# Design of Inspection Robot System Based on Photovoltaic Effect

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**Keywords:** MPPT, Photovoltaic power supply, inspection robot.

**Abstract.** Patrol robots are more and more widely used for their mobility，flexibility, environmental exploration capabilities, autonomous monitoring and many other powerful functions, and can be seen in production, military and other fields. But most of the current inspection robots' working time by the power supply constraints, shortening the working hours and efficiency. In view of this, a photovoltaic driver based on photovoltaic effect is proposed to provide energy for the robot by PV effect, and MPPT algorithm is adopted to greatly improve the efficiency of solar energy conversion. After the hardware system debugging and laboratory testing, the inspection robot to meet the performance requirements for the future optimization of the design lays the foundation.

## 1.    Introduction

With the continuous development of science and technology, various functions, various types of robots more and more came to our real life. Which mobile robot is a dazzling star. Mobile robot is a modern high-tech science and technology integration and highly integrated products, mobile robot design and manufacturing related to mechanical engineering, control principles, electronic technology, computer technology and many other disciplines, is the most representative modern high-tech complex. After several decades of development, mobile robot technology has been widely used in industrial, commercial, agricultural, national defense, aerospace, tourism, office automation, medical and health services and many other areas. With the computer, Cang film, sensors and other related technologies continue to progress and development, mobile robot technology again and again to achieve a new level of development. In China, the steady development of social economy, more and more large enterprises plant, high-tech park, giant shopping malls continue to appear in national life, but these places on the security of the new challenges. It is usually done by human security, but with the continuous expansion of the scope of inspection, indoor and outdoor environment of the different needs, just rely on our human security has been unable to complete the security task. Also in some dangerous environments, human security is not suitable for work, such as in the substation plant, full of high voltage environment, the human body is very dangerous, but these places are related to a community, or even a city Of the normal life, the need for regular security. All this has spawned a special inspection service-oriented mobile robot. The goal of this project is to design a prototype that can meet the inspection of mobile robots, which can meet the outdoor inspection and can complete the indoor work.

## 2.    MPPT Control Structure

MPPT algorithm refers to the maximum power point tracking method of solar cells, is the core of photovoltaic power generation system. MPPT controller by the DC-DCBuck buck conversion circuit, IPM tube drive circuit, DSP chip, voltage and current sampling circuit, liquid crystal display, peripheral interface and power supply circuit and other components [3]. One of the most core DSP chip (digital signal processor) has good stability, high precision, high-speed programmable features, but also generate PWM wave and then adjust the DC-DC circuit duty cycle disturbance to control the output power. DSP chip using the serial port will be pre-programmed algorithm into which to achieve the maximum power point tracking. In addition, the sampling voltage, current can also be through the LCD liquid crystal display or peripheral interface to collect data stored in other equipment. IPM, that is, intelligent power module, can achieve the control voltage under voltage protection, overheating

protection, over current protection and short circuit protection, can control the DC-DC converter on and off the size of the dynamic impedance and then change the duty cycle voltage, current Perturbation. DSP output PWM signal voltage is not enough to drive the IPM tube work, through the establishment of a new driver circuit to make IPM work properly. Finally, the MPPT controller also needs to provide power supply circuit, respectively, to the sampling circuit, DSP chip power supply. This design is the use of step-down controller, no-load state of the input voltage of 10 ~ 60V, the maximum output current of 5A, the input voltage is higher than 15V or more to work properly. The main functions are: to maximize the power output of the battery board close to its own limit; ultra-low loss anti-current circuit to prevent the reverse output of lithium battery damage to the solar panels; with liquid crystal display and control buttons, you can display the photovoltaic panels Input voltage, current and lithium battery real-time charging voltage and the total input power of the photovoltaic board; charging mode for the lithium battery or battery, to maximize the battery to extend battery life; controller input and output can be a large pressure to work efficiently, The efficiency of the panel is 30% ~ 50%.

## 3. MPPT Control and Algorithm

The output power of the PV array is mainly affected by the non-linear function of the light intensity and the ambient temperature and the connected load in the external environment [4]. The PV array obtains the maximum output power point for the condition that the PV array matches the external load impedance. The role of the MPPT algorithm is based on external conditions and load constantly adjust the maximum output power operating point, the timely tracking of the maximum power point and always with the maximum power DC output, thereby enhancing the charging efficiency and solar energy utilization. In fact, the advantages and disadvantages of the algorithm directly affect the lithium battery charging time and robot efficiency. In addition, MPPT controller on the circuit voltage and current monitoring and lithium battery charge and discharge control, not only to prevent lithium battery overcharge, extend the life of lithium batteries, and according to the load requirements, and actively control the solar cell components and lithium the battery outputs the power to the load. When the lithium battery is charged, the output voltage of the solar cell should be greater than the current voltage of the lithium battery, otherwise it will not be charged.

The perturbed output power is measured by comparing the reference voltage or the minor disturbance of the reference current (or indirectly by changing the duty cycle) to determine the perturbation direction of the next cycle before repeated disturbances and observations to allow the solar panel Output the maximum power. MPPT algorithm flow chart shown in Figure 1, the algorithm t-1, t, t + 1 three times the U, I sampling and the corresponding time power Pt-1, Pt, Pt + 1 calculation, where t- 1, t + 1 at the same time to determine whether the power intensity is caused by changes in light intensity. The voltage of each time is determined and the voltage disturbance direction of the next disturbance period is determined. After the acquisition and calculation of the voltage of 1000 points, the voltage U and the corresponding power P of the maximum power point are finally obtained, and then the solar cell Power under the lithium battery charging work.
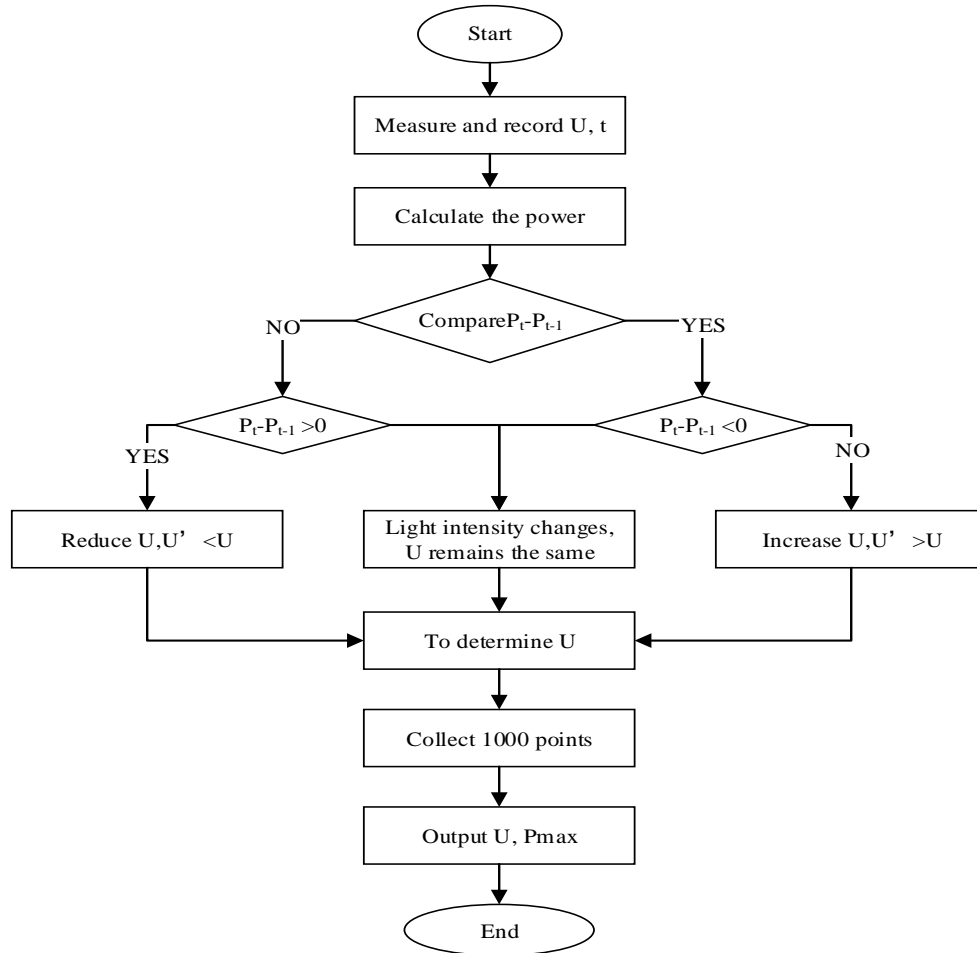
Figure 1. MTTP algorithm

## 4. Inspection Robot System

The biggest advantage of the inspection robot is its ability to explore, is essential for exploration is the sensor module, through the sensor module, the robot can get a variety of surrounding data collection and perception. The robot designed in this paper has the following sensor modules: (1) camera module: through the camera on the surrounding image information mining Set, the most intuitive to reflect the real situation of the surrounding environment. The robot uses a webcam for image acquisition for machine vision. (2) Distance module: the module is located in the front of the body, can accurately measure the distance between the front of the obstacles and the robot. (3) GPS module: the robot can determine the location of their own information, can return to the altitude, the current speed of the robot and other information. (4) Gyroscope module: the robot can determine the current orientation.
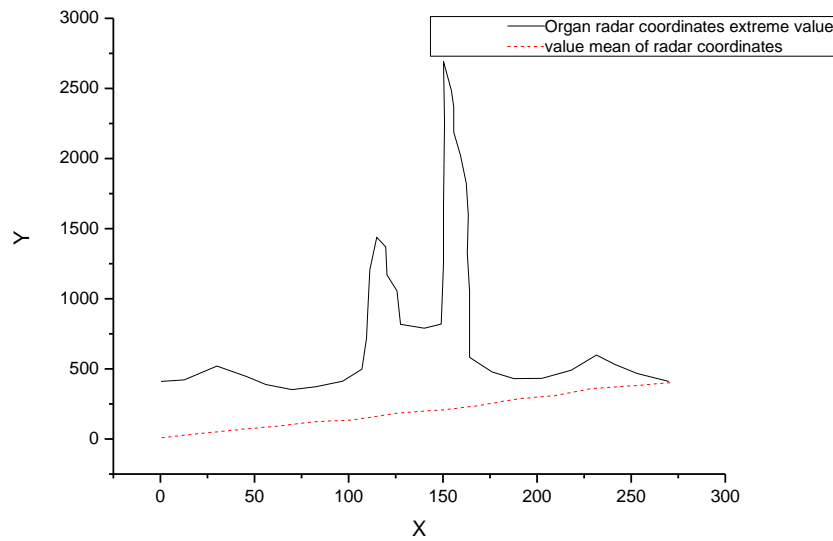
Figure 2. Polar coordinate coordinate system Lidar data

## 5. Conclusion

Through the design of the MPPT algorithm of the PV power supply system and the mechanical construction of the final inspection robot body, the complete design of the inspection robot is completed. In the case of sunshine, it can be verified by experiment and can extend the working time of the inspection robot 2~3 h.

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