROM internal storage space, to 3V ultra-low voltage work, and with the MCS-51 series single-chip fully compatible.

Display part of the LCD to display, because the LCD has low power consumption, the circuit is simple and easy, so we use it. The disadvantage is that observation is not easy, the font is too small.
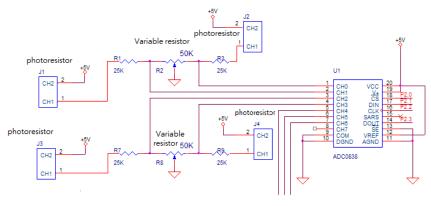
System Hardware Overview

1. This circuit is controlled by the AT89S51 single-chip core, with low power consumption, can work at 5V ultra-low voltage; system clock is provided by the internal interrupt AT89S51.
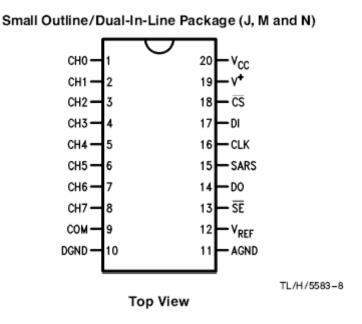
2. ADC0838 sense photoresistor comparison voltage to determine the direction of sunlight, and read into the solar panels, the battery voltage.

3. Display part by the LCD module, the circuit is simple, easy to control

4. Servomotor provides steering

5. LT3652 circuit to enhance the charging efficiency

6. The motor sensor uses an infrared circuit breaker to calculate the motor speed

III.   Circuit Diagram Design

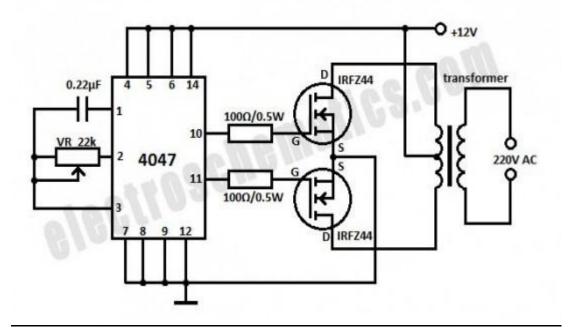• To Sunshine Tracking circuit diagram design

ADC0838 8-Channel MUX

Small Outline/Dual-In-Line Package (J, M and N)

Top View

TL/H/5583-8

Although the microcomputer can be a variety of digital information to do fast and accurate processing, but the human encounter in daily life of various physical quantities (such as temperature and humidity, brightness, weight) are analogical, so to make microcomputer analog signal processing, you must first the analog signal into digital signals into the microcomputer. Analog / digital converter (analog to digital converter) referred to as A / D converter (A / D converter). A / D

The function of the converter is to convert the input analog signal to digital signal output. ADC0838 specifications are as follows:

•   (DC/AC Inverter circuit diagram)

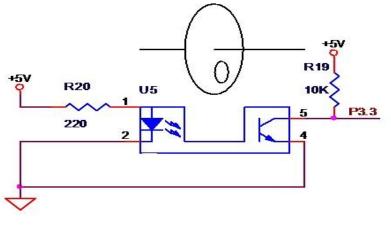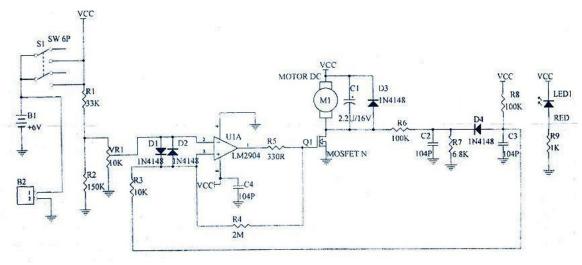- (Photo interrupter circuit diagram)

Photo interrupter principle, photo interrupter has two ends, one end of the infrared transmitter, end receiving end, transmitting and receiving cause transistor 5 and 4 conduction receiver. As shown below, the light-emitting diode emits infrared light so that when the NPN transistor is turned on, 8051 I / O pin is 0V, when there is shelter, infrared light can not make the transistor is turned on, then the 8051 I / O pin to 5V, as a result, the motor can be calculated the time required for one revolution, and then converted into the rotational speed.
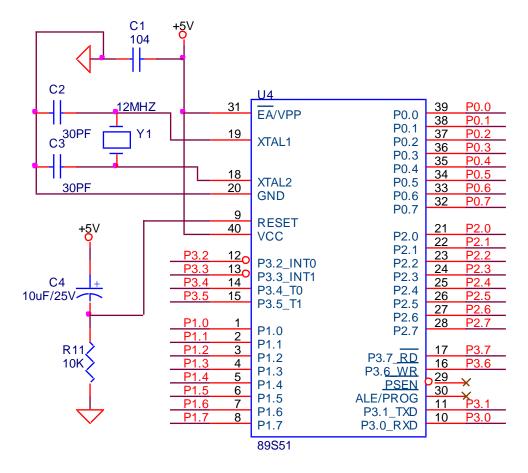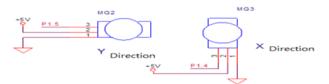
- (PWM circuit diagram)

Through "pulse width modulation" (PWM) manner, by the output filter, and a comparator control, changing the size of the motor current received, and thus achieve the purpose of controlling the rotational speed

(8051 control circuit diagram)

There are four groups of I / O ports (P0, P1, P2, P3) on the single chip. There are four groups of I / O pins P0, P1, P2, P3 and MCS-51 on the AT89S51 single chip.), Each I / O line can be independently for output or input. The minimum system of the single chip is shown in the figure below. The pin 18 and pin 19 are connected to the oscillation circuit. Pin 9 is the reset input pin. After powering on the capacitor, resistor and switch, the 20 pin is the ground terminal. The pin is the power supply side
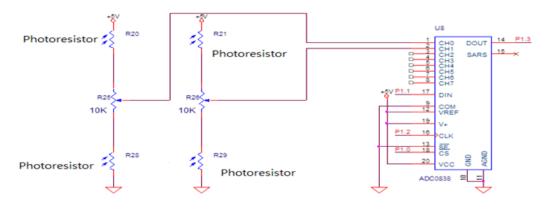
This is 8051, the port point connect a device to running overall system, they main for sunshine tracking to use and compare the sunlight value to change the solar panel turn angle.
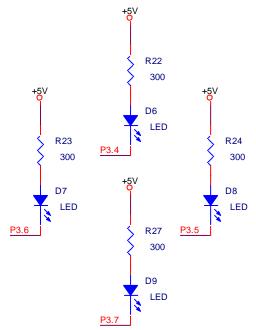(Servo motor circuit)

This servo motor signal wiring connect point, from the circuit we can see servo motor one wiring will connect 8051 (P1.4) and (P1.5) are X axis and Y axis respectively.
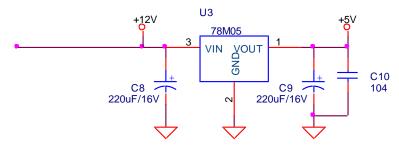
(ADC0838 circuit diagram)

This is ADC circuit, use to analog change to digital value, by 4 photoresistor receives sunlight and compare the value send to 8051
(LED circuit diagram)

+5V

R22
300

D6
LED

P3.4

+5V

R23
300

D7
LED

P3.6

+5V

R27
300

D9
LED
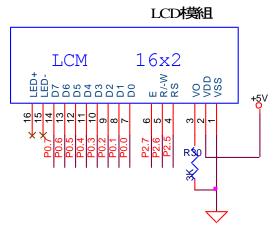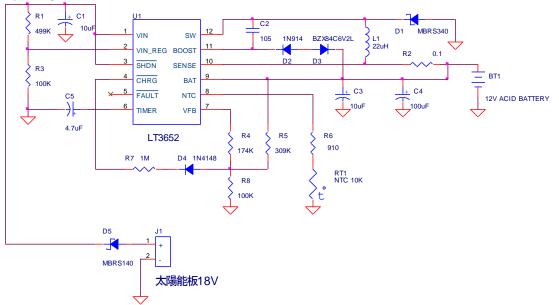
P3.7

+5V

R24
300

D8
LED

P3.5

LED light a signal guide , when the tracking detect a direction to turn and the related LED light will on, we can know the panel turn which the direction

(5V power supply circuit)

U3
78M05
+12V
3 VIN VOUT 1
GND
2
+5V

C8
220uF/16V

C9
220uF/16V

C10
104

This is 5V power supply, The system is 12V change 5v to supply related device
(LCD circuit connect to 8051 point)

LCD模組

LCM   16x2

LED+ LED- D7 D6 D5 D4 D3 D2 D1 D0   E R/W RS   VO VDD VSS

16 15 14 13 12 11 10 9 8 7   6 5 4   3 2 1

P0.7 P0.6 P0.5 P0.4 P0.3 P0.2 P0.1 P0.0   P2.7 P2.6 P2.5
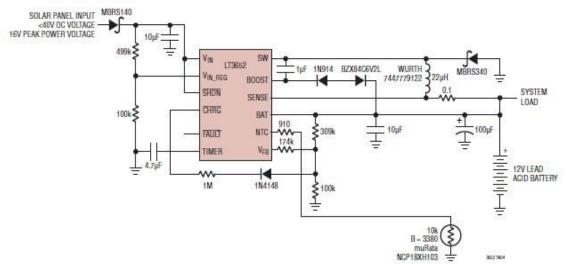
+5V

R30
3K

Battery charge circuit

Linear Technology's LT3652 is a single crystal step-down multi-component battery charger with a maximum input voltage of 32V (40V maximum) and a floating stack of up to 14.4V. The LT3652 incorporates an innovative input voltage regulation circuit that uses a simple self-regulating method to control the input supply voltage to the charger when a poorly regulated power supply such as a solar panel is used. LT3652HV is a high voltage version of the charge chip for floating voltage support up to 18V rechargeable battery stack.
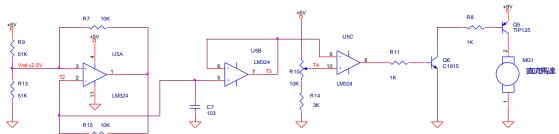
When the input supply voltage falls below a preset value, the linearity of the LT3652 input regulation circuit reduces the output battery charge current. The closed-loop regulator circuit supplies the charge current, which is then loaded into the input power source to maintain the input supply voltage at or above the set level. When using the solar panel output power, LT3652 will set the minimum input voltage of photovoltaic panel peak power voltage VMP, to MPPT effect. The peak voltage can be set by a resistor divider.

If the LT3652 requires more power than the solar panel provides during charging, the LT3652's input regulator circuit reduces the charge current. This can be caused by a rise in the battery charge current, or by a decrease in the solar intensity around the solar panel. Regardless of the cause, the regulator circuit maintains the PV output voltage at the preset VMP, which is set by the resistor divider through VIN_REG.

The input regulator circuit is an easy way to force the solar panel to maintain peak power in the operating mode. The input voltage regulator circuit also allows the system to achieve optimum operating mode when other regulated power supplies are used, which may interrupt the supply in the event of an overcurrent condition.

DC Motor Circuit

ensure a high-quality product, diagrams and lettering MUST be either computer-drafted or drawn using India ink.

IV.   Conclusion

In conclusion of the middle stage of the project, I on this project title 'Microcontroller-based solar power AC motor speed control system'. I initially wanted to express the intention has not more change. Only for work program and plan had made improvements. In work plan, because need to changes the required of work program before, so I changed to each major factor of one leader. System is divided into the following four parts: circuit design and research reference, installation, program and test and commission. In each factor became a leader is require appropriate to division of members. Thereby enabling members are enough to participate in a variety of project.

Through of this opportunity, we can use our experience and knowledge to build up this battery charger. Although I have a lot of problems occurred in difference stages. The purchase of materials to install and testing each device. Also I hope to complete the revised work program and plan in the future. The most important work is the second half of program controller and connected the whole circuit.

In the project, I have a update the knowledge and understand the teamwork is very important, because I try the unbalance to share work, result is make progress delay time, so we learned the time management, in this final year project, I learned a lot of thing, such as how to planning the project work, and how to finish.

Difficulty of working
-         Easy to short circuit
-         Component easy damage
-         Sometime component not suitable for this project to use
-         Testing initial stage will meet unstable condition

References
[1]   M Sunshine tracking
[2]   http://www.dzdiy.com/html/201105/22/Automatic-Sunshine-Tracking.htm
[3]   Microcontroller
[4]   http://www.ermicro.com/blog/?p=1461

Authors

Tony Tsang (MIEEE'2000) received the BEng degree in Electronics & Electrical Engineering with First Class Honours in U.K., in 1992. He received the Ph.D from the La Trobe University (Australia) in 2000. He was awarded the La Trobe University Post-graduation Scholarship in 1998. Prior to joining the Hong Kong Polytechnic University, Dr. Tsang earned several years of teaching and researching experience in the Department of Computer Science and Computer Engineering, La Trobe University. He works in Hong Kong Polytechnic University as Lecturer since 2001. He works in Hong Kong College of Technology in 2015. He has numerous publications in international journals and conferences and is a technical reviewer for several international journals and conferences. His research interests include mobile computing, networking, protocol engineering and formal methods. Dr. Tsang is a member of the IET and the IEEE.