Maximum power point tracker using fuzzy logic controller for solar power traffic light

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CHAPTER 1

INTRODUCTION

Photovoltaic has become one of the strongestcandidates as a secondary energy source. This is because the problem of fossil energy depletion becomes more severe. The term photovoltaic refers to the phenomenon involving the conversion of sunlight into electrical energy via a solar cell. Under certain temperature and light intensity, there is only single maximum-power point (MPP) in a normal cell. Therefore, maximum power point tracking (MPPT) of the solar cell is essential as far as the system efficiency is concerned. Recently, various MPPT techniques have been implemented on a microcontroller unit (MCU) in several solar-powered applications. For example, a RISC microcontroller was employed to realize MPPT using a Perturbation and Observation Method (P&O) method for abattery charging application.

For a transportation industry, one of sectors that gain benefits from such a system, a solar-powered light-flasher (SPLF) isdeveloped. Besides, a hill-climbing algorithm, which is similar to P&O method, is also implemented on RISC microcontroller for an illumination application. The sophisticated Artificial Intelligent (Al) methods, such as Artificial Neural Network (ANN)and Fuzzy Logic Control (FLC), have been developed for solar-powered applications. For FLC, an inference engine is time-consuming. Thus, the relation between input and output of FLC can be stored in a memory-limited lookup table (LUT). The implementations of FLC stored in LUT for MPPT have been successfully implemented for a solar power battery charger (SPBC) and an SPLF, respectively.

Comparatively, the conventional MPPT methods can give poorer performances, but implementation is alwayseasier. Al methods, on the other hand, perform better, but their structure is generally more complicated and requiresrelatively high performance processor. Therefore, Al isnot suitable for some applications where cost is a prime concern. Furthermore, they still lacks of the adaptability required for MPPT controller to efficiently deal with time-varying environments. An alternative to overcome the problem of adaptability is a Self-Organizing Fuzzy Logic Controller (SOFLC) originally proposed byProcyk and Mamdani. By self-organizing, it is meant that the controller can recursively adjust its associated fuzzy rule in accordance with a desired response. Besides, the technique is simple and can be efficiently realized by Look-Up Table (LUT), offering a cost-effective solution to hardware implementation., the authors introduced an application of SOFLC for MPPT in a solar-powered battery charging system Nonetheless, the applications a standalone of solar-powered system has been not investigated. In this paper, the implementation of the Self-Organizing Fuzzy Logic Controller for a Solar-powered Traffic Light Equipment (SOFLC-SPTLE) with built-in MPPT is presented. A low-cost PIC16F876A RISC MCU is employed for the algorithm processing, and it is integrated to a boost converter to form a solar powered battery charging system. There is no external sensory unit required for the system.

1.1 Problem Overview:

Fuzzy logiccan be usedas a mechanism for Battery charging purpose. This energy can be storedand used to power up electrical and electronics devices.With the recent advancement in microscale devices,Fuzzy logic controller can provide a conventional alternative to traditionalpower sources used to operate certain types of sensors/actuators. Umeda (1996) for example successfully developed an equivalent electricalmodel of the piezoelectric material transforming mechanical impact energy to electrical power.

Similarly, Kymissis (1998) examined the application of a piezo film in addition to theceramic to provide power to light up bulbs in a shoe, entirely from walking motion. Kimura'sUS Patent (Kimura 1998) centered on the vibration of a small plate, harnessed to provide arectified voltage signal to run a small transmitter fixed to migratory birds for the purpose oftransmitting their identification code and location. Other works by Clark & Ramsay (2000),Goldfarb (1999) and Elvin (2000; 2001) indicated similar possibility.

The application of Fuzzy Logic Controller is a MPPT Charger can be extended to operate dailylow power electrical appliances such as tuner, light bulb. The aim ofthis paper is to develop the Maximum power for Battery charging application.With the

conventional source of generation of electricitybeing either polluting (Ex; Coal, fossilfuels etc) search for a clean, reusable source of energy.Fuzzy Logic Controller is algorithm based software programming method. We use the embedded C-programming language to built a program for control application.
Conversely,MPPT is maximum power point tracking. In this project, we get maximum power by keeping current constant and voltage maximum. we get maximum voltage to charge the battery. We use pic micro-controller for programming purpose. In the design the control circuit is implemented on aMicrochip.

1.2 Objectives of Dissertation:

We know thatRenewable energies such as solar, wind, hydroelectric and geothermal could potentially help to reduce our dependence on fossil fuels, but are expensive and not always available. Also, developing countries do not have the resources to build energy grids. Maximum energy from Fuzzy Logic Controller could be an economical and efficient solution to the globle energy crisis that faces us today.
The overall aim of study is to produce renewable energy source based on the "Application Of Maximum Power Point Tracking using Fuzzy Logic Control For solar Power Traffic Lights" from FLC over solar arrays and then store it for later various uses such as AC as well as DC applications.

- **Sub Objectives of the Project:-**

1. To Study Working of Fuzzy Logic Controller:

In this project we will study the actual working of Fuzzy Logic Controller. We will also study that how much accuracywe have to get on controller or solar array to get required appropriate output.

2. Selection of Appropriate Components Required:

In this part of the system we will select the components required of specific and appropriate ratings for power supply circuit, Fuzzy Logic controller,Inverter, etc.

3. Design of Block and Circuit Diagram:

Another objective of our project is to study and design block diagram and circuit for proposed system.

4. Overall Reduced Cost:
To reduce the cost for power generation besides increasing the efficiency of power generation of the system.

1.3Outlines of Dissertation:

Chapter 2- Literature Review: Maximum Power from Fuzzy Logic Controller by Using traffic lightsand hardware implementation from various sources like conferences and journal papers and some websites & survey report.

Chapter 3- Objectives completed: In this chapter the various objectives we completed during the implementation of the system are explained.

Chapter 4- Significance of Topic: In this chapter the Significance maximum power from Fuzzy Logic Controller by Using traffic lights application is explained with Constraints or Difficulties Faced during working on it.

Chapter 5-Principle of Operation: In this chapter wediscussed how the fuzzy controller actually works or its principle of operation in brief.

Chapter 6-Project Development Stages: In this chapter we explained that how the project is developed which is divided in no of stages. These stages are explained one by one.
Chapter 7- Hardware Design: In this chapter we explained that how the project hardware is designed which is divided in no of parts. These various parts are explained in this chapter such as solar plate, LCD, Inverter, Fuzzy Logic circuit, PIC Micro-controller, Voltage RegulatorLM317, Step-up Transformer, Voltage Regulator LM7805, Resistance, Battery,Capacitors& Diodes.

Chapter 8- Microcontroller Design: In this chapter we explained the Pin Diagram of Microcontroller,its Overview, Features, Pin Descriptions, Architecture of the Microcontroller, Block Diagram,Typical Characteristics, Electrical Characteristics.
Chapter 9- Block Diagram Description: In this chapter we explained the Design of proposed system such as Fuzzy Logic Circuit, Inverter, Power Supply Circuit, Microcontroller, LCD Module 1602A, Design of Battery charging circuit.
Chapter 10- Hardware Design Circuitry: In this chapter we explained the Design of solar plate, Power Supply Circuit, Design of Fuzzy Logic Controller Circuit and Design of Battery charging circuit.
Chapter 11- Comparative Testing Results: In this chapter comparison of results are explained.
Chapter 12- Advantages and Disadvantages: In this chapter the Advantages and Disadvantages of Application of Maximum Power Point Tracking using Fuzzy Logic Controller For Solar Powered Traffic Lights are explained.
Chapter 13- Applications: In this chapter the Applications of Maximum Power Generation from Fuzzy Logic Controller by Using traffic lights are explained.

Chapter 14- Conclusion and Future Work: This chapter starts with summarizing remarks relating to the objective of the project concerning the performance of our system and suggestions for further research are made towards the end of this chapter.
Chapter 15- Cost Estimation: In this chapter the cost of the total project with components used in the system are explained.

CHAPTER 2

LITERATURE REVIEWS

1. Application of maximum power point tracker with self organized fuzzy logic controllrer solar powered traffic lights-(NoppadolKhaehintung and PhaophakSirisuk, IEEE**)** This paper presents the development of Maximum Power Point Tracking(MPPT) using and adjustable self–organizing Fuzzy Logic Controller for a solar-powered Traffic Light Equipment(SPTLE) with an integrated MPPT system on a low cost microcontroller
2. A Fuzzy-Logic-Controlled Single-Stage Converter for PV-Powered Lighting System Applications-**(**Tsai-Fu Wu ,Senior Member, IEEE, Chien -Hsuan Chang, and Yu-Kai Chen, Member, IEEE)This paper represents a fuzzy logic controlled single-stage converter for photovoltaic power lighting applications.
3. Single-Stage Grid Interactive PV System Using Novel Fuzzy Logic Based MPPT with Active and Reactive Power Control(Nilesh Shah ,R.Chudamani ,IEEE)
    a. This paper represent due to high cost Photovoltaic panel and lower conversion
    b. Efficiency and efficient design of PV system is necessary.

CHAPTER 3

OBJECTIVES COMPLETED

1. To Generate Maximum Power:

An annual consumption of electricity has been increasing rapidly throughout the world. Thus, the usage of electricity increased in the modern day but Power Company generates limited energy. It is difficult to provide power to all consumers. Electrical power management refers to monitoring, controlling the power use in industry, household and commercial sector. There are different limits for both these types of consumers. But consumers are crossing their load limit, due to that it is difficult to provide power to all consumers. Hence we need maximum power generation.

The maximum energy sources are those which have infinite source of energy and which are not going to exhaust easily. The Fuzzy Logic Controller is used as the input for our system. Thepower generation through controller as a source of maximum power energy that we can obtained the pollution free system.

2. To Study the working of Fuzzy Logic Controller:

Thesolar power is the energy source. The solar plate produce the voltage which can be use for power many things. The Fuzzy Logic have algorithmic structure. with the help of fuzzy logic we get more accuracy in the control application.

The working is based on the concept of fuzzy logicthat can be used to extend thelifetime of that system. Thefuzzy logic consist of five member in their application i.e NB,NS,PB,PS,ZE. The maximum power can be obtained at zero(ZE) point. It get protected to a battery from overcharging. The overall charging/discharging process is carried out by using fuzzy logic.

3. To reduce overall cost of system:

The power company generates limited amount of energy but the annual consumption of electricity has been increasing rapidly throughout the world. Thus, the usage of electricity increased in the modern day because consumers are crossing their load limit, due to that it is difficult to provide power to all consumers. Hence the cost of the generation system also increased. This overall cost of system can be reduced as we are using renewable source input for the system.

4. Pollution Free System:

As we know some of the energy generation system produces the pollution by producing harmful gases such as CO_2, CO, SO_2, etc and dust like particles in the environment which causes serious health issues. It is also destroying the Ozone layer of atmosphere which blocks the UV rays and saves us. Hence our system must be pollution free.

The Maximum power point tracking using fuzzy logic controller is clean source of energy and is pollution free and it is also eco-friendly.

CHAPTER 4

SIGNIFICANCE OF TOPIC

4.1 Significance of Topic:

1. **Production of the maximum power:**

   An annual consumption of electricity has been increasing rapidly throughout the world. Thus, the usage of electricity increased in the modern day but Power Company generates limited energy. It is difficult to provide power to all consumers. Electrical power management refers to monitoring, controlling the power use in industry, household and commercial sector. There are different limits for both these types of consumers. But consumers are crossing their load limit, due to that it is difficult to provide power to all consumers. Hence we need maximum power generation.

   The maximum energy sources are those which have infinite source of energy and which are not going to exhaust easily. Solar maximum power is used as the input for our system. The fuzzy logic controller used for maximum power energy that we can obtained better accuracy in charging system.

2. **Fuzzy Logic:**

   The fuzzy logic which is usedto create the maximum power from solar plate and used for charging and discharging process.

3. **Use for AC as well as DC applications:**

   We get the voltage at the first in the form of dc. This voltage is further regulated andpassed to the charging circuit which is connected to the battery and the battery is charged. The charged battery is used for DC applications. Also the output from the battery is inverted used for AC applications.

4. **Reduced cost of Power Generation per unit:**

   The power company generates limited amount of energy but the annual consumption of electricity has been increasing rapidly throughout the world. Thus, the usage of electricity increased in the modern day because consumers are crossing their load limit, due to that it is difficult to provide power to all consumers. Hence the cost of the generation system also increased.

5. **Pollution Free Operation of System:**

   As we know some of the energy generation system produces the pollution by producing harmful gases such as CO_2, CO, SO_2, etc and dust like particles in the environment which causes serious health issues. It is also destroying the Ozone layer of atmosphere which blocks the UV rays and saves us. Hence our system must be pollution free.

4.2 Constraints or Difficulties Faced:

1. Development of fuzzy logic program:

The fuzzy logic program is completely algorithm based on program.

2. Selection of proper material and programming:

The selection of proper material is necessary and very important part while making the MPPT using fuzzy logic controlled charger.We need proper programming for better accuracy while charging.need a pic micro-controller for coding.

CHAPTER 5

PRINCIPLE OF OPERATION

Traffic congestion is a severe problem in many modern cities around the world. Traffic congestion has been causing many critical problems and challenges in the major and mostpopulated cities. To travel to different places within the city is becoming more difficult for the travelers in traffic. Due to these congestion problems, people lose time, miss opportunities, and get frustrated. Traffic congestion directly impacts the companies. Due to traffic congestions there is a loss in productivity from workers opportunities are lost, delivery gets delayed, and thereby the costs goes on increasing. To solve these congestion problems, we have to build new facilities and infrastructure. The only disadvantage of making new roads on facilities is that it makes the surroundings more congested. So for that reason we need to change the system rather thanmaking new infrastructure twice.

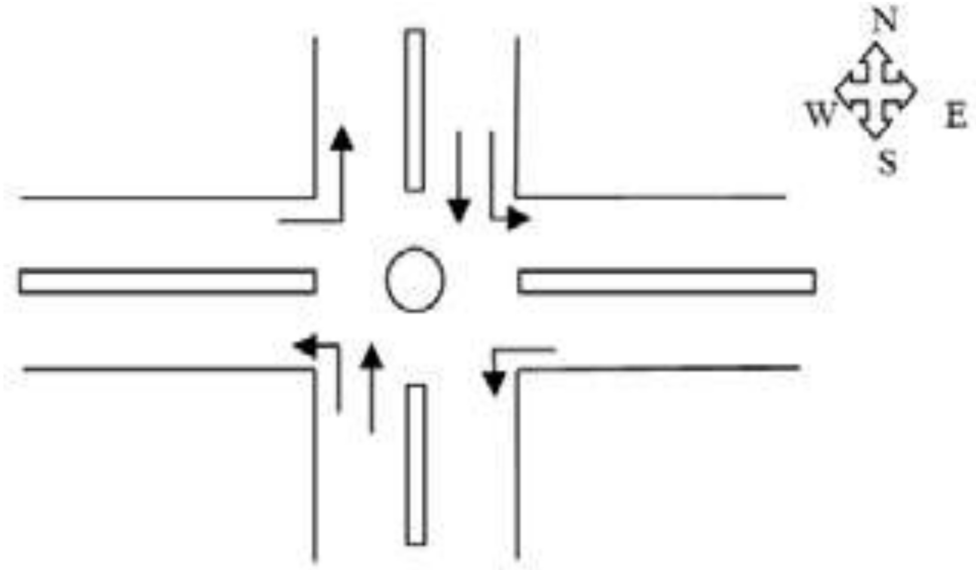


Fig 5.1: Present day technique for control or traffic lights

The goal of this project are improving safety, minimizing travel time and increasing the capacity of Infrastructures. Such improvements are beneficial to health, economy and the environment. Delay reduction at city intersections and travel time savings are major goal of Intelligent Transportation Systems (ITS) Traffic load is highly dependent on parameters such as time, day, season, weather and unpredictable situations such as accidents, special events or constructional activities. If these parameters are not taken into account, the traffic control system will create delays. A traffic So the traffic lights which exist in the junction work according to an algorithm which does not take into account the number of vehicles which arrive at the crossroad. Inefficient configuration of traffic lights based in a fixed cycle protocol can lead to unnecessarily long waiting times for vehicles and even to traffic congestion. Simplifying, in this case, this paper presents a possible solution using the fuzzy logic. It is an approach that allows the implementation of real-life rules by using computeralgorithm.

Fuzzification – Fuzzification is the process of charging a real scalar value into a fuzzy value. This is achieved with different types of membership functions.

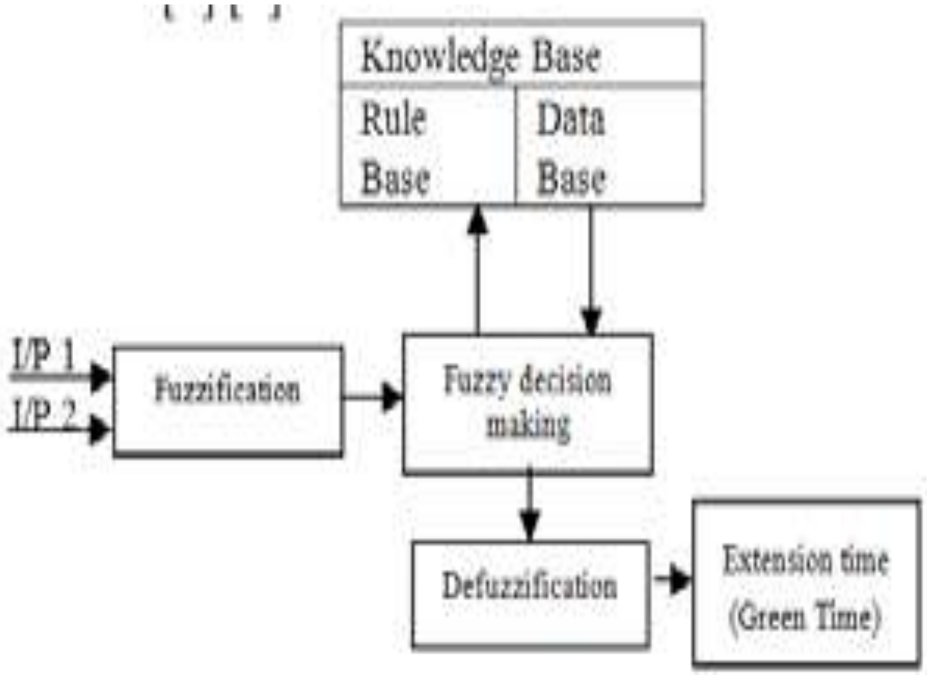
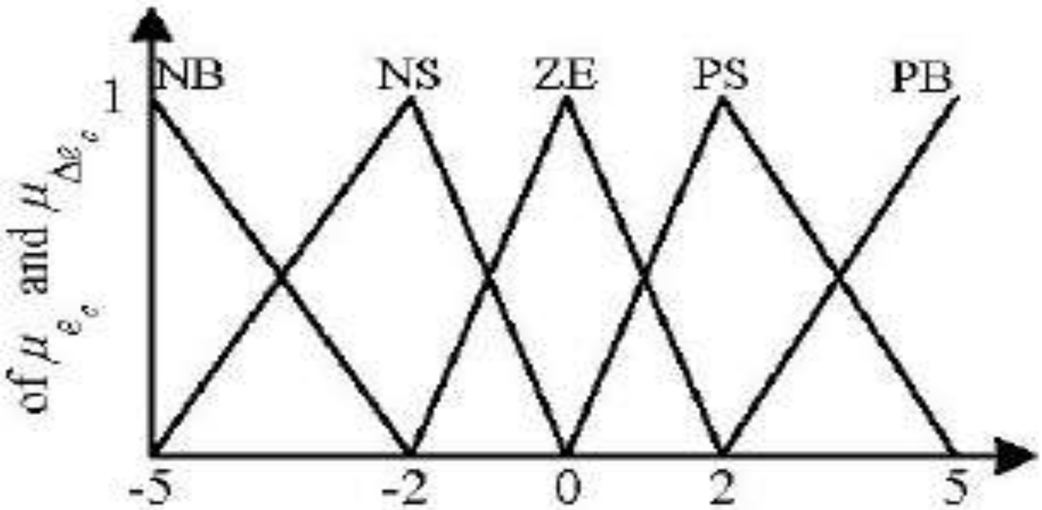


Fig. 5.2: Fuzzy controller structure

Table 1: Fuzzy rule table

E ↓ \ CE →	NB	NS	ZE	PS	PB
NB	ZE	ZE	PB	PB	PB
NS	ZE	ZE	PS	PS	PS
ZE	PS	ZE	ZE	ZE	NS
PS	NS	NS	NS	ZE	ZE
PB	NB	NB	NB	ZE	ZE



A fuzzy logic controller is designed for an isolated 4-Lane trafficintersection: North, South, East and West . In this method we consider two fuzzy input variables and one output fuzzy variable. These input variables are:

• Quantity of the traffic on the arrival side (Arrival);

• Quantity of traffic on the queuing side (Queue).

If the north and the south side is green then this would be the arrival side while the west and east side would be considered as the queuing side, and vice- versa. On the other side the output variable would be the extension time needed for the green light on the arrival side. So based onthe current traffic conditions the fuzzy rules can be formulated. so that the output of the fuzzy controller will approaches to increase or not increases the current green light time. During these methods some points to be remember, which are the four traffic lights work in four sequences, every light having a variable sequence from 10 to 130 seconds depending on the congestion (the number of vehicles from the queue bur also the number of one's which arrive every minute).
All the four traffic lights will be controlled by this same mechanism; If there is no extension of the current green light time, the state of the traffic lights will immediately change to another side which allows the traffic from the alternate traffic flow. In Fuzzy controller structure input 1 (I/P 1) is the arrival of the vehicles and input 2 (I/P 2) is the queuing of vehicles are two parameters which are used to set the extension time for green light are fuzzified and then these parameters are given to fuzzy inference system which actually sets the time but fuzzy in nature which are actually different parameters(decrease, constant, increase) so to convert these performance parameters in crisp we use defuzzification method as shown in Fig.5. 2 which gives the actual time for what time the green When the transportation needs is large, the signal cycle should be increased. The upper bound should not be more than 130 seconds generally, because the driver on the opposite direction may not tolerate that the signal cycle is more than 130 second India. So minimum and maximum signal cycle is set for each phase. When transportation needs is small, the minimum signal cycle is run. On the other side when the transportation needs is large, the maximum signal cycle is the present cycle and traffic congestion is avoided.

CHAPTER 6

PROJECT DEVELOPMENT STAGES

1. Development of Fuzzy logicCircuit:

- The input of the fuzzy logic circuit is solar array and also supplied to the fuzzy circuit..
- Capacitors are connected to the in parallel of 470uF, 25V and a resistor is connected across it.
- The pure DC output is given as input to the Analog to Digital (ADC) pin of the microcontroller.

2. Development of Power Supply Circuit:

- The power supply circuit consist of step-up transformer, full bridge rectifier, capacitors, 7805 regulator, LED, maintained push button,etc.
- The 12/230V step-up transformer converts 12V supply voltage to 230V.
- The full bridge rectifier rectifies the output and filter removes the ripple contents and converts this AC voltage to DC voltage. The 7805 regulator maintains 5V DC output constant which is given to the microcontroller as input supply. When the maintained push button is pressed the power supply circuit gets activated.

3. Development of Battery Charging Circuit:

- We used here lead acid battery of ratings 6V, 4.2AH. Here is a lead acid battery charger circuit using IC LM317.
- The IC here provides the correct charging voltage for the battery.A battery must be charged with 1/10 its Ah value.This charging circuit is designed based on this fact.
- The charging current for the battery is controlled by T1,R1,R2 and R3. Potentiometer can be used to set the charging current.
- Since collector of T1 is connected to adjust pin of IC LM317 the voltage at the output of LM317 increases.
- When battery is fully charged charger circuit reduces the charging current and this mode is called trickle charging mode.

CHAPTER 7

HARDWARE DESIGN

7.1.1LM317 Voltage Regulator:

7.1.1.1 Features:

- Output voltage range: 1.2 to 37 V
- Output current in excess of 1.5 A
- 0.1 % line and load regulation
- Floating operation for high voltages
- current limiting, thermal shutdown, SOA control protection.

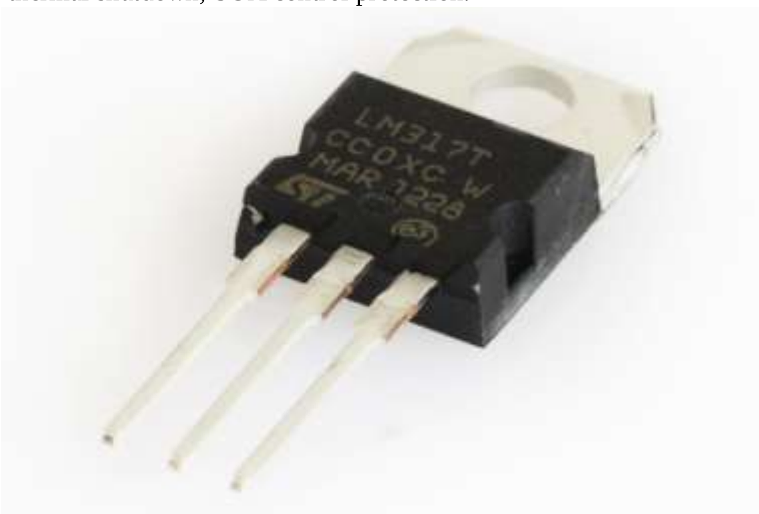


Fig 7.1 LM317T

7.1.1.2 Absolute Maximum Ratings:

Symbol	Parameter		Value	Unit
$V_I - V_O$	Input-reference differential voltage		40	V
I_O	Output current		Internally limited	V
T_{OP}	Operating junction temperature for:	LM117	- 55 to 150	°C
		LM217	- 25 to 150	
		LM317	0 to 125	
P_D	Power dissipation		Internally limited	
T_{STG}	Storage temperature		- 65 to 150	°C

Table 7.1: Absolute Maximum Ratings of LM317

7.1.1.3 Description:

The LM317T is monolithic integrated circuits intended for use as positive adjustable voltage regulators. They are designed to supply more than 1.5 A of load current with an output voltage adjustable over a 1.2 to 37 V range. The nominal output voltage is selected by means of only a resistive divider, making the device exceptionally easy to use and eliminating the stocking of many fixed regulators.

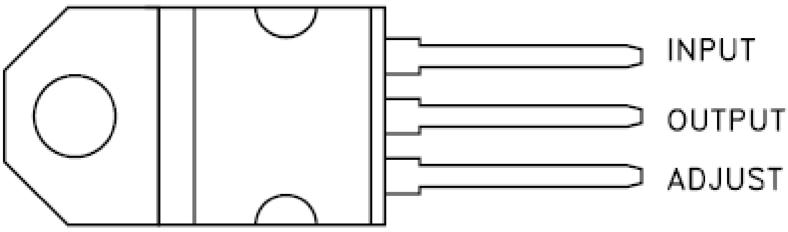


Fig 7.2 LM317T Connection Diagrams

7.1.2LM7805 Voltage Regulator:

7.1.2.1 General Description:

- The LM78XX series of three terminal regulators is available with several fixed output voltages making them useful in a wide range of applications. One of these is local on card regulation, eliminating the distribution problems associated with single point regulation.
- The voltages available allow these regulators to be used in logic systems, instrumentation and other solid state electronic equipment. Although designed primarily as fixed voltage regulators these devices can be used with external components to obtain adjustable voltages and currents.
- The LM78XX series is available in an aluminum TO-3 package which will allow over 1.0A load current if adequate heat sinking is provided. Current limiting is included to limit the peak output current to a safe value. Safe area protection for the output transistor is provided to limit internal power dissipation.

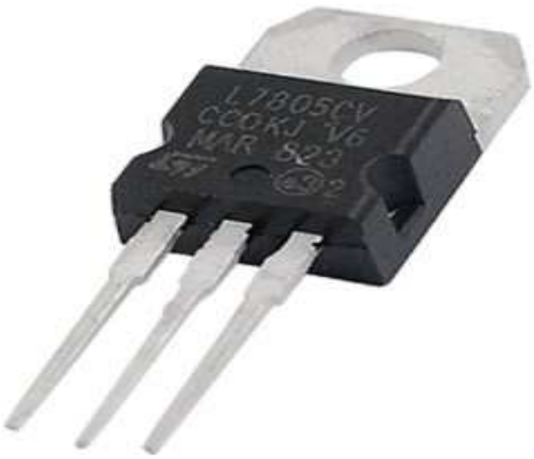


Fig 7.3 LM7805 Voltage Regulator

- If internal power dissipation becomes too high for the heat sinking provided, the thermal shutdown circuit takes over preventing the IC from overheating. Considerable effort was expanded to make the LM78XX series of regulators easy to use and minimize the number of external components.
- It is not necessary to bypass the output, although this does improve transient response. Input bypassing is needed only if the regulator is located far from the filter capacitor of the power supply.
  - The LM7805 consist of terminals. First terminal is for the input voltage of specific range. The second terminal is for the ground andthird terminal is for the output voltage of 5V.

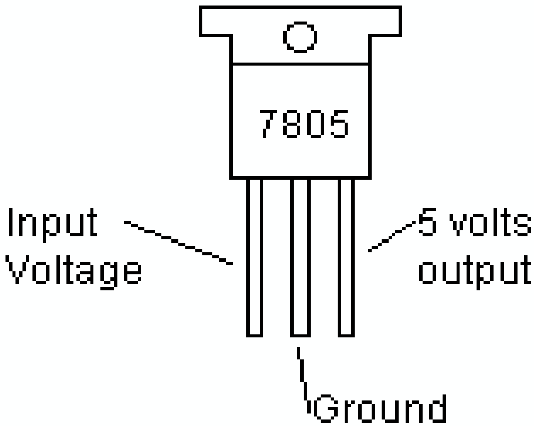


FIG 7.4 Connection Diagrams of LM7805

7.1.2.2 Features:

- Output current in excess of 1A
- Internal thermal overload protection
- No external components required
- Output transistor safe area protection
- Internal short circuit current limit
- Available in the aluminum TO-3 package

7.1.3 Resistance:

- The electrical resistance of a circuit component or device is defined as the ratio of the voltage applied to the electric current which flows through it:

$$R = \frac{V}{I}$$

- If the resistance is constant over a considerable range of voltage, then Ohm's law, I= V/R, can be used to predict the behavior of the material. Although the definition above involves DC current and voltage, the same definition holds for the AC application of resistors.
- Whether or not a material obeys Ohm's law, its resistance can be described in terms of its bulk resistivity. The resistivity, and thus the resistance, is temperature dependent. Over sizable ranges of temperature, this temperature dependence can be predicted from a temperature coefficient of resistance.

7.1.3.1Color Code for Resistors:

- Carbon-composition and carbon film resistors are too small to have the resistance value printed on their housings. Therefore, bands of color are used to represent the resistance value.
- The first and second band represents the numerical value of the resistor and the color of the third band specifies the power-of-ten multiplier. The color bands are always read from left to right starting with the side that has a band closer to the edge.
- For carbon-composition and carbon film resistors, the common tolerances are 5%, 10%, and 20%, indicating that the actual value of the resistor can vary from the nominal value by ±5%, ±10% and ±20%. If the band is gold, it specifies a 5% tolerance; silver specifies a 10% tolerance; if no band is present, the tolerance is 20%.
- Note that the color-code system for capacitors is very similar to that of resistors except there is a fifth band representing the temperature coefficient. This band is the first one closest to one end of the capacitor. The other four fall into the same order as mentioned for resistors. In this case, the second, third, and fourth bands are used to determine the capacitance. The fifth band represents the tolerance of the capacitor.

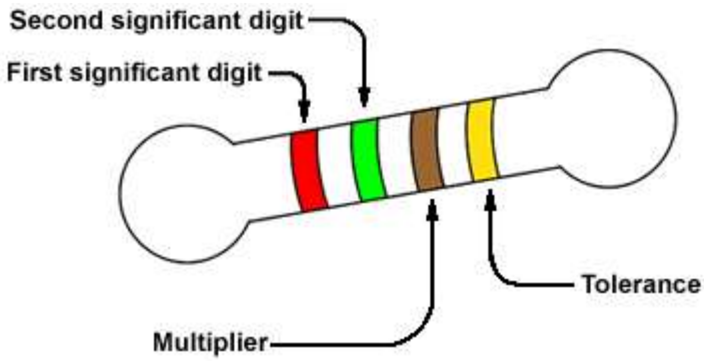
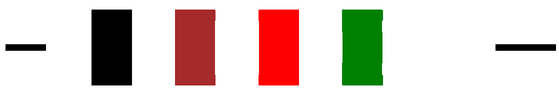


Fig 7.5 Resistor Coding

1: Black
2: Brown
3: Red
4: Green

Value: 100 ohms, 0.5%



➢ The table below shows the color code and their associated value:

Color	First-band Digit	Second-band Digit	Third-band Multiplier	Fourth-band Tolerance
Black	0	0	$10^0 = 1$	
Brown	1	1	$10^1 = 10$	1%
Red	2	2	$10^2 = 100$	2%
Orange	3	3	$10^3 = 1000$	3%
Yellow	4	4	$10^4 = 10000$	4%
Green	5	5	$10^5 = 100000$	
Blue	6	6	$10^6 = 1000000$	
Violet	7	7	$10^7 = 10000000$	
Gray	8	8	$10^8 = 100000000$	
White	9	9	$10^9 = 1000000000$	
Gold				5%
Silver				10%
None				20%

pTable 7.2:Color Code and Their Associated Value

7.1.4Battery:

Battery is an array of electrochemical cells for electricity storage, either individually linked or individually linked and housed in a single unit. An electrical battery is a combination of one or more electrochemical cells, used to convert stored chemical energy into electrical energy. Batteries may be used once and discarded, or recharged for years as in standby power applications. Miniature cells are used to power devices such as hearing aids and wristwatches; larger batteries provide standby power for telephone exchanges or computer data centers.

Lead-acid batteries arethe most common in PV systems because their initial cost is lower and because they are readily available nearly everywhere in the world. There are many different sizes and designs of lead-acid batteries, but the most important designation is that they are deep cycle batteries. Lead-acid batteries are available in both wet-cell (requires maintenance) and sealed no-maintenance versions.

Fig 7.6: Lead Acid Battery

Lead acid batteries are reliable and cost effective with an exceptionally long life. The Lead acid batteries have high reliability because of their ability to withstand overcharge, over discharge vibration and shock. The use of special sealing techniques ensures that our batteries are leak proof and non-spoilable. The batteries have exceptional charge acceptance, large electrolyte volume and low self-discharge, which make them ideal as zero- maintenance batteries.

Lead acid batteries are manufactured/ tested using CAD (Computer Aided Design). These batteries are used in Inverter & UPS Systems and have the proven ability to perform under extreme conditions. The batteries have electrolyte volume, use PE Separators and are sealed in sturdy containers, which give them excellent protection against leakage and corrosion.

7.1.4.1 Features:

- Manufactured/tested using CAD
- Electrolyte volume
- PE Separators
- Protection against leakage

7.1.5 Capacitors:

7.1.5.1 Overview:

- A capacitor consists of two electrodes or plates, each of which stores an opposite charge. These two plates are conductive and are separated by an insulator or dielectric. The charge is stored at the surface of the plates, at the boundary with the dielectric. Because each plate stores an equal but opposite charge, the total charge in the capacitor is always zero.

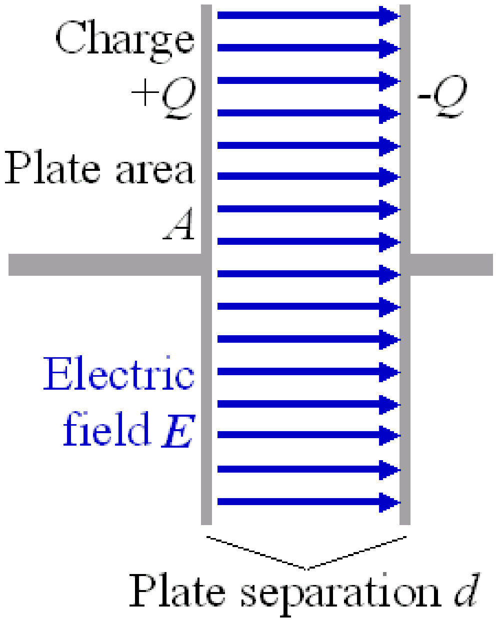


Fig 7.7: Capacitor

- When electric charge accumulates on the plates, an electric field is created in the region between the plates that is proportional to the amount of accumulated charge. This electric field creates a potential difference V=E*d between the plates of this simple parallel-plate capacitor.
- The electrons in the molecules move or rotate the molecule toward the positively charged left plate. This process creates an opposing electric field that partially annuls the field created by the plates. (The air gap is shown for clarity; in a real capacitor, the dielectric is in direct contact with the plates.)

7.1.6 Diodes:

7.1.6.1 Features:

- Diffused Junction
- High Current Capability and Low Forward Voltage Drop
- Surge Overload Rating to 30A Peak
- Low Reverse Leakage Current
- Lead Free Finish

7.1.6.2 Specification of Diode:

In full bridge rectifier we used four diodes for rectification which converts AC voltage to DC voltage. The sizes of diodes are as follow:

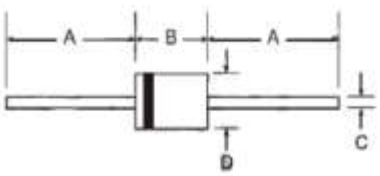


Fig. 7.8: Diode

Dim	DO-41 Plastic	
	Min	Max
A	25.40	—
B	4.06	5.21
C	0.71	0.864
D	2.00	2.72
All Dimensions in mm		

7.1.6.3Thermal Characteristics:

Symbol	Parameter	Value	Units
P_D	Power Dissipation	3	W
R_{0JA}	Thermal Resistance	50	^{0}C/W

Table 7.3: Thermal Characteristics of diode

7.1.7 Printed Circuit Board (PCB):

- Printed circuit boards (PCBs) are by far the most common method of assembling modern electronic circuits. Comprised of a sandwich of one or more insulating layers and one or more copper layers which contain the signal traces and the powers and grounds, thedesign of the layout of printed circuit boards can be as demanding as the design of theelectrical circuit.
- Most modern systems consist of multilayer boards of anywhere up to eight layers (orsometimes even more). Traditionally, components were mounted on the top layer in holeswhich extended through all layers. These are referred as through hole components. Morerecently, with the near universal adoption of surface mount components, you commonlyfind components mounted on both the top and the bottom layers.The design of the printed circuit board can be as important as the circuit design to the overall performance of the final system.
- PCB effects that are harmful to precision circuit performance include leakage resistances, IR voltage drops in trace foils, vias, and ground planes, the influence of stray capacitance, and dielectric absorption (DA). In addition, the tendency of PCBs to absorb atmospheric moisture (hygroscopicity) means that changes in humidity often cause the contributions of some parasitic effects to vary from day to day.
- Here we used the PCB for mounting the power supply unit, microcontroller, LCD module, battery charging circuit, etc.
- In general, PCB effects can be divided into two broad categories, those that mostnoticeably affect the static or dc operation of the circuit, and those that most noticeablyaffect dynamic or ac circuit operation, especially at high frequencies.

CHAPTER 8

BLOCK DIAGRAM DESCRIPTION

8.1 Design of Proposed System:

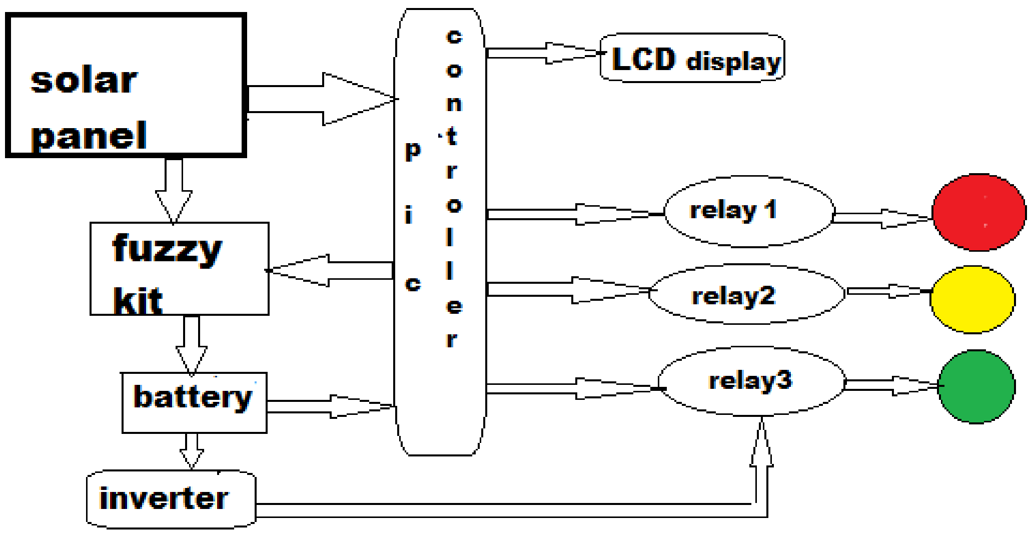


Fig 8.1: Block Diagram of Maximum Power Point Tracking using Fuzzy Logic Control

8.1.1 Fuzzy Circui

1)Fuzzification: The FP requires that each variable used in describing the control rules has to be expressed in terms of fuzzy set notations with linguistic labels. Fig. 7(a) shows the membership functions of the input variable and output variable in which each membership function is assigned with five fuzzy sets, including positive big (PB), positive small (PS), zero (ZE), negative small (NS), and negative big (NB).With these membership functions, manipulation efforts to derive the control output can be reduced significantly, while the steady-state error is kept small enough. As an example, when only the combinations of (ZE, ZE) (ZE, PS), (NS, ZE), and (NS, PS) need to be considered in determining output.

2)*Defuzzification:*The last step to complete the fuzzy control algorithm is to calculate the crisp output of the FP with theprocess of defuzzification. Typically, either the mean of maximum (MOM) or center of area (COA) is used to determine this crisp output.

8.1.2 Power Supply Circuit:

- The power supply circuit consist of step-down transformer, full bridge rectifier, capacitors, 7805 regulator, LED, maintained push button,etc.
- The 230/5V step-down transformer converts 230V supply voltage to 5V.
- The full bridge rectifier rectifies the output and filter removes the ripple contents and converts this AC voltage to DC voltage. The 7805 regulator maintains 5V DC output constant which is given to the microcontroller as input supply. When the maintained push button is pressed the power supply circuit gets activated.

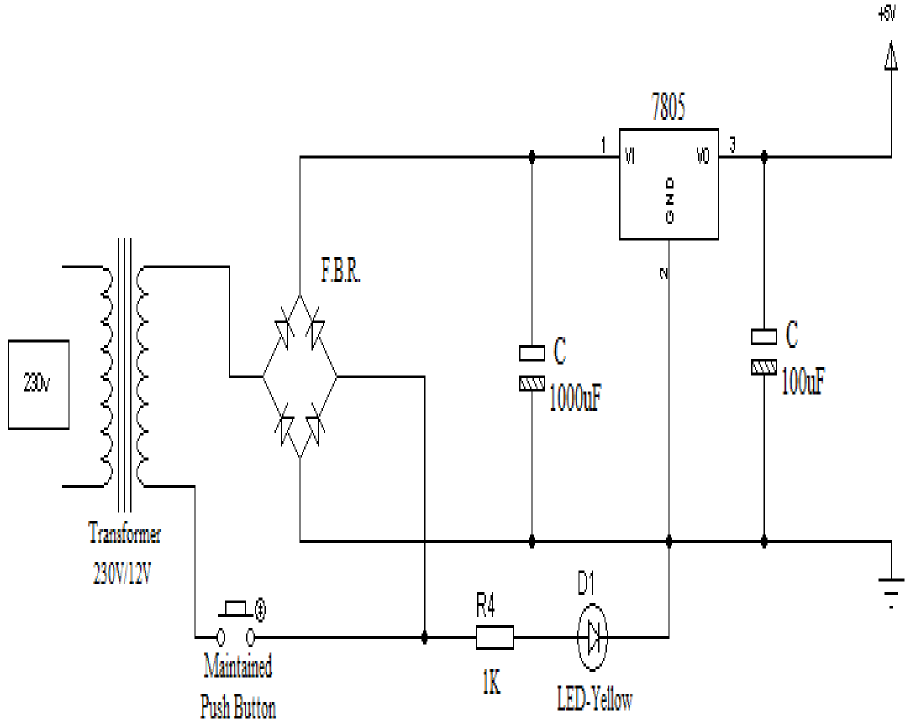


Fig 8.2: Design of Power Supply Circuit

8.1.3Microcontroller:

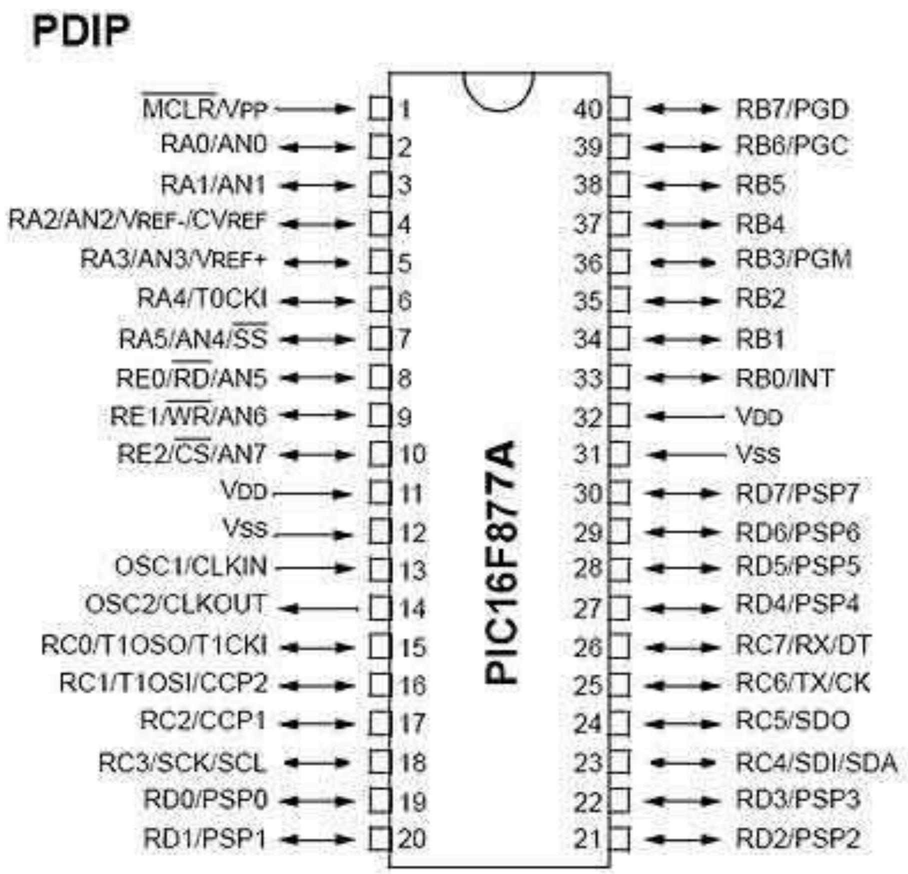


Fig 8.3: Pin Diagram of Microcontroller PIC 16F877A

8.1.4 LCDModule 1602A-1:

8.1.4.1 Structure:

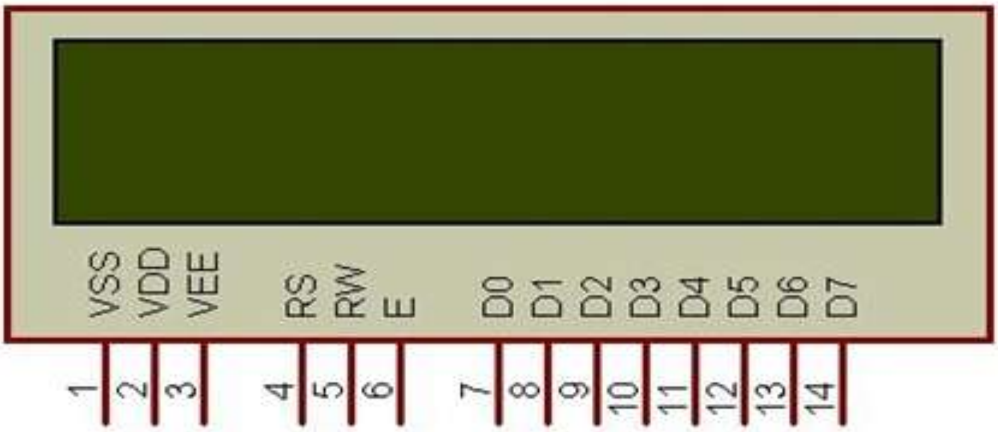


Fig 8.4: Pin Diagram of LCD Module 1602A-1

8.1.4.2 Features:

- Display Mode: STN, BLUB
- Display Format: 16 Character x 2 Line
- Viewing Direction: Front
- Input Data: 4-Bits or 8-Bits interface available
- Display Font: 5 x 8 Dots
- Power Supply: Single Power Supply (5V±10%)
- Driving Scheme: 1/16Duty,1/5Bias
- Backlight(side)

8.1.5 Design of Battery charging circuit:

- We used here lead acid battery of ratings 6V, 4.2AH. Here is a lead acid battery charger circuit using IC LM317.
- The IC here provides the correct charging voltage for the battery.A battery must be charged with 1/10 its Ah value.This charging circuit is designed based on this fact.
- The charging current for the battery is controlled by T1,R1,R2 and R3. Potentiometer can be used to set the charging current.
- Since collector of T1 is connected to adjust pin of IC LM317 the voltage at the output of LM317 increases.
- When battery is fully charged charger circuit reduces the charging current and this mode is called trickle charging mode.

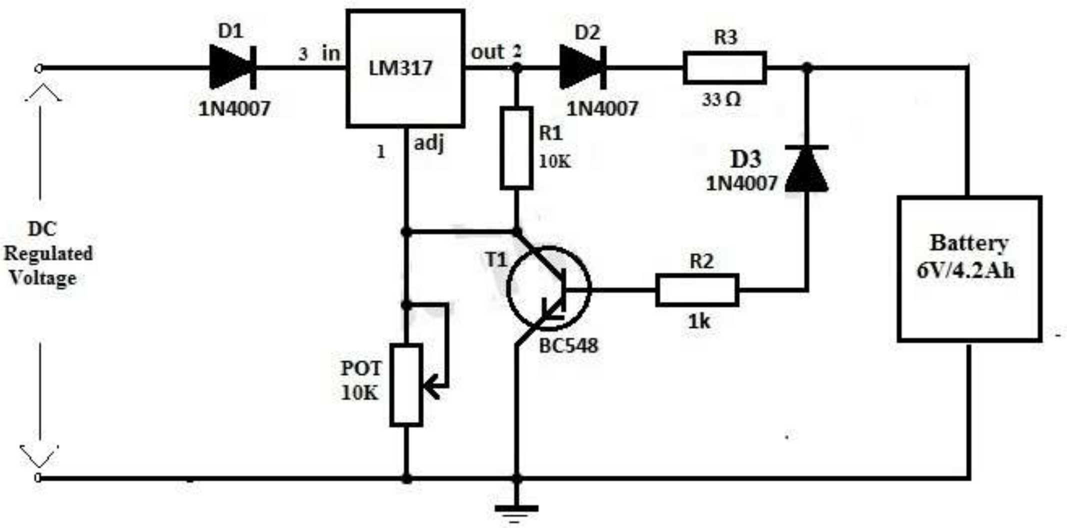


Fig 8.5: Lead Acid Battery Charging Circuit

Notes:

- Connect a battery to the circuit in series with a ammeter. Now adjust R5 to get the required charging current. Charging current = (1/10)*Ah value of battery.
- Input to the IC must be at least 18V for getting proper charging voltage at the output. Take a look at the data sheet of LM 317 for better understanding.Fix LM317 with a heat sink.

CHAPTER 9

HARDWARE DESIGN CIRCUITRY

1. Power Supply Circuit:

- The power supply circuit consist of step-down transformer, full bridge rectifier, capacitors, 7805 regulator, LED, maintained push button,etc.The 230/12V step-down transformer converts 230V supply voltage to 12V.
- The full bridge rectifier converts this AC voltage to DC voltage.The 7805 regulator maintains 5V DC output constant which is given to the microcontroller as input supply.When the maintained push button is pressed the power supply circuit gets activated.

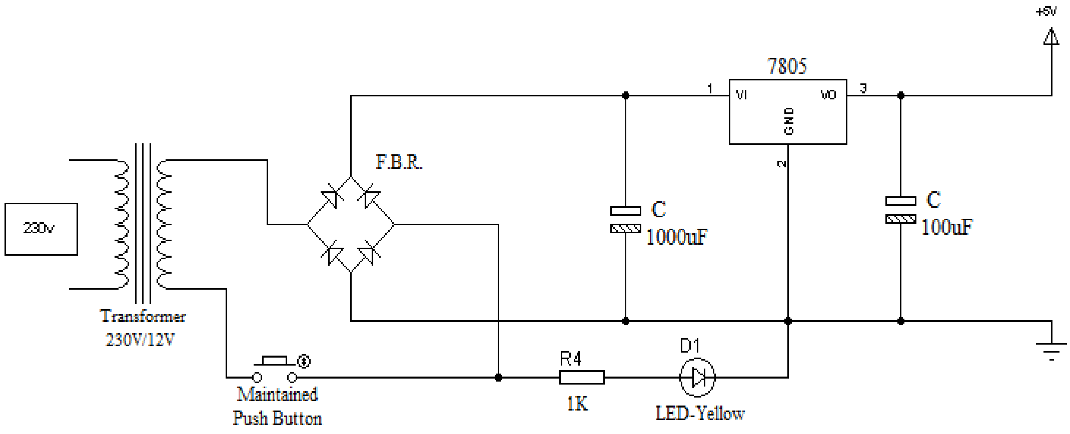


Fig 9.1: Design of Power Supply Circuit

2. Design of Battery charging circuit:

- We used here lead acid battery of ratings 6V, 4.2AH. Here is a lead acid battery1charger circuit using IC LM317.
- The IC here provides the correct charging voltage for the battery.A battery must be charged with 1/10 its Ah value.This charging circuit is designed based on this fact.
- The charging current for the battery is controlled by T1,R1,R2 and R3. Potentiometer can be used to set the charging current.
- Since collector of T1 is connected to adjust pin of IC LM317 the voltage at the output of LM317 increases.
- When battery is fully charged charger circuit reduces the charging current and this mode is called trickle charging mode.

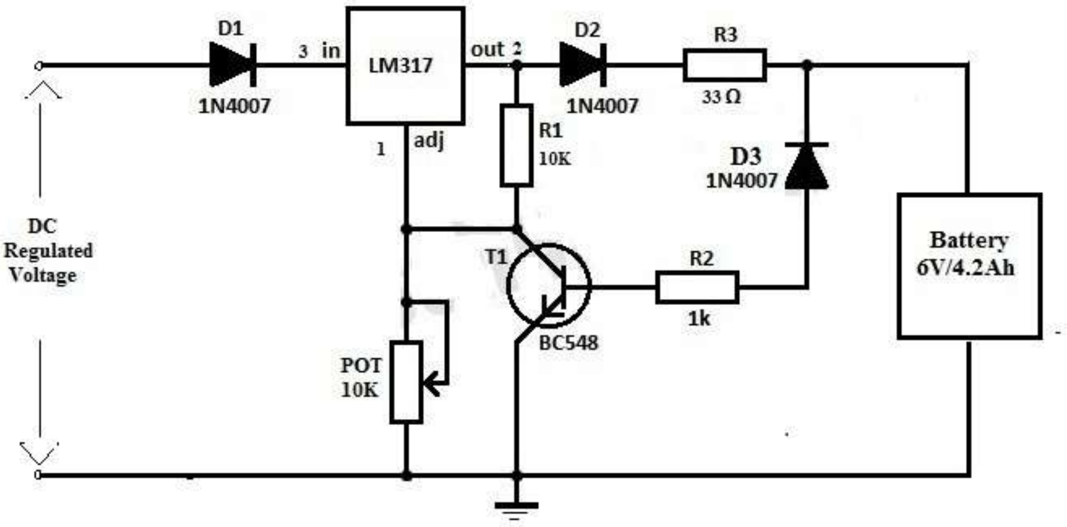


Fig 9.2: Lead Acid Battery Charging Circuit

Notes:

- Connect a battery to the circuit in series with a ammeter. Now adjust R5 to get the required charging current. Charging current = (1/10)*Ah value of battery.
- Input to the IC must be at least 18V for getting proper charging voltage at the output. Take a look at the data sheet of LM 317 for better understanding.
- Fix LM317 with a heat sink.

CHAPTER 10

ADVANTAGES & DISADVANTAGE

ADVANTAGES:

- Less settling time.
- It does not create pollution.
- It requires only initial cost ofimplementation and maintenance.
- Maintenance is easy.
- Works on simple mechanism.
- No need of fuel input.
- Battery is used to store the generated power.
- Better accuracy.

DISADVANTAGES:

- This idea is only applicable to busy traffic.
- Design complicated.
- Initial cost of this arrangement is high.

CHAPTER 11

APPLICATIONS

- Self- powered street lamps.
- Self- powered traffic signals.
- Shopping mall.
- Colleges.
- Cinema theatres.
- Shopping complex.
- Railway stations.
- Footpaths

CHAPTER 12

CONCLUSION AND FUTURE SCOPE

12.1 CONCLUSION:

The proposed work "Application of Maximum Power Point Tracker using Fuzzy Logic Control for Solar Powered Traffic Lights" has been successfully implementable which is the best economical, affordable energy solution to common people. This can be used for many applications in rural areas where power availability is less or totally absent. India is a developing country where energy management is a big challenge for huge population. And this can be implemented with little advancements which reduce the total cost and also reliability is increased.

"Energy canneither be created nor be destroyed it can be transferred from one form to another", this statement of Albert Einstein is true. Use of fuzzy logic control for solar traffic lights is eco-friendlycauses no pollution. It is an inexpensive way of generatingelectricity and is easy to install. In future this method willbe a promising method for generating eco-friendlyelectricity. We also contribute this method at commonplaces like home entrance gates, parking area, bus standsetc. This method will exploits different areas of electricitygeneration.

12.2 FUTURE SCOPE:

There is a bright future of the "Application of Maximum Power Point Tracker using Fuzzy Logic Control for Solar Powered Traffic Lights" from Fuzzy controller and then store it for later various uses. Theexisting sources of fossil fuels are going to lastfor another hundred years.As we are very much aware of the fact that the cost of fossil fuels that includes coal,petrol, diesel and others are increasing at rapidrate in the market. Therefore, it's a time for us tothink in a different direction.

A. ROADS & HIGHWAYS:

Traffic at the road and highways varies throughout the day, with more traffic during the day than at the night,and sometimes 24Hrs a day. The total pressure exerted by moving vehicles on the road surface can be calculatedby considering the average number of vehicles passing through certain point, for a certain time period. Recentexperiments are carried out by Innowattech in Israel; consist of putting PEG 6cm under the road level and at adistance of 30cm apart. From these trials, it has been observed that a vehicle weighing at around 5 tons cangenerate 2000V, and a 1Km cluster of such generator can generate 400Kwh energy. If 600 such vehicles areallowed to go through the road for an hour. it can power up to 600-800 homes.

B. FOOTPATHS:

Footpath is the most common place where piezoelectric material can be implemented to generate small amountof energy due to motion of the people. some similar places are shopping malls, dance floor, subway etc. theconcept focuses on the large number of people moving in dense areas to step on tiles embedded in the floorwhich would use the fuzzy logic control to generate electricity that could be saved and used. About 3W to 6W per step can be converted. If one consider the average energy generated per rush hour then it is possible touse that energy for powering the low power electronic devices such as display screens.

C.RAILROAD TRACKS:

The railroad tracks are the important place which is responsible for generation of huge energy as the hugeamount of pressure is exerted by trains on the railroad tracks. Here the pads of piezoelectric materials are placedat juncture where wheel makes the contact with tracks and it receives maximum pressure like used in airportrunways, the pads are arranged in such order that a large force is tolerated and greater amount of charge isstored.

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