Low Cost, Portable and Extendable Power Bank

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Abstract— In the following paper, a new innovative design in which simple and effective components are utilized in a circuit that enhances the capabilities of the portable power banks available in the market is discussed. Components such as DC voltage regulators and USB cable have been used to create a circuit that has more utility compared to products available in the market. It offers additional advantages and simpler approach to these portable power banks.

Index Terms— Battery, Extendable, IC 7805, Portable power bank, Voltage regulator

1 Introduction

THE concept of being able to charge mobile phones on the go has been a pleasant help to almost everyone in the present times. Ever since the increasing abilities and the decreasing cost of smart phones, their utility has increased but their power consumption is high. The present day smart phones have a very large storage capacity and the parallelism with respect to apps associated with them is increasing rapidly. Running many applications at a time causes the phones to drain out quickly. Although increased charge consumption for a host of parallel and quick applications is a good bargain, this also calls for the phone being charged frequently. As power supply sockets are not available all the time, power banks come in handy.

The power banks available in the market do not have the ability to extend beyond a fixed number of ports. The design is rigid to a high extent. The cost of these power banks is comparatively very high as well. Other than that, using the present day power banks, we cannot do much, other than charging phones. Say, we need to use some other USB device like a USB light or music player with USB connection. They cannot be done easily with them. In order to power those devices, we will have to do so separately. The following article describes another innovative design to construct a power bank that reduces these problems to a great extent.

The major components used in the working of the power bank design are the USB cable, IC 7805 and the Battery.

2 Major Components Used

2.1 USB Cable

The USB cable is a versatile product and that is being used here to deliver the current and voltage to the phones and other devices used. The internal structure of USB [1] is as explained:

2.1.1 Vcc (DC)

This is the most important part used in the making of the power bank. The USB cable works on specifically and only 5V. Any voltage greater than this will damage the device used and any voltage lesser than this might not power it to a sufficient extent. This property of the USB cable to handle 5V is highly advantageous, as, most of the phones charge within 5V. Although the current ratings will vary, that can be adjusted by using the battery.

2.1.2 Ground

This connects to the ground of the circuit.

2.1.3 D+ and D-

These are data wires. These are utilized when the USB cable is used to transfer data from one device to the other. They do not play any role in charging of the phone. But, many of the present day phones will not work if the D+ and D- pins are not given any value. Hence, they are given a dummy value using the resistors and the phone is "tricked" into believing that it is connected to an external device and hence charges.

Each one of the wires is connected to an internal pin inside the USB.

2.2 IC 7805

This is a voltage regulator IC. This regulates the input DC voltage to 5V DC. This is the main voltage conversion necessary to power the phone. Most of the phones are charged via the USB cable. The USB cable, as discussed earlier can handle a maximum of 5V. This will be got by the usage of IC 7805 [2]. In this IC, only the voltage will be regulated. The current however, will remain almost the same, with a very negligible drop. Most of the adapters used will give 16 – 24V DC. This needs to be fed to the input of the IC and the output will be regulated to 5V (Fig 1) "[3], [4], [5]" which can be used to charge the phone.

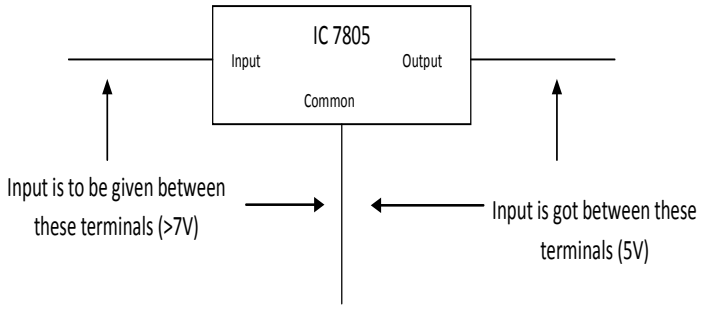

Fig. 1. Connection of IC 7805 in the circuit

2.3 Battery

The battery used in this circuit must be rechargeable with a high number of charge and discharge cycles. It must also give a constant current and voltage of desired value over a long period of time. Depending on the number of ports, different batteries with different current outputs and voltages can be used.

3 Circuit and Circuit diagram

The circuit is constructed as shown in the (Fig 2). Since different phones have different charging pins, the USB cable (female end) is used to adjust to all phones and other devices. The phones have to be connected to their USB extensions and used.

The various LEDs indicate that part of the circuit that is on. The resistors are used to limit the flow of current into the LEDs so that they will not burn. The switches are used to activate that part of the circuit.

The external leads go to the external charger. That adapter can be of any type and must give a voltage greater than 7V (considering two sub-circuits are added) for it to work.

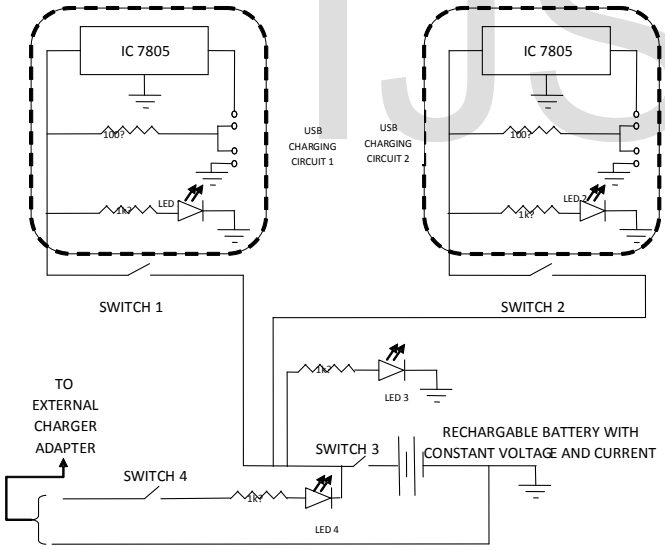

Fig. 1. Circuit diagram

4 Working of the circuit

When the circuit must be switched on, switch 3 must be closed. This glows LED 3 indicating the working of the circuit. Now, depending upon which port we need to charge from, switch 1 or switch 2 needs to be closed. Since they are connected in parallel, both can be switched on at the same time if needed. Depending on which port is selected, the indicator LEDs will glow. In order to switch off the necessary port, again, switch 1 or 2 need to be opened.

When the power bank itself needs to be charged, the output of the LEDs will be less bright, indicating to be put onto charge. Then, any kind of adapter can be connected to the rechargeable battery and switch 4 has to be closed (depending on which adapter is used while creating the hardware). This is also indicated by an LED. Hence, this is highly effective, yet, very easy to use.

5 Equations

The current drop across each LED – resistor combination is 100mA. The output current needed is 700mA to 1A. Hence, we have to choose the battery to give a compensated current i.e. compensating all the losses in LED – resistor combinations. Considering the case of only two sub-circuits as shown,

Current = Output current needed + [(number of LED and resistor combinations)*100mA]
= 800mA + (3*100mA)
= 800mA + 300mA
= 1100mA
= 1.1A

Hence, the current by the voltage source should be 1.1A.

In a similar way, depending upon the number of ports, and hence in turn the number of LED-resistor combinations, the battery can be selected.

6 Advantages of this Design

6.1 Extendable

In this design, all one has to do to get additional ports is to connect another sub-circuit shown in the circuit diagram, between Vcc and Ground in the similar fashion as shown with two sub-circuits. In this way as many as 5 or 6 ports can be connected if needed. Depending on the number of ports that can be added the hardware design must have slots and the battery must be varied. [a maximum of only 24 V, 900 mA is needed]

6.2 Cost Effective

The overall cost of this circuit is very less and cost of production would also be very less.

6.3 Small in Size

This circuit is very compact, can easily be made and is very small in size and less in weight.

6.4 Simple Design

The design is very simple and not at all complex to use.

6.5 Device Compatibility

Not only mobile phones, but any other devices such as LED lamps, or night lamps to aid in typing for keyboards without

backlight, or USB vacuums to clean keyboards, or USB connectable fans or any other gadget that works with USB cable can be used here. As the USB female is connected, any of these devices will also work on this device.

6.6 Low Power Consumption

The power consumed is very low as compared to other charger circuits, as, DC power is used.

6.7 Flexible Charging of the Bank

Usually a specific charger is needed to charge the power bank. But, in this case, any charger adapter can be used to charge the battery. Be it any old unused charger available in our homes or, the phone charger adapter itself, any of these can be used, with a very little change in the hardware of the device.

7 Conclusion

This design will help in reducing overall cost of the device and also help people by relaxing the need of phone chargers and separate chargers for USB devices. It will definitely be helpful over the days, as, the speed and advancements in phones are at an exponential rate which decreases the charge of phones greatly. Hence, this calls for easier solutions to phone charging. This will also prove helpful to the newly emerging wearable electronic gadgets as, the size and power rating is ideal for that usage as well.

References

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