

RFID Reader and coin based mobile charger using solar panel

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ABSTRACT

The mobile phone market is a vast industry, and has spread into rural areas, public places and railways etc. as an essential means of communication. While the urban people use more complex mobiles with good power batteries lasting for several days, the rural people buy the mobile phones that require charging instantly. So many times battery becomes dead in the middle of conversation particularly at inconvenient times when access to a standard charger is not possible, so we use this RFID and coin-based mobile battery chargers are made to solve this huge problem. The user has to plug the mobile phone into one of the adapters and insert a coin or RFID card then phone will then be given a power for charging. The capacity of mobile charging is developed with the help of fixed values. It is, of course, possible to continue charging the mobile by inserting more coins or RFID card. The RFID and coin-based mobile charger designed in this paper is providing a unique service to the rural public area. Where grid power is not available for partial/full daytime so we use coin based mobile charger using radio frequency identification and a source of revenue is provided. The RFID and coin-based mobile battery charger can be quickly and easily installed outside any business purpose. This compact product is designed to cater for the growing number of rural mobile users worldwide. A suitable microcontroller is programmed for all the controlling applications. The source for charging is obtained from solar energy.

I. INTRODUCTION

The growth of mobile phone market is phenomenal in recent years and the need for charging the mobile battery is required anytime and anywhere. In many developing countries the grid power is not available for few hours to several hours on daily basis especially in semi urban and rural areas where the mobile phones are the essential communication device. While the urban population use more sophisticated mobiles with good power batteries lasting for few days, the rural population buy the pre owned mobile phones that require charging frequently even two or three times a day.

Most of the times cell phone battery becomes low or dead at inopportune times when standard charger is not accessible. As we know that, in most of the building nations the electric power supply is not accessible for many hours. These days mobile phones are the vital communication gadget. The RFID and coin-based mobile battery charger can solve this problem. In cases where there is unpredictable electric power supply and solar energy is available, this secured mobile phone charger is very useful. For charging the phone, the user needs to insert the coin or swipe the card and connect the phone to one of the charger pins for charging battery for a specific period of time.

The solar power application to battery charging has been studied in the past. Solar chargers convert light energy into DC current for a range of voltage that can be used for charging the battery. They are generally portable but can also be firmly mounted. In this design of RFID card and coin based mobile charger a fixed solar panel of size is used to charge the battery upto maximum of 2.0 amp in bright sun light. In this paper, the design and development of a RFID card and coin based universal mobile battery charger based on solar power is discussed and it is primarily designed for both rural and urban areas where the mobiles are the basic needs for communication and the main power is not available all the time.

The RFID reader and coin based mobile battery charger developed in this work provides a unique service to the rural and urban areas. The RFID Reader and the coin based mobile charger can be quickly and easily be installed outside any business premises. The mobile phone market is a vast industry, and has spread into rural areas as an essential means of communication. While the urban population use more sophisticated mobiles with good power batteries lasting for several days, the rural population buy the pre owned mobile phones that require charging frequently.

Many a times battery becomes flat in the middle of conversation particularly at inconvenient times when access to a standard charger isn't possible. The RFID based and coin based mobile chargers are designed to solve this problem. The user has to plug the mobile phone into one of the

adapters and insert a coin or swipe the card; the phone will then give a micro-pulse for charging. The charging capacity of the mobile is designed with the help of pre defined values. The microcontroller used is Arduino Uno R3. Driver circuit consists of relay, which acts as a switch to turn on and turn off. The different mobile charger requires different size pins.

II. PRIOR ART SEARCH

In recent times, there have been lots of advancements in technologies being developed for charging the mobile phones. In most cases solar energy is used for charging the mobile phones. Solar energy converts light energy into DC current that can be used for charging the mobile phones.

In M.S.Varadarajan "Coin Based Universal Mobile Battery Charger". 2012 IOSR Journal of Engineering (IOSRJEN) A fixed solar panel of size 635x550x38mm, 37WP is used to charge the mobile phones up to maximum 2.0 amp[1]. The target of this venture is embeddings the coin utilizing charge for your cell phone in broad daylight places. This venture is extremely valuable to individuals who are largely utilizing cell phone without charging condition in broad daylight places. In this undertaking, who are for the most part utilizing cell phones in outside of home are office without charging condition. The coin based cell phone charger is exceptionally valuable to that individual for utilizing coin to charge for that portable. The IR (infrared) transmitter is utilized to transmit IR motion in the transmitter side. The IR recipient is utilized to get the IR motion in the beneficiary side. Between the IR transmitter and beneficiary, embed a coin to change the extremity of heartbeat in SCU input. The 555 IC is go about as a clock to produces high heartbeat for specific day and age. Driver circuit is utilized for give the adequate information voltage of hand-off. The hand-off will on to actuate the 230v charger, we will utilize charger to charge for our cell phone.

The Infra-Red Sensor is another way to charge mobile phones. In .K S.B.Sridevi, A. Sai Suneel. Nalini, "International Journal of Innovative Research in Science, Engineering and Technology", The Infra-Red transmitter transmits IR signals in the transmitter side and receives the IR signal in the IR receiver side. Based on the signal between the IR transmitter and receiver, insert a coin to change the polarity of pulse in SCU input. The SCU converts low pulse to high pulse and fed as input into driver circuit and driver circuit provides sufficient input voltage of relay. This will be used for charging the mobile phones.

The microcontroller performs the countdown time period for 3 minutes, with LCD display shows the actual time left. During the time period a relay was out latch and finishing time in progress [2].

In Daniel A. Pritchard, "Sun Tracking by Peak Power Positioning for Photovoltaic Concentrator Arrays", control systems magazine, 2011. [3], it experimentally investigated the working of Coin based mobile charger with solar tracking system by peak power positioning

[3]. In this experiment the operational amplifiers can operate the ON/OFF and directional functions of the structured five motors. These motors rotate in two axes. The tracker's sun sensor is mounted. From the output of this device it will check the outputs are all equal, then the collector structure is nearly perpendicular to the sun and tracking error is reduced.

According to Robert Weissbach, Pennsylvania State University-Erie AC 2007-1213: "A microcontroller-based solar panel tracking system" [4], the renewable energy is the main source of one of the renewable energy sources is solar energy. This energy generated more energy because the solar panel is to maintain a perpendicular to the sun's rays [4]. By using an IoT, the mobile phone can be charged. In this scenario, it monitors the solar energy as well as battery power when the coin is inserted in the coin box. Once the coin is detected, it sends signal to the Raspberry pi and it trigger the relay and the LCD display show the countdown time. The Raspberry pi can collaborate with the outside world. The relay generates the voltage and fed as input to mobile phones.

According to Kalyani U. Chafle, B. M. Faruk, R. S. Shrivastava, N.S.Sawarkar Research Scholar, Yavatmal, INDIA "Coin based mobile charger on solar energy" To give control supply routinely, here they have utilized sun oriented board. This sunlight based board assimilated the light from the sun then this will create the light vitality and this sun powered charger change over light vitality into DC current for a scope of voltage that can be utilized for charging the 12v rechargeable battery daylight to successfully assemble sun based vitality. In this way, a couple of overcast, stormy days can noticeably affect the vitality framework.

According to US patent, High efficiency direct coupled switched mode power supply: The power supply can also include crowbar circuit protecting it against damage by clamping the output to ground if it exceeds a particular voltage. Sun based Vitality Stockpiling Is Costly. Sunlight based vitality must be utilized immediately, or it can be

put away in huge batteries. These batteries, utilized as a part of off-the-framework galaxies, can be charged amid the day with the goal that the vitality is utilized during the evening. This is a decent answer for utilizing sun oriented vitality throughout the day yet it is likewise very costly.

III. SYSTEM REQUIREMENTS

HARDWARE REQUIREMENTS

- Regulated Power Supply Board

Regulated Power Supply Board

BLOCK DIAGRAM

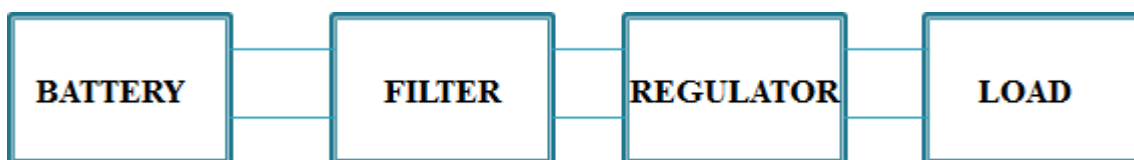


Fig 3.1.1 (a): Block Diagram

SCHEMATIC

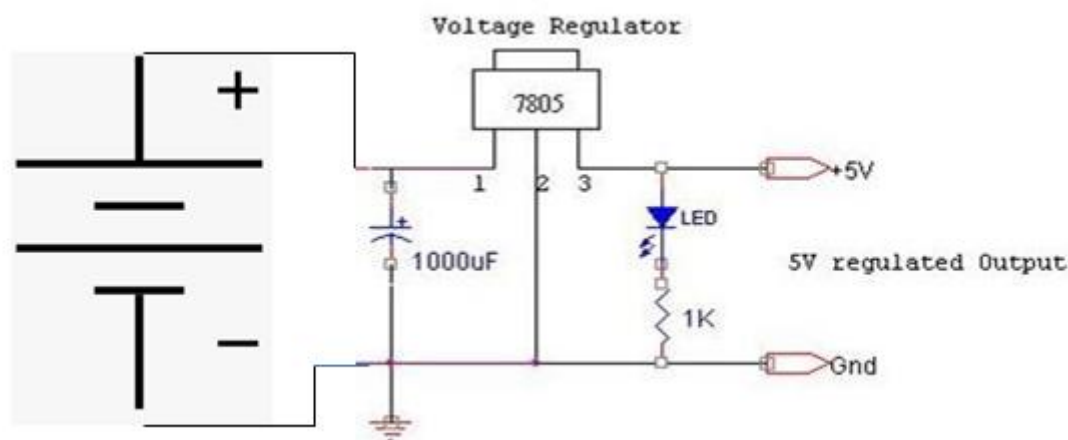


Fig 3.1.1 (b): Schematic

DC FILTERATION

The rectified voltage from the rectifier is a pulsating dc voltage having very high ripple content. But this is not we want, we want a pure ripple free dc waveform. Hence a filter is used. Different types of filters are used such as capacitor filter, LC filter, Choke input filter, π type filter.

REGULATION

This is the last block in a regulated DC power supply. The output voltage or current will change or fluctuate when there is change in the input from ac mains or due to change in load current at the output of the regulated power supply

- RFID Reader 125KHz TTL
- Keypad Membrane 4*4
- LCD 16*2 with driver PCB
- Relay SPDT Board with driver
- Solar Panel
- Battery 12V,5A , Lead-Acid Rechargeable
- Coin Vending Machine
- Junction Box

or due to other factors like temperature changes. This problem can be eliminated by using a regulator. A regulator will maintain the output constant even when changes at the input or any other changes occur. Transistor series regulator, Fixed and variable IC regulators or a zener diode operated in the zener region can be used depending on their applications. IC's like 78XX and 79XX are used to obtained fixed values of voltages at the output. With IC's like LM 317 and 723 etc we can adjust the output voltage to a required constant value.

RFID Reader

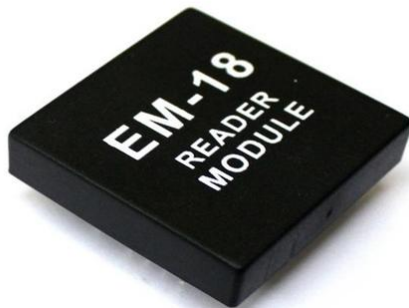


Fig 3.1.2: EM-18 RFID Reader

The RFID reader reads EM4100 family transponder tags that are brought in proximity to the reader and output the unique tag identification number through serial port @9600 bps.

The reader output 12 byte including one start, stop byte and 10 unique data byte. The start byte and stop byte are used to easily identify that a correct string has been received from the reader (they correspond to a line feed and carriage return characters, respectively). The middle ten bytes are the actual tag's unique ID. Vertical and horizontal parity checking has been done in card reading algorithm to ensure data integrity. One status LED is provided to indicate card detection. The normal detection range is 10-15CM for Card Type TAGs. The RFID uses the EM4102 protocol.

All communication is 8 data bits, no parity, 1 stop bit, non-inverted, least significant bit first (8N1). The baud rate is configured for 9600bps, a standard communications speed supported by most any microprocessor or PC, and cannot be changed. RFID Reader Module initiates all communication. The RFID Reader Module can connect directly to any TTL-compatible UART or to an RS232-compatible interface by using an external level shifter.

RFID (radio frequency identification) systems use data strings stored inside RFID tags

or transponders to uniquely identify people or objects when they are scanned by an RFID reader. These types of systems are found in many applications such as passport protection, animal identification, inventory control systems, and secure access control systems, robotics, navigation, inventory tracking, payment systems, and car immobilization. Because passive tags require a strong RF field to operate, their effective range is limited to an area in close proximity to the RFID reader. The distance over which the RFID tag is usable is affected by such things as the tag shape and size, materials being used in the area near the reader, and the orientation of the reader and tag in respect to each other and in their operating environment. The smaller a tag, the closer it must be to the reader to operate. Each transponder tag contains a unique identifier (one of 1, 099, 511, 627, 776, possible combinations) that is read by the RFID Reader Module and transmitted to the host via a simple serial interface.

The EM-18 RFID Reader module operating at 125kHz is an inexpensive solution for your RFID based application. The Reader module comes with an on-chip antenna and can be powered up with a 5V power supply. Power-up the module and connect the transmit pin of the module to receive pin of your microcontroller. Show your card within the reading distance and the card number is thrown at the output. Optionally the module can be configured for also a weigand output.

Key Specifications:

- Power requirements: 4.5 to 5.5 VDC
- Current Requirement: <120mA
- Communication: Serial at 9600 baud (8N1)
- Dimensions: 63mm x 98mm x 5 mm
- Operating temp range: -40 to +185 °F (-40 to +85 °C)



Fig 3.1.3(a): Keypad 4*4 Module

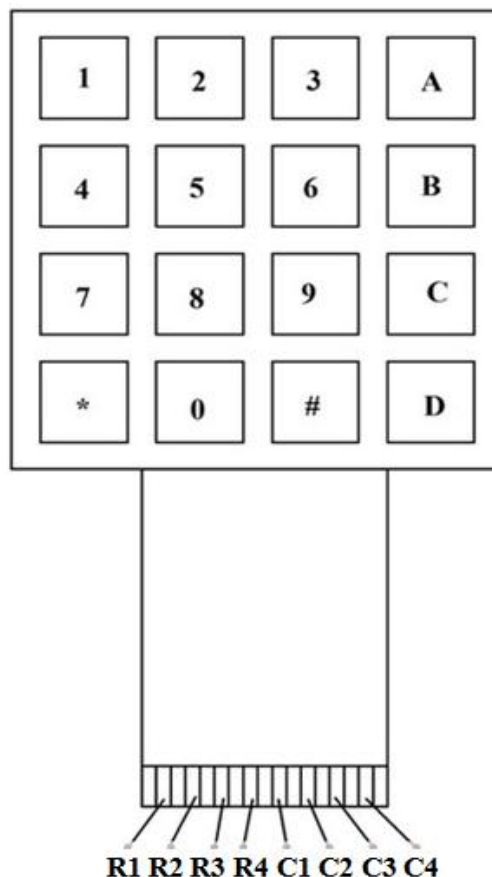


Fig 3.1.3(b): Keypad 4*4 Pinout

A 4x4 keypad will have eight terminals. In them four are rows of matrix and four are columns of matrix. These 8 pins are driven out from 16 buttons present in the module. Those 16 alphanumeric digits on the module surface are the 16 buttons arranged in matrix formation.

4x4 Keypad Module Features and Specifications

- Maximum Voltage across EACH SEGMENT or BUTTON: 24V
- Maximum Current through EACH SEGMENT or BUTTON: 30mA
- Maximum operating temperature: 0°C to + 50°C
- Ultra-thin design
- Adhesive backing
- Easy interface
- Long life

LIQUID CRYSTAL DISPLAY 16*2

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on.

A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data.

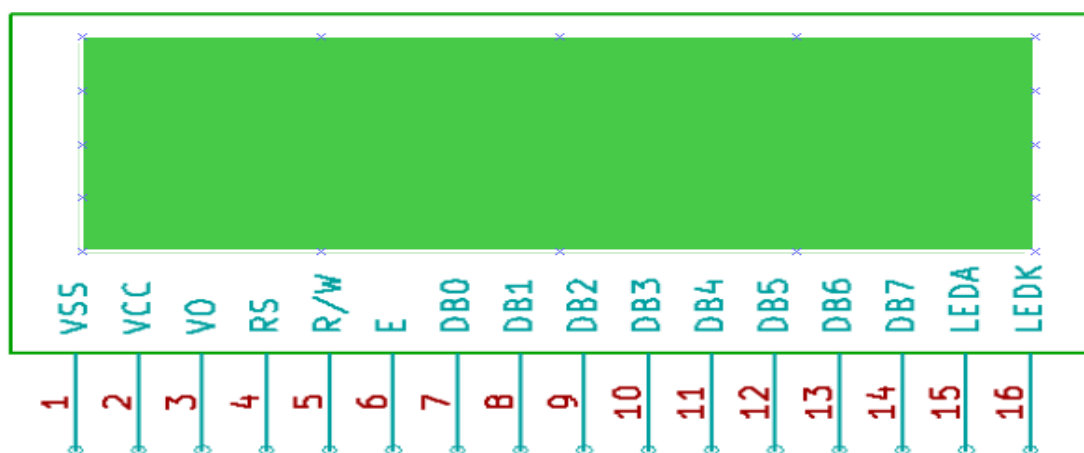


Fig 3.1.4(a): LCD 16*2 Pin-out

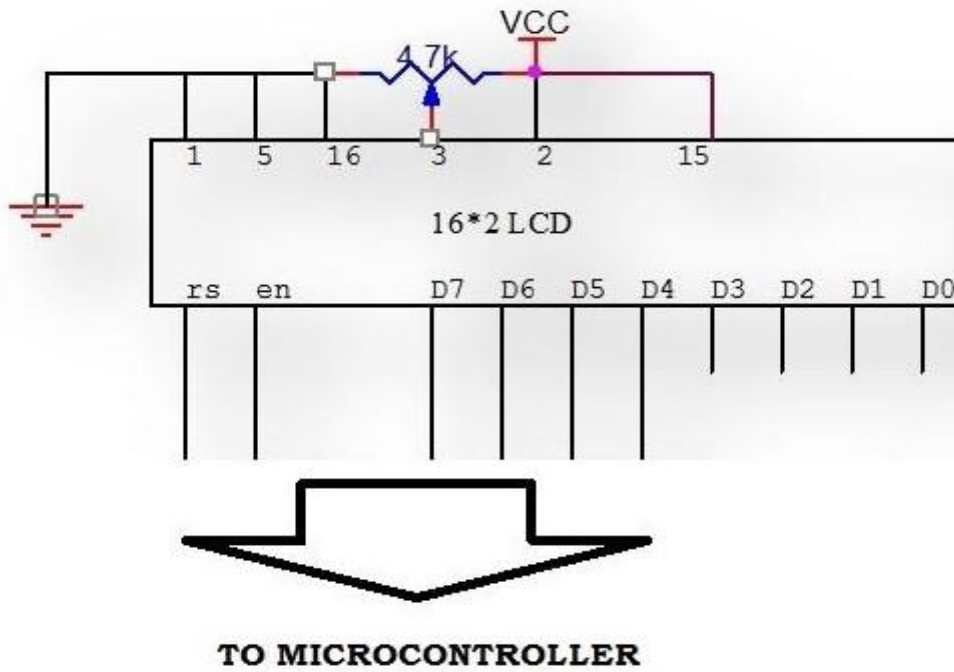
The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the

cursor position, controlling display etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD.

PIN DESCRIPTION

Pin No	Function	Name
1	Ground (0V)	Ground
2	Supply voltage; 5V (4.7V – 5.3V)	Vcc
3	Contrast adjustment; through a variable resistor	VEE
4	Selects command register when low; and data register when high	Register Select
5	Low to write to the register; High to read from the register	Read/write
6	Sends data to data pins when a high to low pulse is given	Enable
7	8-bit data pins	DB0
8		DB1
9		DB2
10		DB3
11		DB4
12		DB5
13		DB6
14		DB7
15	Backlight V _{CC} (5V)	Led+
16	Backlight Ground (0V)	Led-

Table 3.1.4(b): LCD 16*2 Pin Description



*Fig 3.1.4(c): LCD 16*2 Schematic*

Relay SPDT Board with driver

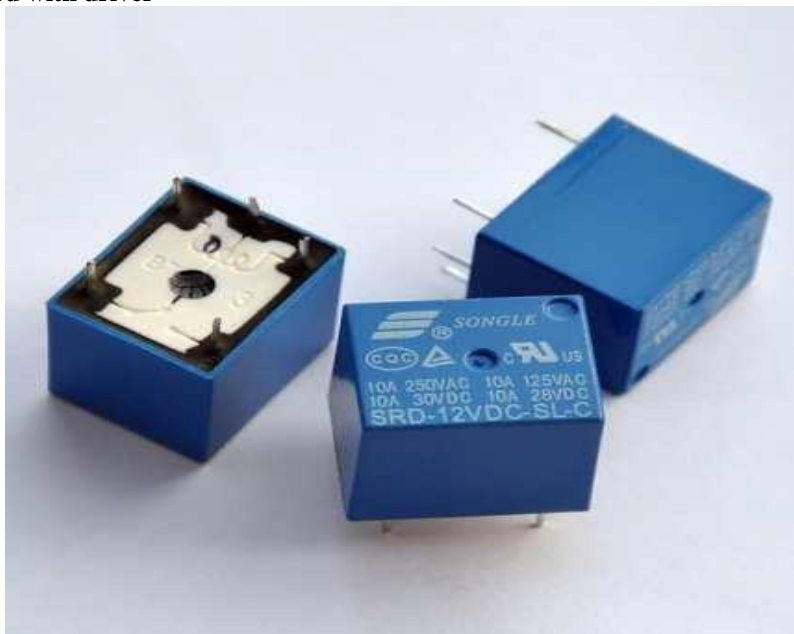


Fig 3.1.5(a): 5V RELAY – SPDT (SINGLE POLE DOUBLE THROW)

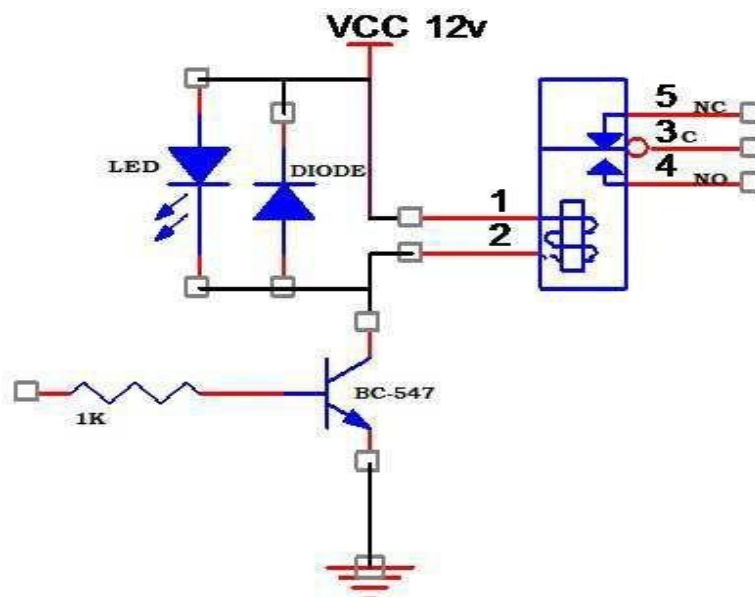


Fig 3.1.5(b): 5V RELAY SCHEMATIC

C : COMMON
NC: NORMALLY CONNECTED NO:
NORMALLY OPEN

Solar Panel

Above circuit is a relay driver using the NPN transistor BC 547. The relay is connected between the positive rail and the collector of the transistor. When the input signal passes through the 1 K resistor to the base of the transistor, it conducts and pulls the relay. IN 4007 diode eliminates back e.m.f when the relay switches off and protects the transistor. LED indicates the on status of the relay.

The coils of the relay (1, 2) are connected to +12V and collector of the transistor respectively. When input is high to the transistor base through some resistance, it conducts and provides the ground to pin (2) of the coils to complete the circuit and switch ON the relay. As Relay switches ON, C and NO will be in contact. When the input to the transistor base is at Logic Low, the relay will be in OFF state and C will be in Contact with NC.



Fig 3.1.6: 5W , 12V Solar Panel

Solar Panels are as good as power supplies of an average of 12V in bright sunlight. Solar charger circuits need voltage regulators so as to charge the batteries at constant voltage. The battery charging process should be stopped once it is fully charged and this is ensured using a Zener diode which will start conducting at the cutoff voltage.

12V, 5A , Lead-Acid Rechargeable Battery

The charger circuit is a simple, ready to use lead acid battery charger and is a good way to store solar energy. It is a clean energy source and it is high time we understand its importance and

embrace it in our daily lives. Solar cells are the heart of any circuit. Batteries are the easiest way to store energy. Hence solar charger circuit aim at charging batteries rather than driving components. Rechargeable batteries like Lead-Acid , Li-ion and NiMH are used depending on the users requirements. Here we have used sealed Lead Acid ones. It is also very necessary to cutoff charging once the battery is fully charged. This is managed using a Zener diode which switches on at the cut-off voltage and diverts the current through the transistor. The battery is thus charged at constant voltage and at desired rates depending on the amount of current supplied.



Fig 3.1.7: 12V, 5A Lead-Acid Battery

SOFTWARE REQUIREMENTS

- Arduino Uno R3
- I2C board

Arduino Uno R3

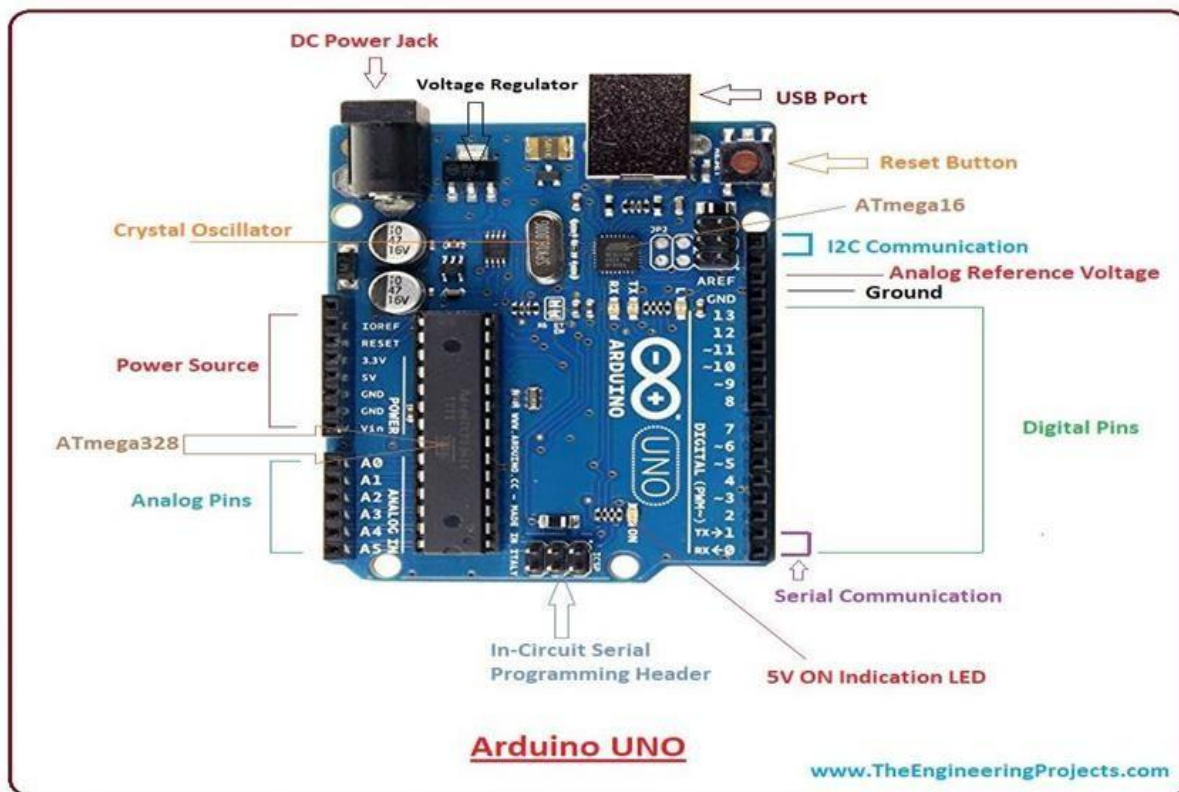


Fig 3.2.1: Arduino Uno R3

Arduino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It can be connected to a computer with a USB cable or power it with a AC-to-DC adapter or battery. The ATmega328 on the Arduino Uno comes pre programmed with a bootloader that allows you to upload new code to it without the use of an external hardware programmer. It communicates using the original STK500 protocol. You can also bypass the bootloader and program the microcontroller through the ICSP (In-Circuit Serial Programming) header using Arduino ISP or similar.

The ATmega328 has 32 KB (with 0.5 KB occupied by the bootloader). It also has 2 KB of SRAM and 1 KB of EEPROM (which can be read and written with the EEPROM library).

Technical specifications:

- Microcontroller: microchip ATmega328P
- Operating Voltage: 5 Volt
- Input Voltage: 7 to 20 Volts
- Digital I/O Pins: 14 (of which 6 provide PWM output)
- Analog Input Pins: 6
- DC Current per I/O Pin: 20 mA
- DC Current for 3.3V Pin: 50 mA
- Flash Memory: 32 KB of which 0.5 KB used by bootloader
- SRAM: 2 KB
- EEPROM: 1 KB
- Clock Speed: 16 MHz

Each of the 14 digital pins on the Uno can be used as an input or output, using pinMode(), digitalWrite(), and digitalRead() functions. They operate at 5 volts.

- Serial: 0 (RX) and 1 (TX). Used to receive

(RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the ATmega8U2 USB-to-TTL Serial chip.

- External Interrupts: 2 and 3. These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value.
- PWM: 3, 5, 6, 9, 10, and 11. Provide 8-bit PWM output with the analogWrite() function.
- SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI communication using the SPI library.
- LED: 13. There is a built-in LED driven by digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.
- TWI (Two Wire interface): A4 or SDA pin and A5 or SCL pin. Support TWI communication using the Wire library.
- The Uno has 6 analog inputs, labeled A0 through A5, each of which provide 10 bits of resolution (i.e. 1024 different values). By default they measure from ground to 5 volts, though it is possible to change the upper end of their range using the AREF pin and the analogReference() function.
- AREF Reference voltage for the analog inputs. Used with analogReference().
- Reset. Bring this line LOW to reset the microcontroller.

I2C Board

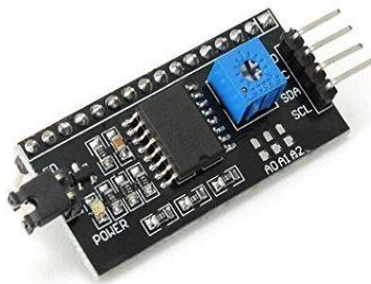


Fig 3.2.3(a): I2C Board

I2C is a serial protocol for two-wire interface to connect low-speed devices like microcontrollers, EEPROMs, A/D and D/A converters, I/O interfaces and other similar peripherals in embedded systems. It was invented by Philips and now it is used by almost all major IC manufacturers. Each I2C slave device needs an

address – they must still be obtained from NXP (formerly Philips semiconductors).

Each slave device has a unique address. Transfer from and to master device is serial and it is split into 8-bit packets. All these simple requirements make it very simple to implement I2C interface even with cheap microcontrollers that have no special I2C hardware controller. You only need 2 free I/O pins and few simple i2C routines to send and receive commands.

The initial I2C specifications defined maximum clock frequency of 100 kHz. This was later increased to 400 kHz as Fast mode. There is also a high speed mode which can go up to 3.4 MHz and there is also a 5 MHz ultra-fast mode. I2C uses only two wires: SCL (serial clock) and SDA (serial data). Both need to be pulled up with a resistor to +Vdd. There are also I2C level shifters which can be used to connect to two I2C buses with different voltage.

Basic I2C communication is using transfers of 8 bits or bytes. Each I2C slave device has a 7-bit address that needs to be unique on the bus. Some devices have fixed I2C address while others have few address lines which determine lower bits of the I2C address. This makes it very easy to have all I2C devices on the bus with unique I2C address. There are also devices which have 10-bit address as allowed by the specification. 7-bit address represents bits 7 to 1 while bit 0 is used to signal reading from or writing to the device. If bit 0 (in the address byte) is set to 1 then the master device will read from the slave I2C device. Master device needs no address since it generates the clock (via SCL) and addresses individual I2C slave devices.

The two wires, or lines are called Serial Clock (or SCL) and Serial Data (or SDA). The SCL line is the clock signal which synchronizes the data transfer between the devices on the I2C bus and it's generated by the master device. The other line is the SDA line which carries the data. The two lines are "open-drain" which means that pull up resistors need to be attached to them so that the lines are high because the devices on the I2C bus are active low. Commonly used values for the resistors are from 2K for higher speeds at about 400 kbps, to 10K for lower speed at about 100 kbps.

The data signal is transferred in sequences of 8 bits. So after a special start condition occurs comes the first 8 bits sequence which indicates the address of the slave to which the data is being sent. After each 8 bits sequence follows a bit called Acknowledge. After the first Acknowledge bit in

most cases comes another addressing sequence but this time for the internal registers of the slave device. After the addressing sequences follows the

data sequences as many until the data is completely sent and it ends with a special stop condition.

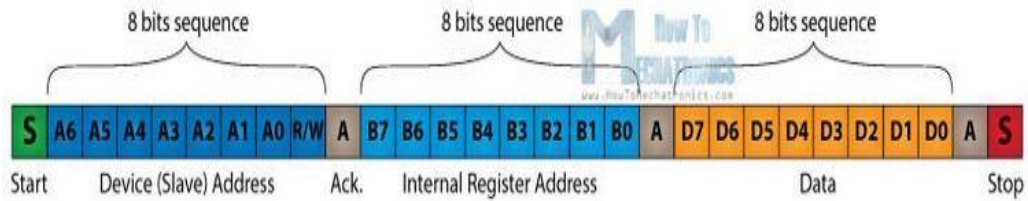


Fig 3.2.3(b): I2C Protocol



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