



PV FAULT DETECTOR

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ABSTRACT

The system is a prototype of a fault detector which identifies the fault immediately when occurred by prior act approach. The system use the value generated by the photo voltaic panel for fault detection. The fault is categorized into two states when the efficiency of a panel fluctuates due to settlement of dust on the PV panel surface, the dust is cleaned using an embroiler set up as preliminary litigate. When the efficiency of a panel drops to zero, an alert is sent to the corresponds through SMS along with address of the panel using GSM module and buzzer tone is alarmed. Also address of the panel is displayed using LCD. All experiments are conducted under a controlled testing environment. Results reveal that the intrinsic parameters, such as the reverse saturation current, output resistance, and junction capacitance, of the damaged panels can significantly deviated from the nominal values. This gives an indication of the health of the panel. Moreover, the prototype sends the estimated intrinsic parameters to the PV system over the power cable through power line communication. Therefore, the merits of this concept lie in its modularity, scalability, and remote fault diagnosis capability.

KEYWORDS

Solarpanel,GSM,Embroliar,LCD,SMS,Photo voltaic.

INTRODUCTION

In this paper, we are introduced a embedded system technique for detecting the faults, which are occurred in solar panel while continuously

monitoring the solar power panels remotely. The main objective of this work is to eliminate the faults which are occurred in solar panels such as, cell breaking, dust formation in solar panels and wire breaking between cell and battery. In order to eliminate these faults, we are using GSM modems, these GSM modems sends messages promptly to the relevant person when fault occurred. Then it easy to identify the faults by the related person and it can be solved within less period. In generating stations (consumer places), solar panels are connected in series and voltage across each solar panel is 5v, ADC convert the analog current to digital current and ADC pin is connected to microcontroller, then it gives the output voltage of 5v, in case if any variation occurred because of breaking cells in solar panel then GSM will send message. And also, other objective of this research is to study the effects of dust accumulation on the performance of solar PV panels. Experiments were conducted using dust particles on solar panels with a constant-power light source. And we obtained in this technique, that the accumulated dust on the surface of photovoltaic solar panel can reduce the system's efficiency effectively. Then, in case any wire is broken between the battery and load or any receiver part then the GSM will send the fault information. Finally, this proposed technique provides effective results on these three faults which are mentioned above.

PROBLEM STATEMENT:

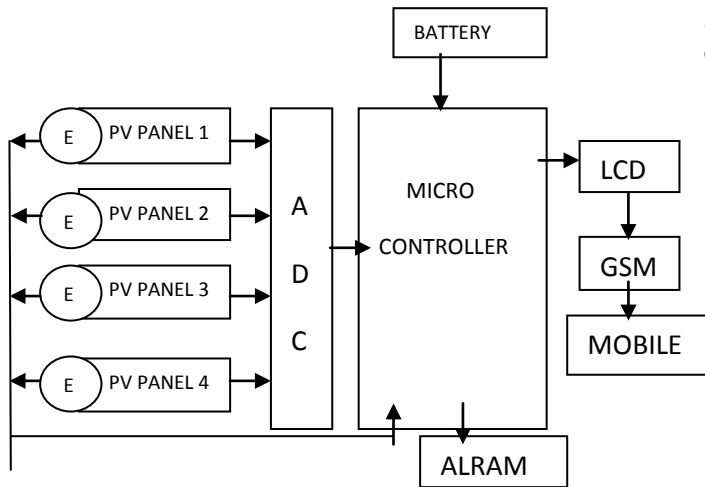
EXISTING SYSTEM:

There is no effective software for

- Detection of solar panel fault in solar park or photovoltaic power station.

- Monitoring health of the panels.

ARCHITECTURE DIAGRAM:



PROPOSED SYSTEM:

The fault is categorized into two states when the efficiency of a panel fluctuates due to settlement of dust on the PV panel surface, the dust is cleaned using an embroiler set up as preliminary litigation.

When the efficiency of a panel drops to zero, an alert is sent to the corresponds through SMS along with address of the panel using GSM module and buzzer tone is alarmed. Also address of the panel is displayed using LCD.

FUNCTIONS:

PHOTO VOLTAIC SYSTEMS

Our major source of energy today is the combustion of fossil fuels such as coal; natural gas & petroleum are used directly by us. Development of gas turbine & the internal combustion engines has made it possible to use the heat involved in combustion of fuels to generate electric & mechanical energy. It appears that we will run out of petroleum and natural gas by about 2020 unless domestic supplies are extend by taking one or more of the following steps

- Reduce the consumption of fuels.
- Use of more coal.
- Develop new sources of energy.

The first two options are infeasible in current scenario because the use of petroleum fuel is inevitable for a man to fulfill his basic amenities. Use of Coal introduces more harmful gasses in the atmosphere and waste product of coal combustion can change the earth into a graveyard.

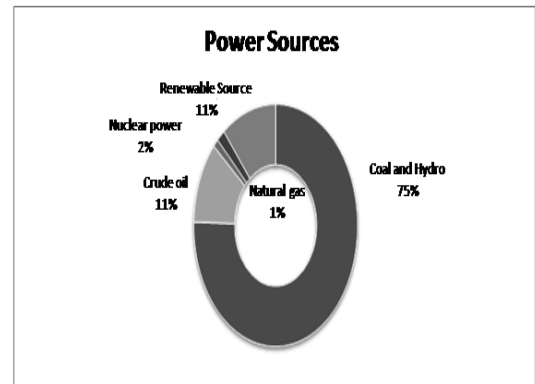


Fig.1 Percentage of Power Sources

An alternative to the nuclear and fossil fuel power is renewable energy technologies (hydro, wind, solar, biomass, geothermal, and ocean). Largescale hydroelectric projects have become increasingly difficult to carry through in recent years because of competing use of land and water. Reliensing requirements of existing hydro plants may even lead to removal of some dams to protect or restore wildlife habitats. So the use of renewable energy sources is the only way to support the growing power demand.

Various types of Renewable energy are,

- Wind Energy
- Geo Thermal Energy
- Biomass Energy
- Tidal Energy
- Solar Energy

WIND ENERGY

Electric energy is generated by converting energy in wind to rotational motion by use of wind turbine. The rotational motion of wind turbine is converted into electrical energy by using an electrical generator.

The wind has got the capacity to serve as a renewable source of energy for the benefit of human beings. In India the wind power is of great significance as there are large coastal, hilly & desert

areas where wind energy can be usefully exploited for the generation of electric energy.

GEOTHERMAL ENERGY

The energy generated by utilising the heat stored in the interior layers of earth is known as geothermal energy. This is achieved by injecting water into deep holes into earth and heating the water with the heat in the interior earth.

TIDAL ENERGY

The conversion of energy in tide is achieved by utilising the difference in the tide level of high tide and low tide.

BIOMASS ENERGY

The conversion of energy in chemical reactions taking place in degraded food or biological products is known as Biomass Energy.

SOLAR ENERGY

Energy in the sunlight is converted into electrical energy by using photo voltaic cell. The photons in the sunlight impact in the semiconductor surface to produce free electrons. Unlike the dynamic wind turbine, the pv installation is static, does not need strong tall towers, produces no vibration or noise, and needs no cooling. Because much of the current pv technology uses crystalline semiconductor material similar to integrated circuit chips, the production costs have been high.

PHOTO VOLTAICS

The electrical potential developed between two dissimilar materials when their common junction is illuminated with radiation of photon. The photovoltaic cell, thus, converts light directly into electricity. The pv effect was discovered in 1839 by French physicist Becquerel

THE PV CELL

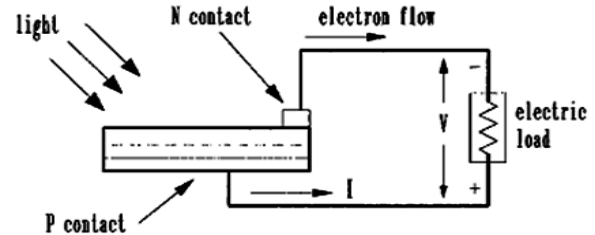


Fig.2 The Photo Voltaic Effect

The physics of the pv cell is very similar to the classical p-n junction diode. When light is absorbed by the junction, the energy of the absorbed photons is transferred to the electron system of the material, resulting in the creation of charge carriers that are separated at the junction. The charge carriers may be electron-ion pairs in a liquid electrolyte, or electron-hole pairs in a solid semiconducting material. The charge carriers in the junction region create a potential gradient, get accelerated under the electric field and circulate as the current through an external circuit. The origin of the photovoltaic potential is the difference in the chemical potential, called the fermi level, of the electrons in the two isolated materials. When they are joined, the junction approaches a new thermodynamic equilibrium. Such equilibrium can be achieved only when the Fermi level is equal in the two materials. This occurs by the flow of electrons from one material to the other until a voltage difference is established between the two materials which have the potential just equal to the initial difference of the Fermi level. This potential drives the photocurrent.

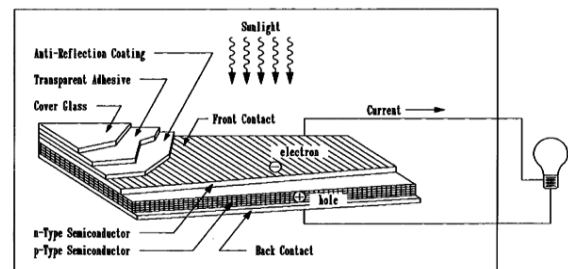


Fig.3 Construction of PV cell

MODULE AND ARRAY

The solar cell described above is the basic building block of the pv power system. Typically, it

is a few square inches in size and produces about one watt of power. For obtaining high power, numerous such cells are connected in series and parallel circuits on a panel (module) area of several square feet. The solar array or panel is defined as a group of several modules electrically connected in series-parallel combinations to generate the required current and voltage.

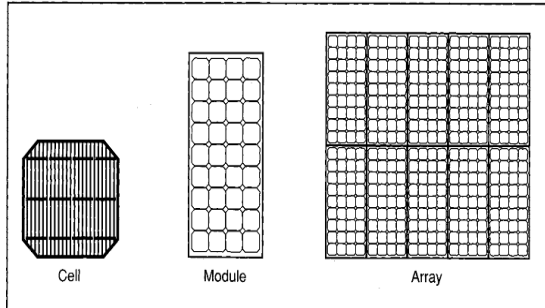


Fig.4 Cell, Module and Array

EQUIVALENT CIRCUIT OF PV CELL

The complex physics of the pv cell can be represented by the equivalent electrical circuit shown. The circuit parameters are as follows.

The output-terminal current I is equal to the light-generated current I_L , less the diode-current I_d and the shunt-leakage current I_{sh} . The series resistance R_s represents the internal resistance to the current flow, and depends on the p-n junction depth, the impurities and the contact resistance. The shunt resistance R_{sh} is inversely related with leakage current to the ground. In an ideal pv cell, $R_s = 0$ (no series loss), and $R_{sh} = \infty$ (no leakage to ground). In the equivalent circuit, the current delivered to the external load equals the current I_L generated by the illumination, less the diode current I_d and the ground-shunt current I_{sh} . The open circuit voltage V_{oc} of the cell is obtained when the load current is zero.

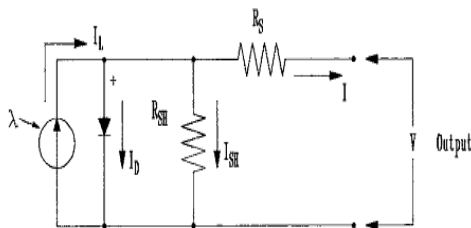


Fig.5 Equivalent Circuit of PV cell

The major factors influencing the electrical design of the solar array are as follows:

- The sun intensity.
- The sun angle.
- The load matching for maximum power.
- The operating temperature.

I-V AND P-V CURVES

The electrical characteristic of the pv cell is generally represented by the current versus voltage (i-v) curve.

Figure 2.6 shows the i-v characteristic of a pv module under two conditions, in sunlight and in dark. In the first quadrant, the top left of the i-v curve at zero voltage is called the shortcircuit current. This is the current we would measure with the output terminals shorted (zero voltage). The bottom right of the curve at zero current is called the open-circuit voltage. This is the voltage we would measure with the output terminals open (zero current). In the left shaded region, the cell works like a constant current source, generating voltage to match with the load resistance. In the shaded region on the right, the current drops rapidly with a small rise in voltage. In this region, the cell works like a constant voltage source with an internal resistance. Somewhere in the middle of the two shaded regions, the curve has a knee point.

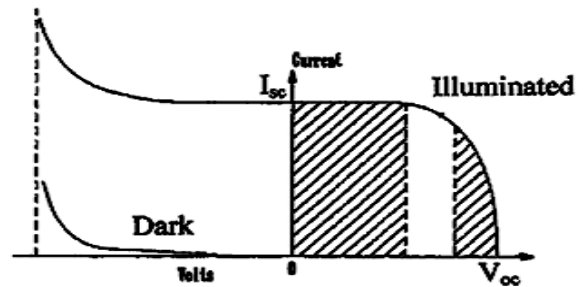
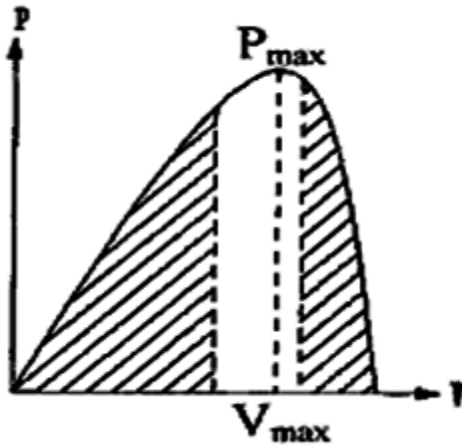


Fig.6 i-v Curve



X

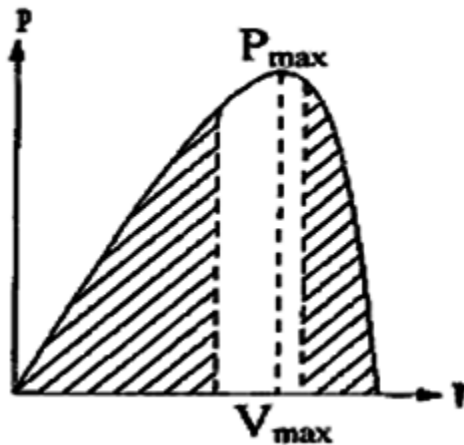


Fig.7 P-V Curve.

The cell produces no power at zero voltage or zero current, and produces the maximum power at voltage corresponding to the knee point of the i-v curve. This is why pv power circuits are designed such that the modules operate closed to the knee point, slightly on the left hand side. The pv modules are modeled approximately as a constant current source in the electrical analysis of the system.

In this project the pv- cell is modelled as constant voltage source. The pv cell is modelled using following formulae.

$$V_{pv} = -V_t \cdot \log(I_{pv}/I_0 + 1) \quad -1$$

$$V_{pv} = I_{pv} [V_d/R_p + I_0 (\exp(V_d/V_t) - 1)] \quad -2$$

$$P_{pv} = V_{pv} I_{pv} \quad -3$$

Where,

- V_{pv} = Voltage generated by PV cell.
- I_{pv} = Current output of the PV cell.
- I_0 = Short circuit Current.
- V_t = Open Circuit Voltage.
- V_d = Voltage across the diode.

GSM MODEM



Fig.8 Model of GSM modem

- sim300 - GSM/GPRS engine.
- Works on frequencies egsm 900 mhz, dcs 1800 mhz and pcs 1900 mhz.
- Sim300 features GPRS multi-slot class 10/class 8 (optional) and supports the GPRS coding schemes.

Features of GSM Kit:

This GSM modem is a highly flexible plug and play quad band GSM modem for direct and as integration to rs232.

- Supports features like voice, data/fax, SMS, GPRS and integrated TCP/IP stack.
- Control via at commands.
- Use ac – dc power adaptor with following ratings · dc voltage: 12v /1a.
- Current consumption in normal operation 250ma, can rise up to 1amp while transmission.

This document describes the hardware interface of the simcom sim300 module that connects to the specific application and the air interface. As sim300 can be integrated with a wide range of applications, all functional components of sim300 are described in great detail. This document can help you quickly understand sim300 interface specifications, electrical and mechanical details. with the help of this document and other sim300 application notes, user guide, you can use sim300 module to design and set-up mobile applications quickly.

LIQUID CRYSTAL DISPLAY:

LCD stands for Liquid Crystal Display. LCD is finding wide spread use replacing LEDs (seven segment LEDs or other multi segment LEDs) because of the following reasons:

1. The declining prices of LCDs.
2. The ability to display numbers, characters and graphics. This is in contrast to LEDs, which are limited to numbers and a few characters.
3. Incorporation of a refreshing controller into the LCD, thereby relieving the CPU of the task of refreshing the LCD. In contrast, the LED must be refreshed by the CPU to keep displaying the data.
4. Ease of programming for characters and graphics.

These components are “specialized” for being used with the microcontrollers, which means that they cannot be activated by standard IC circuits. They are used for writing different messages on a miniature LCD.

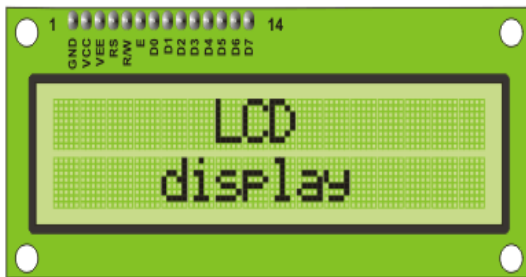


Fig.9 LCD Display

A model described here is for its low price and great possibilities most frequently used in practice. It is based on the HD44780 microcontroller (*Hitachi*) and can display messages in two lines with 16 characters each. It displays all the alphabets, Greek letters, punctuation marks, mathematical symbols etc. In addition, it is possible to display symbols that user makes up on its own. Automatic shifting message on display (shift left and right), appearance of the pointer, backlight etc. are considered as useful characteristics. There are pins along one side of the small printed board used for connection to the microcontroller. There are total of 14 pins marked

with numbers (16 in case the background light is built in).

CONCLUSION:

The fault is categorized into two states when the efficiency of a panel fluctuates due to settlement of dust on the PV panel surface, the dust is cleaned using an embroiler set up as preliminary litigate. When the efficiency of a panel drops to zero, an alert is sent to the corresponds through SMS along with address of the panel using GSM module and buzzer tone is alarmed. Also address of the panel is displayed using LCD. All experiments are conducted under a controlled testing environment. Results reveal that the intrinsic parameters, such as the reverse saturation current, output resistance, and junction capacitance, of the damaged panels can significantly deviated from the nominal values. This gives an indication of the health of the panel. Moreover, the prototype sends the estimated intrinsic parameters to the PV system over the power cable through power line communication.

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