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IOT based Fault Diagnostic Device for Photovoltaic Panels

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Abstract- **A device for fault diagnostic of photovoltaic panels is presented. At the present condition there is only a static panel, but in this system maximum power tracking can be implemented using LDR. It will rotate according to the maximum sunlight. When we compare with existing system can't able to find out the fault in the appropriate panel or in a row of panels. By using the IoT the fault can be detected in which row the fault has occurred. As the voltage decreases there is an indication of the fault in the panel.**

Keywords – Photovoltaic systems, reliability, fault diagnosis, solar panels, IoT

I. INTRODUCTION

At present 90% of pv panels are static. As there was Energy acquired was very less because the sunrise is in the east and sets in the west. The maximum power was not obtained in the static panels. But by using the LDR sensors the panel will rotate from the east to west .by using the relay the load can be controlled. for example, in a thousand of panels if any fault occur the output voltage will be decreased automatically. Manually the fault detection was very difficult but in this proposed system the whole system is connected to IOT. Manual checking can be reduced. all are looking for smart application like without any manual work and earth cables. By using the earth cables many of the disadvantages will be based. The fault can be used estimated very easily when there is an any crack or panel filled with a dust particle, Then the voltage decreases at which row the voltage decreased can be determined and after that manually it can be checked. By using the power track system, the maximum power can be used. There are many advantages in this project when compared to an existing system. it is renewable source of energy. in this system it consists of LDR battery, POT, dc motor, motor drive by advancing the materials it increases the cell efficiency.

Block diagram

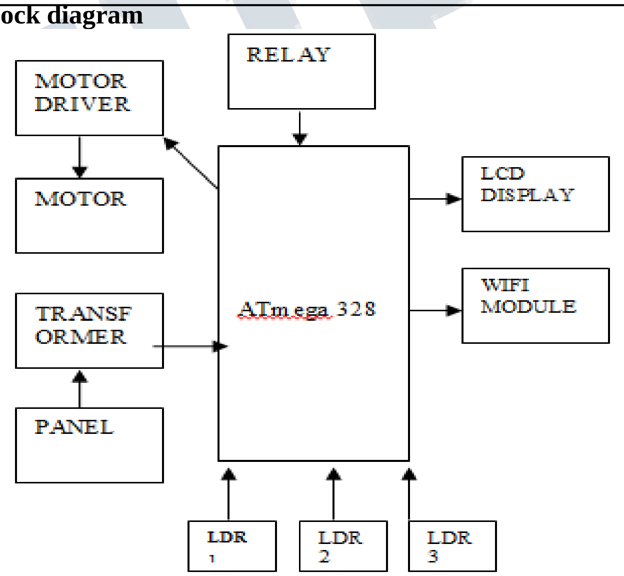

Fig. 1 Connection of the proposed fault diagnostic device to a PV system.

III. LIGHT DEPENDENT RESISTOR

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

if incident light on a photo resistor exceeds a certain frequency, photons absorbed by the semiconductor bound electrons enough energy to jump into the conduction band. the resulting free electrons (and its hole partners) conduct electricity, there lowering resistance. the resistance range and sensitivity of a photo resistor can substantially differ among dissimilar devices. Moreover, unique photo resistors react substantially differently to photons within certain wavelength bands. a photoelectric device can be either intrinsic or extrinsic.

An intrinsic semiconductor has its own charge carriers and is not an efficient semiconductor, for example, silicon. in intrinsic devices the only available electrons are in the valence band, and hence the photon must have enough energy to excite the electron across the entire band gap. Extrinsic devices have impurities also called dopants, added whose ground state energy is closer to the conduction band; since the electrons do not have as far to jump, lower energy photons (that is, longer.
wavelengths and lower frequencies) are sufficient to trigger the device. If a sample of silicon has some of its atoms replaced by phosphorus atoms (impurities), there will be extra electrons available for conduction. This is an example of an extrinsic semiconductor.

Fig.2 LDR07 CdS Light Dependent Resistor

There are many types of photo resistors, with specifications and models. Can be coated with or packaged in different materials that vary the resistance, depending on the use for each LDR.

Applications:
Photo resistors come in many types. Inexpensive cadmiu sulphide cells can be found in many consumer items such as camera light meters, street lights, clock radios, alarm devices, night lights, outdoor clocks, solar street lamps and solar road studs, etc.

IV. PHOTO VOLTAIC SYSTEMS

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

4.1THE PV CELL

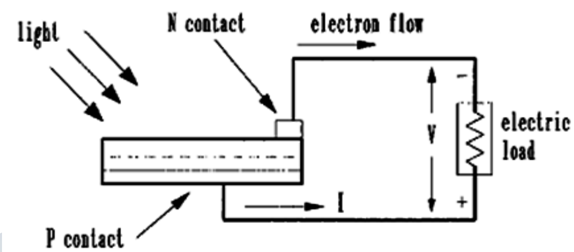

Fig3 Photo The Voltaic Effect

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 flow of electrons from one materialto 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. The rotor (together with the axle and attached commutator) rotate with respect to the stator. The rotor consists of windings (generally on a core), the windings being connected the commutator. above diagram shows a common motor layout -- with the rotor inside the stator (field) magnets. The geometry of the brushes, commutator contacts.

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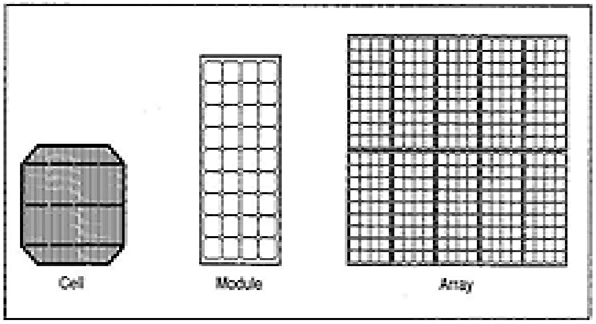

Fig.4 Cell, Module and Array

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.

V. DC MOTOR

Fig.5 DC Motor

In any electric motor, operation is based on electromagnetism current-carrying conductor .
generates a magnetic field; when this is then placed in an external magnetic field, it will experience a force proportional to the current in the conductor, and to the strength of the external magnetic field. As you are well aware of from playing with magnets as a kid, opposite (North and South) polarities attract, while like polarities (North and North, South and South) repel. The internal configuration of a DC motor is designed to harness the magnetic interaction between a current carrying conductor and an external magnetic field to generate rotational motion.

Every DC motor has six basic parts -- axle, rotor (a.k.a., armature), stator, commutator, field magnet(s), and brushes. In most common DC motors (and all that BEAMers will see), the external magnetic field is produced by high-strength permanent magnets1. The stator is the stationary part of the motor -- this includes the motor casing, as well as two or more permanent magnet pole pieces. The rotor (together with the axle and attached commutator) rotate with respect to the stator. The rotor consists of windings (generally on a core), the windings being electrically connected to the commutator. The above diagram shows a common motor layout -- with the rotor inside the stator (field) magnets.geometry of the brushes, commutator contacts, and rotor windings are such that when power is applied, the polarities of the energized winding and the stator magnet(s) are misaligned, and the rotor will rotate until it is almost aligned with the stator's field magnets.
As the rotor reaches alignment, the brushes move to the next commutator contacts, and energize the next winding. Given our example two-pole motor, the rotation reverses the direction of current through the rotor winding, leading to a "flip" of the rotor's magnetic field, driving it to continue rotating.In real life, though, DC motors will always have more than two poles (three is a very common number). In particular, this avoids "dead spots" in the commutator. So since most small DC motors are of a three-pole design, let's tinker with the workings of one.

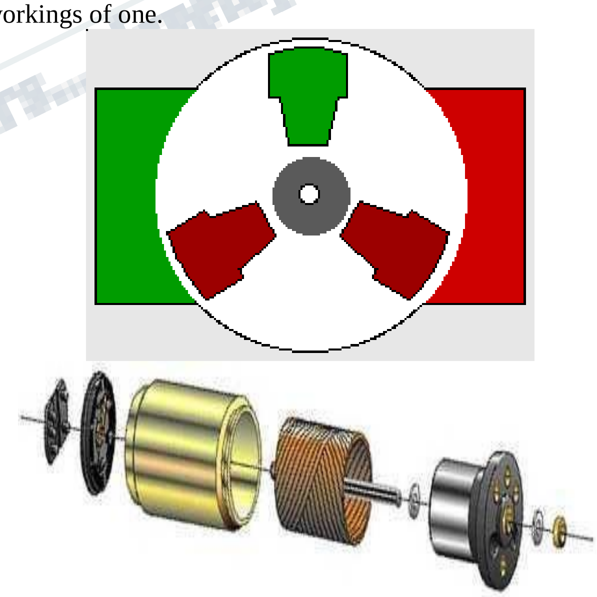

Fig.6 Parts of DC Motor

The coreless design also allows manufacturers to build smaller motors; meanwhile, due to the lack of iron in their rotors, coreless motors are somewhat prone to overheating. As a result, this design is generally used just in small, low-power motors. BEAMers will most often see coreless DC motors in the form of pager motors.

VI. MOTOR DRIVE

A motor controller is a device or group of devices that serves to govern in some predetermined manner the performance of an electric motor.[1] A motor controller might include a manual or automatic means for starting and stopping the motor, selecting forward or reverse rotation, selecting and regulating the speed, regulating or limiting the torque, and protecting against overloads and faults. Applications Every electric motor has to have some sort of controller. The motor controller will have differing features and complexity depending on the task that the motor will be performing. The simplest case is a switch to connect a motor to a power source, such as in small appliances or power tools. The switch may be manually operated or may be a relay or contactor connected to some form of sensor to automatically start and stop the motor. small motor controllers, which rely on the supplying circuit to have over current protection. Small motors may have built-in overload devices to automatically open the circuit on overload. Larger motors have a protective overload relay or temperature sensing relay included in the controller and fuses or circuit breakers for over current protection.

VII. POTENTIOMETER

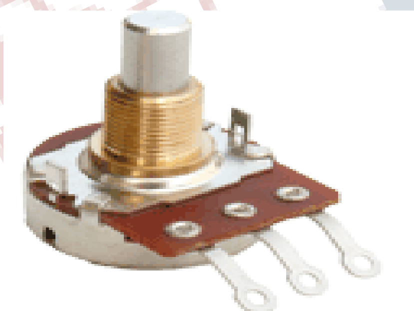

Fig.7 Potentiometer

A potentiometer is a manually adjustable variable resistor with 3 terminals. Two terminals are connected to both ends of a resistive element, and the third terminal connects to a sliding contact, called a wiper, moving over the resistive element.The position of the wiper determines output voltage of the potentiometer. The potentiometer essentially functions as a variable voltage divider. The resistive element can be seen as two resistors in series (potentiometer resistance), where the wiper position determines the resistance ratio of the first resistor to second resistor.

8. RELAYS

A relay is an electrically controllable switch widely used in industrial controls , automobiles and appliances .The relay allows the isolation of two separate sections of a system with two different voltage sources a small amount of voltage/current on one side can handle a large amount of voltage/current on the other side but there is no chance that these two voltages mix up.

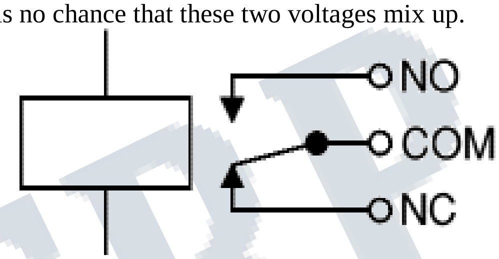

Fig.8 Circuit symbol of relay

IX. BATTERY (ELECTRICITY)

There are two types of batteries: primary batteries (disposable batteries), which are designed to be used once and discarded, and secondary batteries (rechargeable batteries),which are designed to be recharged and used multiple times.

X. WIFI- ESP8266

This is Wi-Fi serial transceiver module, based on ESP8266 SoC., The SOC has Integrated TCP/IP protocol stackESP8266 is a highly integrated chip designed for the needs of a new connected world. It offers a complete and self-contain Wi-Fi networking solution, allowing it to either host the application or to offload all Wi-Fi networking functions from another application processor.

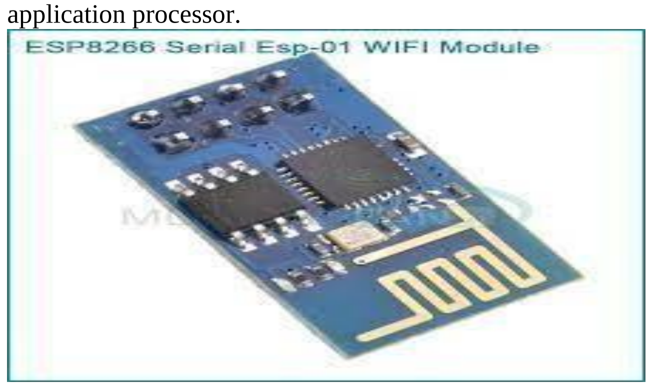

Fig.9 WIFI Module

XI. CONCLUSIONS

This paper presents a fault diagnostic device for PV panels. Detailed implementation of the device and its performance have been given. Experiments reveal that proposed device can provide operators with a fault diagnosis tool without interruption of power generation. Furthermore, the merits lie in its modularity, scalability, and remote sensing capability without modifying existing infrastructure.

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