Internet of Things (IoT) based Smart Irrigation System using Solar Power

Minor Research Project

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ABSTRACT

To develop a solar power-based smart irrigation system using Internet of Things (IoT) to reduce human effort and improve productivity. Irrigation is defined as the artificial application of water to land or soil. The irrigation process can be used for the cultivation of agricultural crops during the span of inadequate rainfall and for maintaining landscapes. An automatic irrigation system does the operation of a system without requiring the manual involvement of people. The smart irrigation system does the work quite efficiently and with a positive impact on the place where it is installed. Once it is installed in the agricultural field, the water distribution to crops and nurseries becomes easy and doesn't require any human support to perform the operations permanently. Application of IoT is proving beneficial for monitoring renewable energy generation. This application of IoT uses system based on Arduino to monitor parameters of the solar panel. The solar panel is monitored by the system continuously and the power output is transmitted over the internet to the IoT Network. It now uses an effective Interface to display these solar panel parameters to the user and it also alerts user when the outcome falls underneath the cut-off points specified.

The automatic irrigation system on sensing soil moisture project is intended for the development of an irrigation system that switches submersible pumps on or off by using relays to perform this action on sensing the moisture content of the soil. The main advantages of using this irrigation system are that it reduces human interference and ensures proper irrigation.

CONTENTS

CHAPTER1

INTRODUCTION

In the field of AUTOMATION, use of proper method of agricultural pump appliances is important because the main reason is intelligent operation and use of modern technology. Also it reduces human effort and may be widely used for Vegetable agricultural fields which requires frequent water supply with day to day changing temperature

MATERIALS REQUIRED:

1) Moisture Sensor
2) Node MCU (ESP8266)
3) PCB (Printed Circuit Board)
4) DC Water Pump
5) Battery
6) Relay
7) Resistors
8) Solar Panel

Irrigation is defined as artificial application of water to land or soil. Irrigation process can be used for the cultivation of agricultural crops during the span of inadequate rainfall and for maintaining landscapes. An automatic irrigation system does the operation of a system without requiring manual involvement of persons.

An automatic irrigation system does the work quite efficiently and with a positive impact on the place where it is installed. Once it is installed in the agricultural field, the water distribution to crops and nurseries becomes easy and doesn't require any human support to perform the operations permanently.

The automatic irrigation system on sensing soil moisture project is intended for the development of an irrigation system that switches submersible pumps on or off by using relays to perform this action on sensing the moisture content of the soil. The main advantage of using this irrigation system is to reduce human interference and ensure proper irrigation.

Electricity is the most essential needs in the lives of everyone in this modern world. The energy consumption graph is rising from day to day, while energy resources are diminishing in parallel. For the generation of electricity, many number of sources are used to balance the lack of electricity. There are two prime sources to generate electricity: one is the conventional sources of energy and the another one is non-conventional sources of energy. Several carriers of the energy like nuclear fuels and fossil fuels too are utilized, yet they are not the renewable resources and these are said to be the non-conventional resources.

In its broadest sense, solar power source plays a vital role in achieving the sustainable power source. Sun's rays serve as a significant source for the electricity generation by converting it into electric power and this application is conventional, which is known as the Solar Thermal Energy.

CHAPTER 2

LITERETURE SURVEY

We have analyzed some papers below. This paper [1] has pro-posed a system that is very basic and doesn't bring anything new to the table. It uses a system that has sensors for moisture, temperature and humidity, and uses arduino to execute its functions. It is partially automated as the user needs to keep a check on the water level of the system. This system uses a GSM module for communication. This paper [2] proposes a method that that uses multiple sensors i.e Temperature, moisture, humidity and light to make a smart irrigation system. The data is sent to a web server for data analyzing and processing, it is stored in JSON format. The light sensor senses the light, to maximize the functioning of the plant, a light is deployed as well. They plan to use smart algorithms to optimize the system. It advertises that it has 92% efficiency than the rest. [3]IoT is used for irrigation in this project as the moisture sensor detects the content of water inside the soil and accordingly informs the user through the computer it is connected to via a notifications. The system compares the moisture with the threshold value and starts the water pump in accordance and stops the pump accordingly. The system has limited range as it is using a computer to connect to the arduino board via usb cable since it is not feasible to use for a farm. The system make use of an arduino board, moisture sensors and an water pump. The system [4] proposes a method in which it will use a master and slave configuration where the raspberry pi will control various adruino devices with Zigbee protocol. The raspberry pi will keep checking its email for any commands which will be in the form of ”Turn on the pump for Y minutes.” This command will turn on the relay to the water pump for the said Y minutes. There is an ultrasonic sensor that keeps monitoring the water tank level and ill notify the user with an email only. The system [5] proposes a method to implement a method for smart irrigation with an Arduino and a Raspberry pi. The system uses Zigbee as a communication method between the two. The system can be controlled through cherry py with the ip address of the raspberry pi board, i.e it has a short range. In this system the raspberry pi does all the calculations and directs the result of it to Arduino's via zigbee. The system [6] proposes a method in which it will scan the soil for moisture and act accordingly i.e start the pump and stop as well. The system is different than others because it uses Bayes theorem to predict the values of future via Data mining. This helps the user understand the pattern of water pumping process in different seasons and can act accordingly for water storage as well. This system has been developed for a web user, so no mobile application. This is done so as to reap the benefit of the computer to store the values and predict the values as well as it requires some amount of computation. This system [7] pro-poses a method in which they use a GSM to control the system of watering the plants according to its threshold value. The sys-tem uses a temperature, humidity, Rainfall, Water level sensors. The system will not pump water if there is rainfall, which saves resources! The system is controlled via a smart phone, it conveys the command to the system either via a SMS or via internet, This makes the system operatable via long range, thus giving the user freedom to be anywhere and operate the system. This system [8] proposes a method in which it calculates the amount of water required by the plant under the current/ongoing scenario. It calculates the light intensity as more the intensity the more is water loss by evaporation. It calculates the wind as well to find the loss of water done by wind. This information that is generally not calculated and comes under the error part, and is generally omitted. The larger this is not calculated the output is faulty

CHAPTER 3

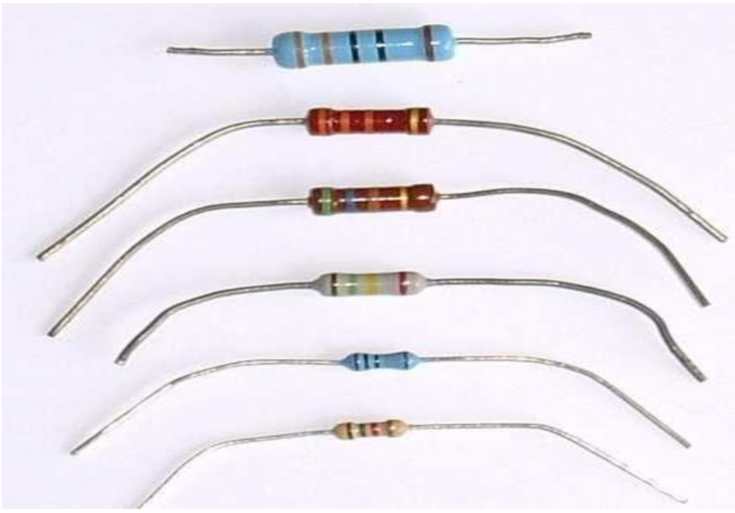
HARDWARE REQUIREMENTS

A. RESISTOR

A resistor is a two-terminal electronic component designed to oppose an electric current by producing a voltage drop between its terminals in proportion to the current, that is, in accordance with Ohm's law:

$$V = IR$$

Resistors are used as part of electrical networks and electronic circuits. They are extremely commonplace in most electronic equipment. Practical resistors can be made of various compounds and films, as well as resistance wire (wire made of a high-resistivity alloy, such as nickel/chrome). The primary characteristics of resistors are their resistance and the power they can dissipate. Other characteristics include temperature coefficient, noise, and inductance. Less well-known is critical resistance, the value below which power dissipation limits the maximum permitted current flow, and above which the limit is applied voltage. Critical resistance depends upon the materials constituting the resistor as well as its physical dimensions; it's determined by design.

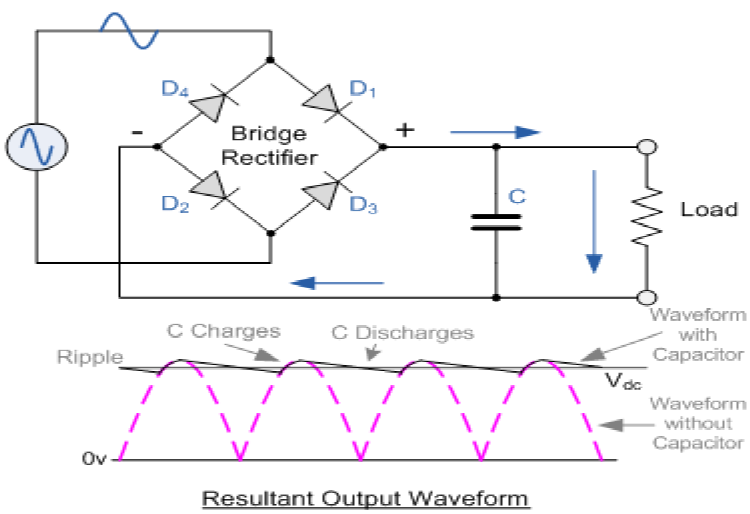


Resistors can be integrated into hybrid and printed circuits, as well as integrated circuits. Size, and position of leads (or terminals) are relevant to equipment designers; resistors must be physically large enough not to overheat when dissipating their power.

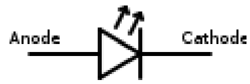
B. RECTIFIER AND FILTER

A rectifier is an electrical device that converts alternating current (AC), which periodically reverses direction, to direct current (DC), current that flows in only one direction, a process known as rectification. Rectifiers have many uses including as components of power supplies and as detectors of radio signals. Rectifiers may be made of solid state diodes, vacuum tube diodes, mercury arc valves, and other components. The output from the transformer is fed to the rectifier. It converts A.C. into pulsating D.C. The rectifier may be a half wave or a full wave rectifier. In this project, a bridge rectifier is used because of its merits like good stability and full wave rectification. In positive half cycle only two diodes (1 set of parallel diodes) will conduct, in negative half cycle remaining two diodes will conduct and they will conduct only in forward bias only.

Capacitive filter is used in this project. It removes the ripples from the output of rectifier and smoothens the D.C. Output received from this filter is constant until the mains voltage and load is maintained constant. However, if either of the two is varied, D.C. voltage received at this point changes. Therefore a regulator is applied at the output stage. The simple capacitor filter is the most basic type of power supply filter. The use of this filter is very limited. It is sometimes used on extremely high-voltage, low-current power supplies for cathode-ray and similar electron tubes that require very little load current from the supply. This filter is also used in circuits where the power-supply ripple frequency is not critical and can be relatively high. Below figure can show how the capacitor changes and discharges.



C. LED :

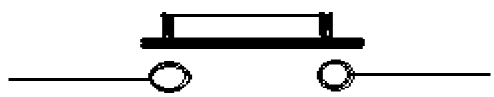


A light-emitting diode (LED) is a semiconductor light source. LEDs are used as indicator lamps in many devices, and are increasingly used for lighting. When a light-emitting diode is forward biased (switched on), electrons are able to recombine with holes within the device, releasing energy in the form of photons. This effect is called electroluminescence and the color of the light (corresponding to the energy of the photon) is determined by the energy gap of the semiconductor. An LED is often small in area (less than 1 mm^2), and integrated optical components may be used to shape its radiation pattern. LEDs present many advantages over incandescent light sources including lower energy consumption, longer lifetime, improved robustness, smaller size, faster switching, and greater durability and reliability.

D. PUSH BUTTON

A push-button (also spelled pushbutton) or simply button is a simple switch mechanism for controlling some aspect of a machine or a process. Buttons are typically made out of hard material, usually plastic or metal. The surface is usually flat or shaped to accommodate the human finger or hand, so as to be easily depressed or pushed. Buttons are most often biased switches, though even many un-biased buttons (due to their physical nature) require a spring to return to their un-pushed state. In industrial and commercial applications push buttons can be linked together by a mechanical linkage so that the act of pushing one button causes the other button to be released. In this way, a stop button can "force" a start button to be released. This method of linkage is used in simple manual operations in which the machine or process have no electrical circuits for control. Pushbuttons are often color-coded to associate them with their function so that the operator will not push the wrong button in error. Commonly used colors are red for stopping the machine or process and green for starting the machine or process.

Red pushbuttons can also have large heads (mushroom shaped) for easy operation and to facilitate the stopping of a machine. These pushbuttons are called emergency stop buttons and are mandated by the electrical code in many jurisdictions for increased safety. This large mushroom shape can also be found in buttons for use with operators who need to wear gloves for their work and could not actuate a regular flush-mounted push button. As an aid for operators and users in industrial or commercial applications, a pilot light is commonly added to draw the attention of the user and to provide feedback if the button is pushed. Typically, this light is included into the center of the pushbutton and a lens replaces the pushbutton hard center disk.



(Push ON Button)

E. TRANSISTOR

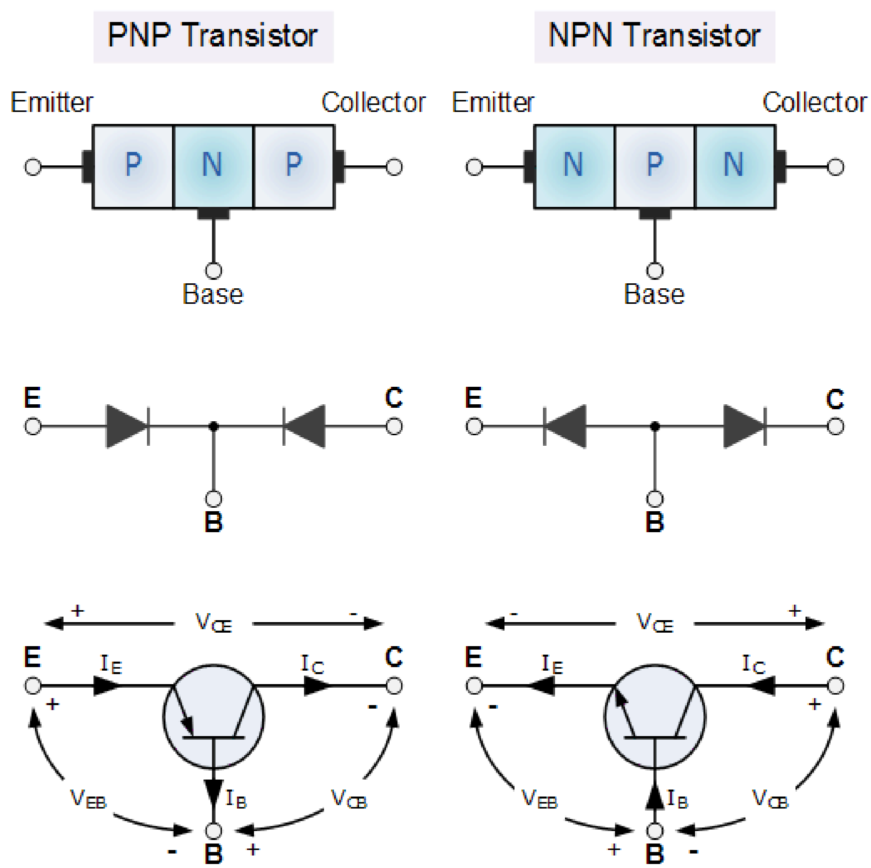
BC547 (NPN) AND **BC557** (PNP) :

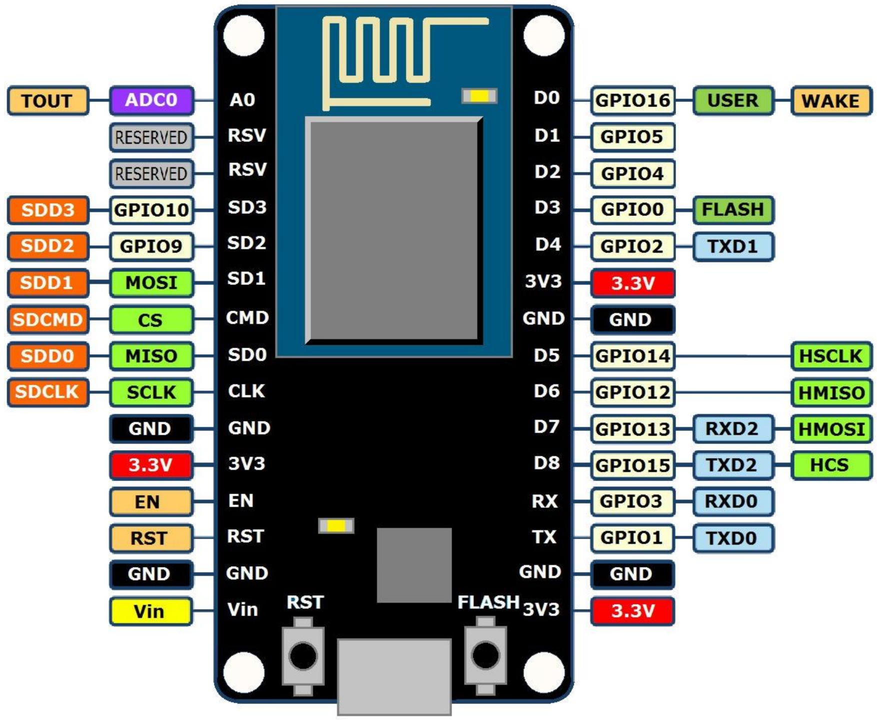
Transistors are three terminal active devices made from different semiconductor materials that can act as either an insulator or a conductor by the application of a small signal voltage. The transistor's ability to change between these two states enables it to have two basic functions: switching or amplification. Then bipolar transistors have the ability to operate within three different regions:

- Active Region - the transistor operates as an amplifier and $I_C = \beta I_B$
- Saturation - the transistor is fully-ON operating as a switch and $I_C = I_{saturation}$
- Cut-off - the transistor is "fully-OFF" operating as a switch and $I_C = 0$

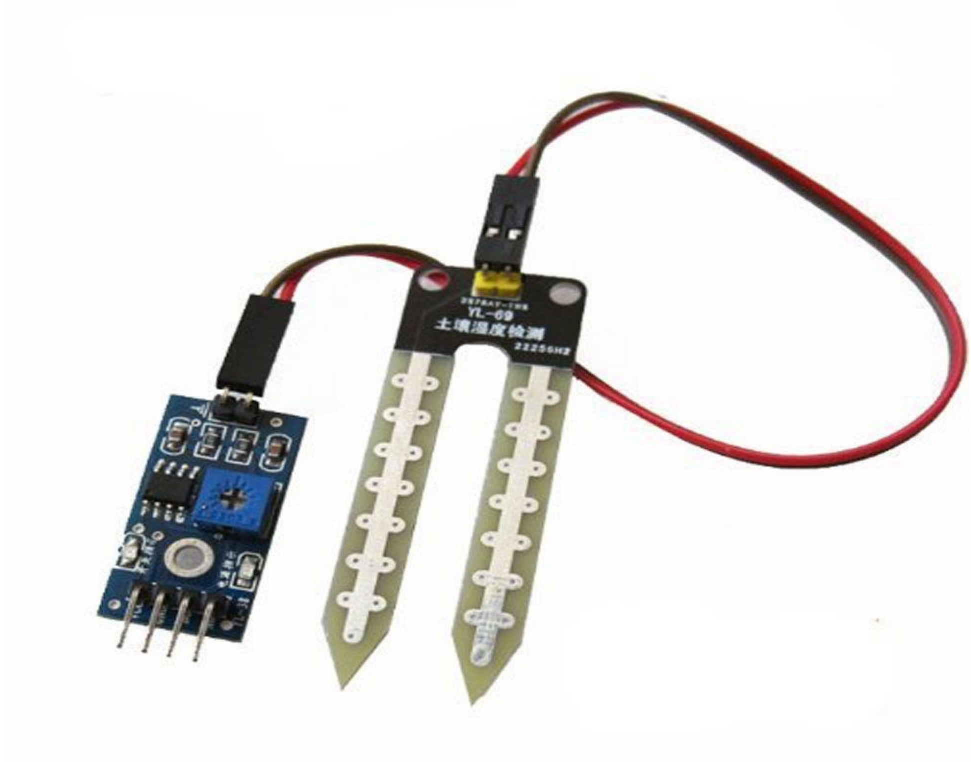
The word Transistor is an acronym, and is a combination of the words Transfer Varistor used to describe their mode of operation way back in their early days of development. There are two basic types of bipolar transistor construction, NPN and PNP, which basically describes the physical arrangement of the P-type and N-type semiconductor materials from which they are made. A transistor is made of a solid piece of semiconductor material, with at least three terminals for connection to an external circuit. The Bipolar Junction Transistor basic construction consists of two PN-junctions producing three connecting terminals with each terminal being given a name to identify it from the other two. These three terminals are known and labeled as the Emitter (E), the Base (B) and the Collector (C) respectively.

Bipolar Transistors are current regulating devices that control the amount of current flowing through them in proportion to the amount of biasing voltage applied to their base terminal acting like a current-controlled switch. The principle of operation of the two transistor types NPN and PNP, is exactly the same the only difference being in their biasing and the polarity of the power supply for each type.




TOUT
ADC0
A0
D0
GPIO16
USER
WAKE
RESERVED
RSV
D1
GPIO5
RESERVED
RSV
D2
GPIO4
SDD3
GPIO10
SD3
D3
GPIO0
FLASH
SDD2
GPIO9
SD2
D4
GPIO2
TXD1
SDD1
MOSI
SD1
3V3
3.3V
SDCMD
CS
CMD
GND
GND
SDD0
MISO
SD0
D5
GPIO14
HSCLK
SDCLK
SCLK
CLK
D6
GPIO12
HMISO
GND
GND
D7
GPIO13
RXD2
HMOSI
3.3V
3V3
D8
GPIO15
TXD2
HCS
EN
EN
RX
GPIO3
RXD0
RST
RST
TX
GPIO1
TXD0
GND
GND
GND
GND
Vin
Vin
RST
FLASH
3V3
3.3V


SONGLE
SRD-12VDC-SL-C



Solar Panel 6 Volt 5 Watt

CHAPTER 4

SOFTWARE REQUIREMENTS

A. ThingsSpeak Cloud Setup

ThingsSpeak is an open-source IOT platform application, which offers different services, that are only focused on building IOT applications. It is an API that stores and retrieves the information from the sensor or the objects/things associated with the system through the internet that utilizes Hypertext Transfer Protocol (HTTP) from the local network to the cloud. All the information logs that are received from the sensors will get updated by ThingsSpeak cloud platform application, tracking the location applications, and the status application providing to the clients(users) and taken from the clients. To use the ThingsSpeak application, the client needs to create an account which contains various channels aimed at observing the various parameters in the framework or in monitoring the parameters in a remote device. This cloud allows the administrator(user) to envision the information in graphical representation. Energy yield information is transferred to a router with internet-based monitoring, making it accessible through the online interface. Your solar panel output information can be accessed from anywhere you can get an internet connection, which is the primary benefit of frameworks like these.

Fig.8 ThingsSpeak Cloud Setup

B. Arduino Integrated Development Environment (IDE)

Arduino IDE is the open-source development platform compatible for Mac OS X, windows and Linux (both 32 and 64bits) operating system. This software is mainly used for editing, compiling and uploading the code into the Arduino device. Both C and C++ programming languages are supported in this environment. It is easy to install. You can easily add libraries according to the hardware module. And also, software update will be available from time to time.

CHAPTER 5

METHODOLOGY OF PROPOSED MODEL

A . The Sun is a direct source of energy:

Using renewable energy technologies, we can convert the solar energy into electricity Solar powered lighting is a relatively simple concept in a basic way the system operates like a bank account withdrawal from the battery to power the light source must be compensated for by commensurate deposits of energy from the solar panels. As long as the system is designed so deposits exceed withdrawals on an average daily basis, the battery remains charged and light source is reliably powered.

- The sun provides a direct source of energy to the solar Panel.
- The Battery is recharged during the day by direct –current (DC) electricity produced by the solar panel.
- Electronic controls are used between the battery, light source and solar panels to protect the battery from over charge and discharge and to control the timing and operation of the light.

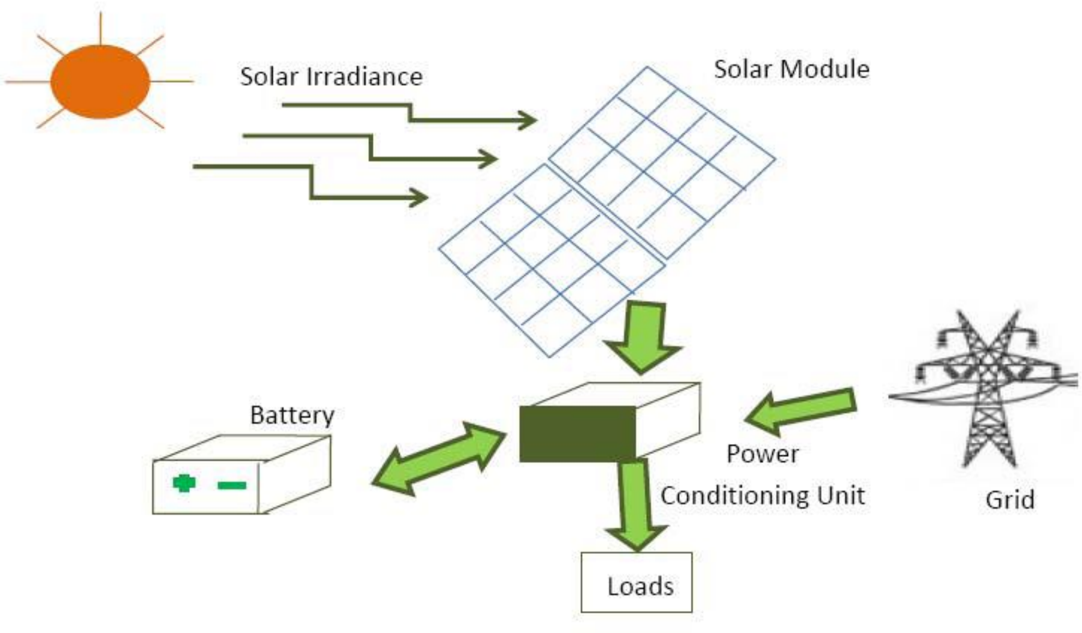
B. Photovoltaic (PV): Basic Design Principles and Components

Single PV cells (also known as “solar cells”) are connected electrically to form PV modules, which are the building blocks of PV systems. The module is the smallest PV unit that can be used to generate substantial, amounts of PV power. Although individual PV cells produce only small, amounts of electricity, PV modules are manufactured with varying electrical outputs ranging from a few watts to more than 100 watts of direct current (DC) electricity. The modules can be connected into PV arrays for powering a wide variety of electrical equipment. Two primary types of PV technologies available commercially are crystalline silicon and thin film. In crystalline-silicon technologies, individual PV cells are cut from large single crystals or from ingots of crystalline silicon. In thin film PV technologies, the PV material is deposited on glass or thin metal that mechanically supports the cell or module. Thin-film-based modules are produced in sheets that are sized for specified electrical outputs .In addition to PV modules, the components needed to complete a PV system may include a battery charge controller, batteries, an inverter or power control unit (for alternating-current loads), safety disconnects and fuses, a grounding circuit, and wiring.

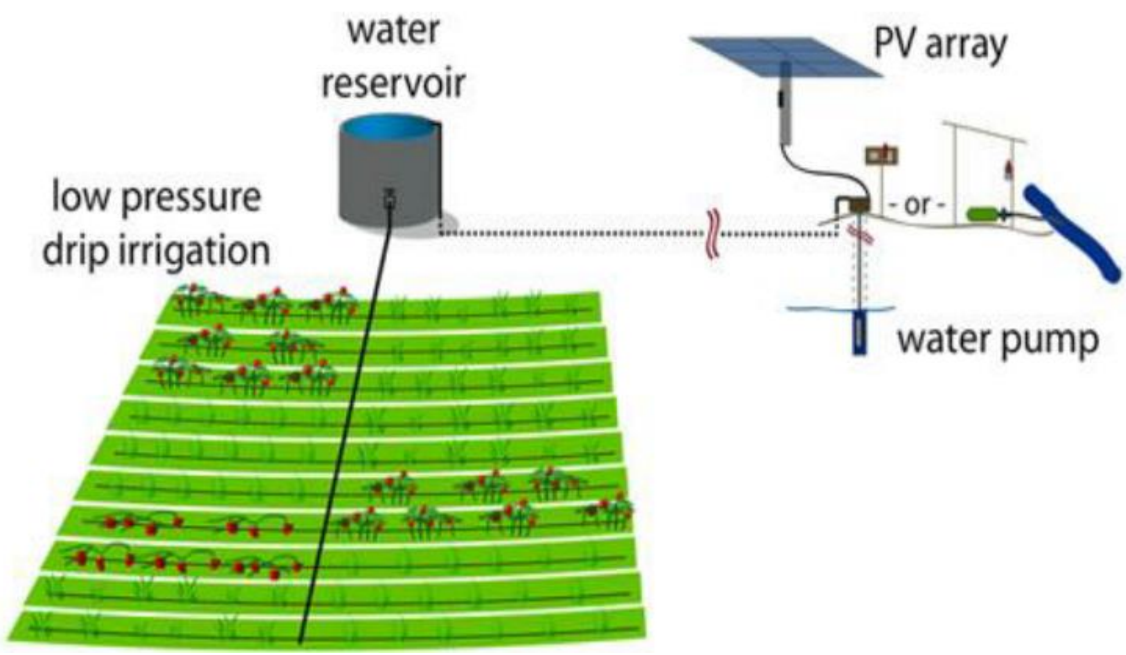
When Are PV Systems Appropriate?

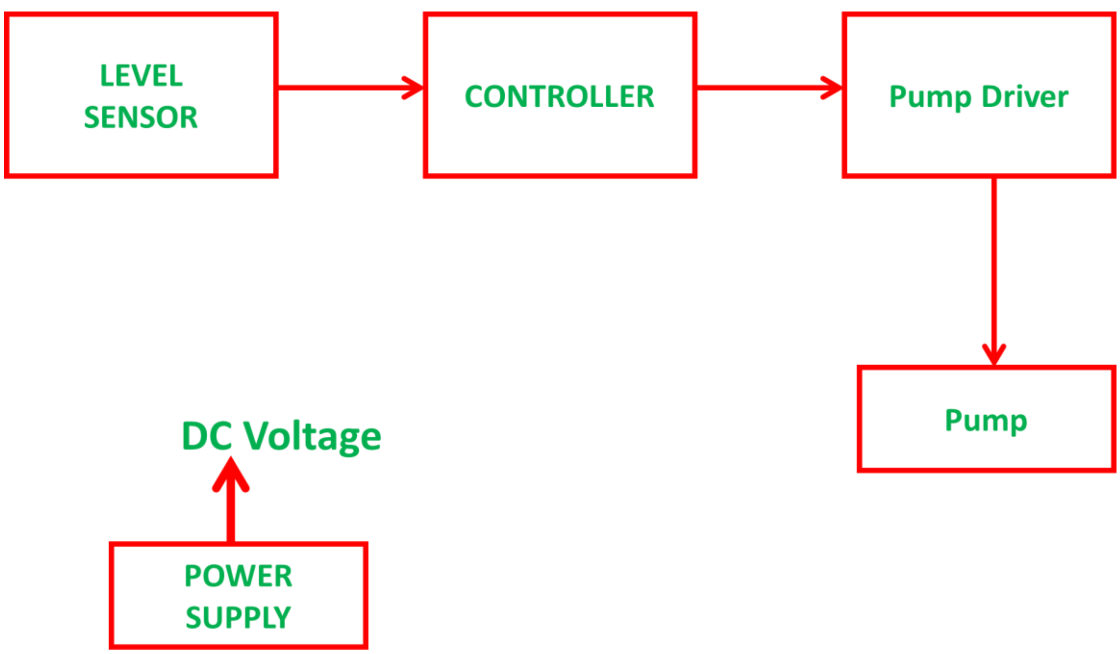
People select PV systems for a variety of reasons. Some common reasons for selecting a PV system include

- Cost—When the cost is high for extending the utility power line or using, another electricity-generating system in a remote location, a PV system is often the most cost-effective source of electricity.
- Reliability—PV modules have no moving parts and require little maintenance compared to other electricity-generating systems.
- Modularity—PV systems can be expanded to meet increased power requirements by adding more modules to an existing system.
- Environment—PV systems generate electricity without polluting the environment and without creating noise.
- Ability to combine systems—PV systems can be combined with other types of electric generators (wind, hydro, and diesel, for example) to charge batteries and provide power on demands.



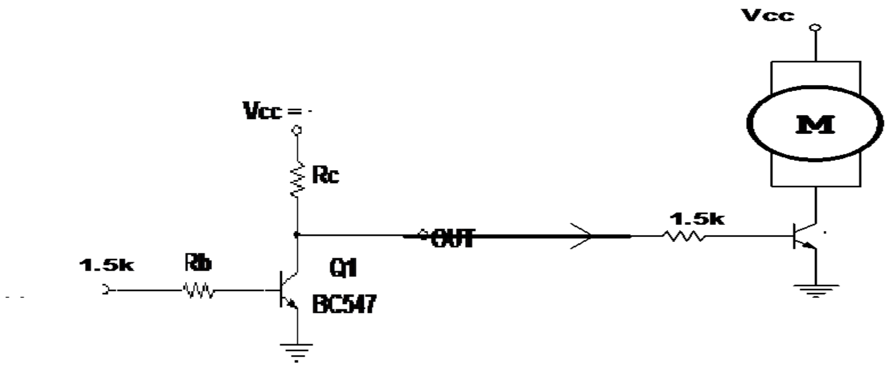
Solar PV Generation Process





The circuit comprises of sensor parts built using a Transistor named BC547. BC547 's are configured here as a driver circuit for pump. A water level sensor is inserted in the soil to sense whether the soil is wet or dry. The controller is used to control the whole system by monitoring the sensors and when sensors sense the dry soil condition then the controller will send command to relay driver IC the contacts of which are used to switch on the load and it will switch off the

load when all the sensors are in wet water condition. The controller does the above job as it receives the signal from the sensors through the output of the SENSOR,
This is safest and no manpower is required. This is very useful to all climatic conditions and it is economic friendly.



BENEFITS

An automatic irrigation system does the work quite efficiently and with a positive impact on the place where it is installed. Once it is installed in the agricultural field, the water distribution to crops and nurseries becomes easy and doesn't require any human support to perform the operations permanently.
With the increasing demand of energy via greener methods and the gradual depletion of fossil fuels, solar energy conversion has regained the spotlight of the global energy activities. Our planet receives 160,000TW solar energy, while the present global energy demand is about 16TW. While the solar resource is virtually unlimited, conversion of solar energy to readily usable form is too expensive to be commercially successful at present. Furthermore, reliable solar technology has to be complemented by energy storage system to accommodate the daily and seasonal variations in the solar radiation. From this perspective, many countries have formulated their long term solar energy utilization roadmap. For instance, the Japanese roadmap includes development of solar photovoltaic at competitive price by 2030. Large demonstrative projects (~MW) are underway in USA, Australia, and in several European countries. These projects serve multiple purposes.

- First, the projects tend to reduce the overall cost of the energy technology as large scale utilization of a particular technology, in general, tends to reduce the cost of that technology. This has also encouraged the entrepreneurs to invest in solar energy technologies.
- Second, the projects are serving as test platforms for large scale solar energy utilization technologies.

- Third, these projects are engaging the academic institutions in long-term solar energy research, development, and pedagogical activities.
- Fourth, these projects have increased the awareness of green technologies amongst the public.

All such projects and roadmaps are, however, only a part of the country-specific long term energy vision, with solar energy aiming to supplement conventional energy technologies. None of these initiatives, at this stage, claim to replace the existing fossil fuel based systems immediately.

Being a developing country with a huge burden of fuel import, the need of solar energy research and development in India cannot be over-emphasized. The geographical location of India is also quite favorable for solar energy implementation. However, a densely-populated country like India, with a fragmented electricity market, poses endless challenges to the scientists and entrepreneurs. The nature of Indian electricity market is quite unique, and cannot be compared directly with other countries. Unlike USA or Japan, India has *numerous villages and islands unconnected from the main grid,* spatial and seasonal variation in agricultural demand, and cottage- to large-scale industrial sectors. Our country, therefore, requires solar energy development at different scales such as, small (~W) to large (~MW), grid-connected to islanded, supplemented with some energy-storage to no-storage capabilities. Also important is the hybridization of solar energy with other renewable sources. Considering this socio-economic scenario, the present state of solar energy technology in India stands far from being adequate, but

several initiatives are being planned. On 30th June 2008 the Prime minister of India, Dr.

Manmohan Singh, announced the National Plan for Climate Change.[1] This includes a National Solar Mission to "significantly increase the share of solar energy in the total energy resources while recognizing the need to expand the scope of other renewable and non-fossil options such as nuclear energy, wind energy, and biomass". The departments of Science and Technology (DST) and the ministry for New and Renewable Energy (MNRE) have taken initiatives to promote formation of networks of premier research institutes to work on solar power generation related projects. One such scheme is DST's Pan-IIT Solar Energy Initiative (PSI) with a goal of delivering a 1MW solar based islanded energy grid in 5yrs. A multi-disciplinary team from four departments of IIT Kanpur has been participating in this initiative.

To further strengthen the contribution to the National Solar Mission and the PSI, it is felt

that a broader inter disciplinary group can be formed at the institute level aiming to develop short and long term technology in the area of power electronics component and system design, solar energy materials, supplementary energy storage and conversion devices. An establishment of Solar Energy Research Enclave will catalyze the accomplishing of this goal of national importance, and this is the genesis of this proposal for Solar Energy Research Enclave (SERE).

One of the major concerns in the power sector is the day-to-day increasing power demand but the unavailability of enough resources to meet the power demand using the conventional energy sources. Demand has increased for renewable sources of energy to be utilized along with conventional systems to meet the energy demand. Renewable sources like wind energy and solar energy are the prime energy sources which are being utilized in this regard. The continuous use of fossil fuels has caused the fossil fuel deposit to be reduced and has drastically affected the environment depleting the biosphere and cumulatively adding to global warming.

Solar energy is abundantly available that has made it possible to harvest it and utilize it properly. Solar energy can be a standalone generating unit or can be a grid connected generating unit depending on the availability of a grid nearby. Thus it can be used to power rural areas where the availability of grids is very low. Another advantage of using solar energy is the portable operation whenever wherever necessary.

In order to tackle the present energy crisis one has to develop an efficient manner in which power has to be extracted from the incoming solar radiation. The power conversion mechanisms have been greatly reduced in size in the past few years. The development in power electronics and material science has helped engineers to come up very small but powerful systems to withstand the high power demand. But the disadvantage of these systems is the increased power density. Trend has set in for the use of multi-input converter units that can effectively handle the voltage fluctuations. But due to high production cost and the low efficiency of these systems they can hardly compete in the competitive markets as a prime power generation source.

The constant increase in the development of the solar cells manufacturing technology would definitely make the use of these technologies possible on a wider basis than what the scenario is presently. The use of the newest power control mechanisms called the Maximum Power Point Tracking (MPPT) algorithms has led to the increase in the efficiency of operation of the solar modules and thus is effective in the field of utilization of renewable sources of energy.

Photovoltaics (PV) is the field of technology and research related to the application of solar cells for energy by converting sun energy (sunlight, including sun ultra violet radiation) directly into electricity. Due to the growing demand for clean sources of energy, the manufacture of solar cells and photovoltaic arrays has expanded dramatically in recent years. Photovoltaic production has been doubling every 2 years, increasing by an average of 48% each year since 2002, making it the world's fastest-growing energy technology. At the end of 2008, the cumulative global PV installations reached 15,200 Megawatts. Roughly 90% of this generating capacity consists of grid tied electrical systems. Such installations may be ground-mounted (and sometimes integrated with farming and grazing) or built into the roof or walls of a building, known as Building Integrated Photovoltaic or BIPV for short. Net metering and financial incentives, such as preferential feed-in tariffs for solar generated electricity; have supported solar PV installations in many countries including Australia, Germany, Israel, Japan, and the United States.2

1.2 Type of solar cells available

The PV cells are manufactured by hundreds of manufacturers worldwide and there are several different technologies available. There are three main type of commercially available PV cells viz.

1. Mono crystalline silicon PV
2. Polycrystalline silicon PV
3. Thin film amorphous silicon PV

At present the first two categories dominate world markets constituting 93% of it the last one accounts for 4.2% of the market. There are other type of solar cells but are less in use viz. concentrated photovoltaic, hybrid solar cells, multi junction solar cells etc.

However, their production is lower because of less usage till now, and thus they are truly not commercial.

The **silicon based technologies**, crystalline(c)-Silicon, multi-crystalline(mc)-Silicon, amorphous (a)-silicon are the dominant technologies at 24%, 19% and 12% efficiencies at cell levels [1,2,3]. The efficiencies at module levele are 5-6 % lower due to variety of reasons. Most of the Indian companies are producing at 15-17% efficiencies at cell levels and at about 12-13% at module levels. There is scope of improvement in different technologies. We like to put up state of the art efficient modules.

A **Thin-Film Solar Cell** (TFSC), also called a Thin-Film Photovoltaic Cell (TFPV), is a solar cell that is made by depositing one or more thin layers (thin film) of photovoltaic material on a substrate. The thickness range of such a layer is wide and varies from a few nanometers to tens of micrometers.

Many different photovoltaic materials are deposited with various deposition methods on a variety of substrates. Thin Film Solar Cells are usually categorized according to the photovoltaic material used.

CHAPTER 6

RESULT ANALYSIS

For the current status of the solar panel to be sensed, the sensors are used, that is the current is sensed, using the current sensor. The solar panel is rotated by the DC Motor, using the DC Servo Motor relying on the LDR, with the goal that the panel gets the maximum sunlight at every moment. To the motor, relay serves as the driver. To the sensor, LDR and the relay, the controller is wired. LDR and the analog signal from the sensor acts as controller's input and the relay is supplied with the output signal, on the basis of the input from LDR and parameters of the solar panel like power and voltage generated which are calculated from the sensor's current signal are displayed on the LCD.

An interface is shared across the controller and the cloud server utilizing the Wi-Fi module, subsequently the panel parameters like voltage, current and power generated are transferred to the server. Along these lines, the ongoing status of the panel can be viewed remotely. It can be compared and analysed, as the parameters of the panel are stored in the server every hour and every day.

Data from the different solar panels is integrated by Internet of Things platform and applies analytics to share the most significant data with applications made to address specific requirements.

CHAPTER 7

CONCLUSIONS

Internet of Things (IoT) driven framework is aimed at getting an ideal power output from the solar panels, in this project. The different solar panel parameters like voltage, current and temperature are displayed on the LCD by using this IOT technology. The daily, weekly and monthly analysis becomes simple and efficient, as this system keeps continues track of the solar power plant. With the help of this analysis, it is possible to identify any issue occurred within power plant as there would be discrepancy in the information produced by the framework. Solar panel is worked at its maximum efficiency the entire day, by the solar tracking.

FUTURE SCOPE

The controller needs an external source to work, however, by means of the power generated by the solar module itself, the controller's input supply of the power can be met. Dual axis solar panel tracking can be done, for very large solar panel. It is possible to foresee the future predictions of parameters, by analysing the information. Using various machine learning algorithms, Artificial intelligence this can be implemented, so that the system can turn out to be smart enough to take decisions about information and performance.

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