Bangladesh University of Engineering and Technology

Department of Electrical and Electronic Engineering

Project Report

Project Title: Battery Voltage Indicator

Course No.: EEE 202

Course Title: Electronic Circuits I Laboratory

Level: 2 **Term:** 1

Section: C1

Group No.: 05

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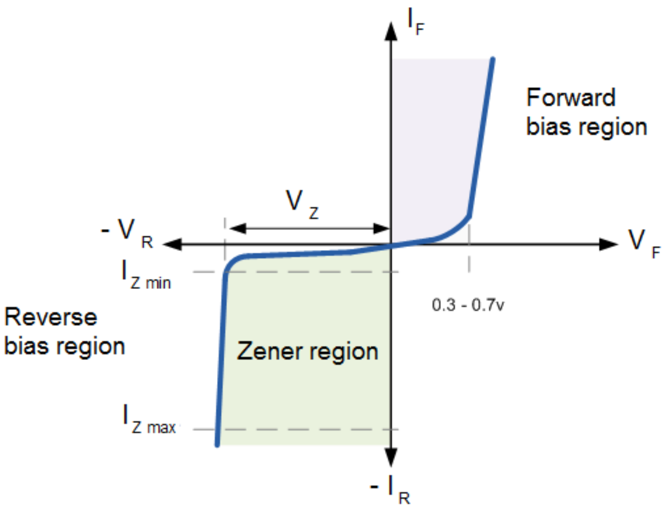
Introduction: A voltage level indicator is a circuit which shows a response if the voltage input is greater than a certain threshold value. If the voltage is greater than a certain level then an output such as an LED lights up. As low voltage or overcharging shorten the life in batteries, this indicator circuit lets the user know the status of the battery of a device. We can use this voltage monitor circuit in car batteries, UPS systems, mining, battery suppliers and service groups. Energy efficiency, long lifetime, excellent color rendering and controllable facilities make the voltage level indicator more convenient.

Theory: Zener diode is a type of p-n junction (diode) that operates in the breakdown region. Zener diodes allow the current to flow in a reverse bias situation.



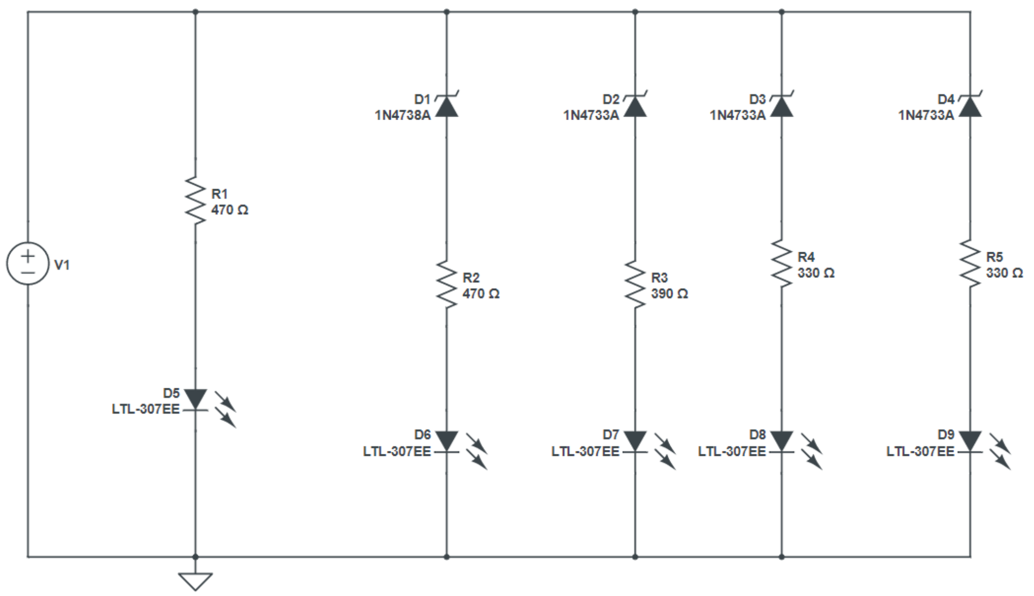
Zener diodes can operate as a voltage regulator. Every zener diode has a specific voltage (V_Z) of its own. As long as the supplied voltage cannot provide a voltage greater than that specific voltage, zener diodes will operate as cut-off. As soon as the supply crosses that threshold limit, the zener will turn ON and current will flow through the cathode of the zener, that is, in reverse bias direction.

Light-emitting diode (LED) is a special type of diode that emits light when current flows through it. Electrons in the semiconductor recombine with holes, releasing energy in the form of photons. The color of the light (corresponding to the energy of the photons) is determined by the energy required for electrons to cross the band gap of the semiconductor.

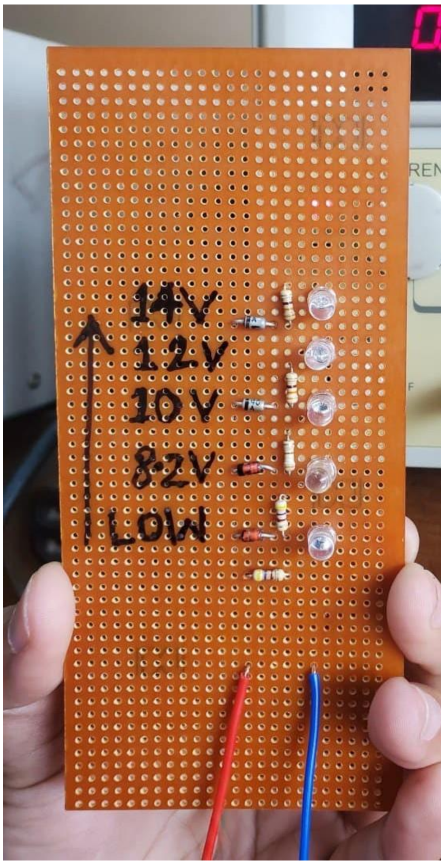
Components and Costing:

Equipment	Quantity	Cost
Variable DC supply	1 unit	N/A
Zener Diode (8.2V, 9.1V, 10V, 12V)	4 pieces	BDT 20/-
LED	5 pieces	BDT 15/-
Resistors (330Ω, 390 Ω, 470 Ω)	5 pieces	BDT 3/-
PCB board	1 piece	BDT 25/-
Connecting wires	As much required	BDT 5/-
Total Cost		BDT 68/-

Circuit Setup:

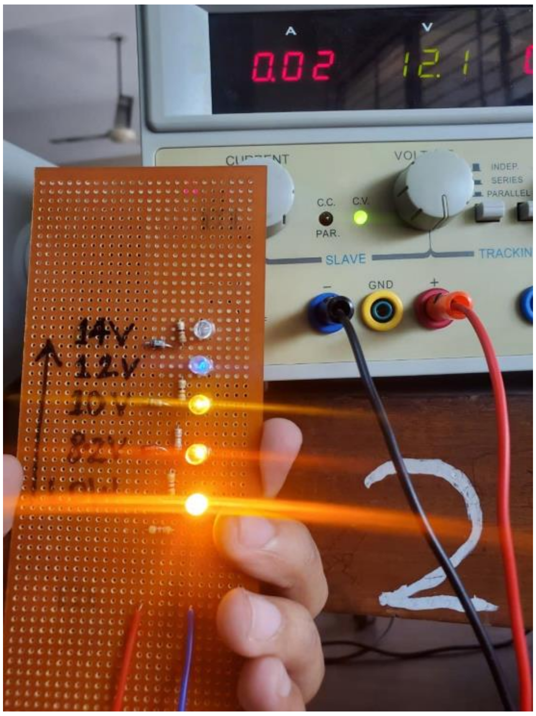


The circuit is implanted as below:



Work Flow: We are considering a variable DC voltage supply instead of a battery to better understand how the circuit will feature at different voltage levels of battery. We have connected five parallel branches with the voltage source each branch having a zener diode, a resistor and an LED except one branch which does not have any zener diode. When we start supplying voltage starting at a very small voltage (1.9 V), the LED of the branch devoid of zener diode lights up, but all other LEDs remain OFF. Then we start increasing the voltage supply. When the voltage supply reaches (8.4 V), the LED in the second branch of turns ON, others remain OFF. We continue to increase the voltage supply and the LEDs turn ON at 10.5 V in the third branch, at 12.2 V in the fourth branch and at 14 V in the fourth branch. All five LEDs light up with full glow at the voltage above 18 V.

Description: As we know zener diodes operate in the cut-off mode below zener voltage (V_z), the zener diodes we used in the circuit keep their branch open until the supply reaches to V_z , ultimately, corresponding LEDs remain turned OFF. That's why only the LED of the branch that does not have a zener diode turns ON as soon as we apply voltage. The voltage supply when it crosses the threshold limit of V_z causes the corresponding zener to turn ON and let the current to flow through the LED of that branch causing the LED to light up. Also, the glow of LEDs increases with the level of voltage supply since the rest of the supplied voltage other than V_z is dropped at the resistor and LED. We used a resistor to decrease the current flow through the LED, otherwise the LED may get defected.



In this picture, three LEDs are ON with full glow and another one is dim. It means, supply voltage is about 65% of the maximum capacity (65% of 18 V = 11.7 V). In this fashion, we get to know how much voltage we are receiving from the battery.

Discussion: This circuit of battery voltage indicator is quite easy to build up and can be applied to all kinds of DC voltage sources. Here, we used the zener of maximum 12V, but we can use a zener of higher voltage according to necessity and get the idea of the voltage level we are receiving from the supply. Also, by increasing the number of branch and zener diodes of lower zener voltage difference among branches, we can increase the precision of the voltage level. The circuit can be used instead of voltmeter in the DC circuits where high precision is not mandatory. A voltmeter may cost around 250/- BDT whereas this circuit costs only 65/- BDT which decreases the cost to some extent. So, our project is cost effective, durable, energy efficient and easily accessible by all people.