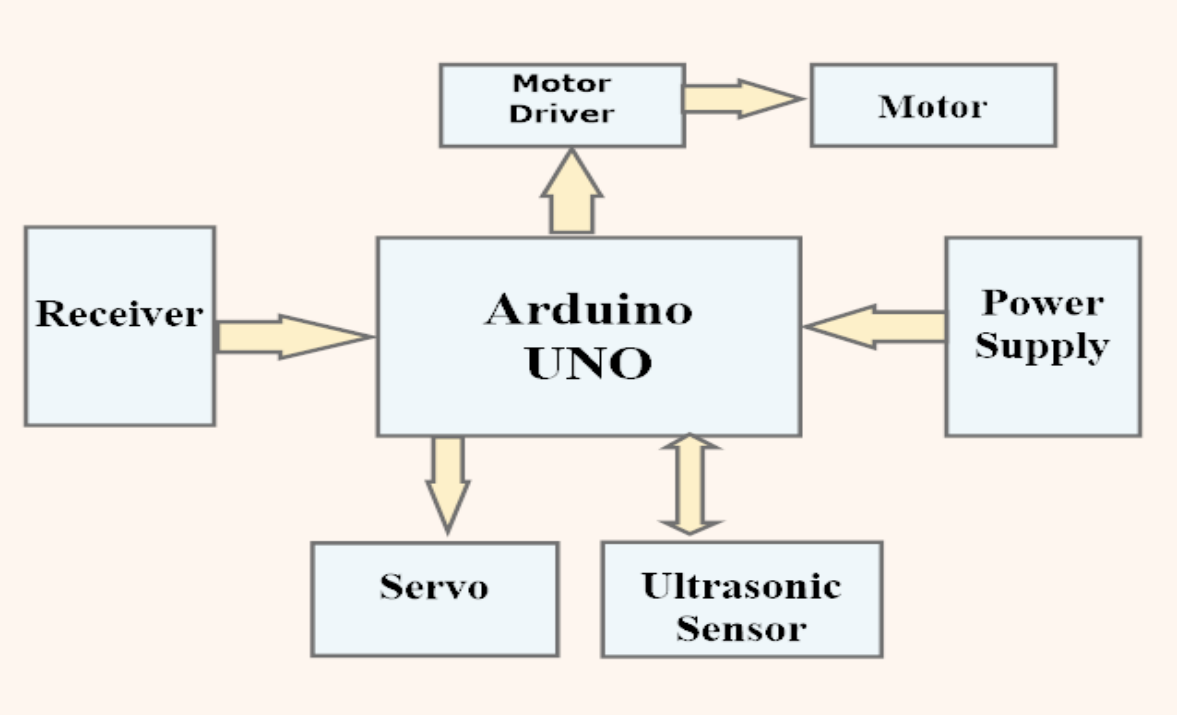
ROBOT:

In this report, we introduce a new technique in Robotic technology about human following robot with Bluetooth control that can be operated in 2 modes. First mode can be operated in human following mode that follows human with the help of transmitter which is placed in user's belt/shoe. In second mode the robot can be operated using Bluetooth. The aim of the robot is to reduce the human effort, this robot helps to carry the user's luggage wherever he moves and the old aged people who can't carry their luggage due to heaviness of the luggage. The proposed system comprises an idea of having automated robot that can carry small materials in human reachable areas using ultrasonic beacons to guide the movements of the robot, this robot. This robot is also used in filmography, trollies that is used in metro Politian malls etc. In second mode the robot can be controlled with Bluetooth application which will be used by the user, only the user can connect to that Bluetooth and control the robot. This concept is mainly based on ultrasonic control based.

BLOCK DIAGRAM OF PROJECT:



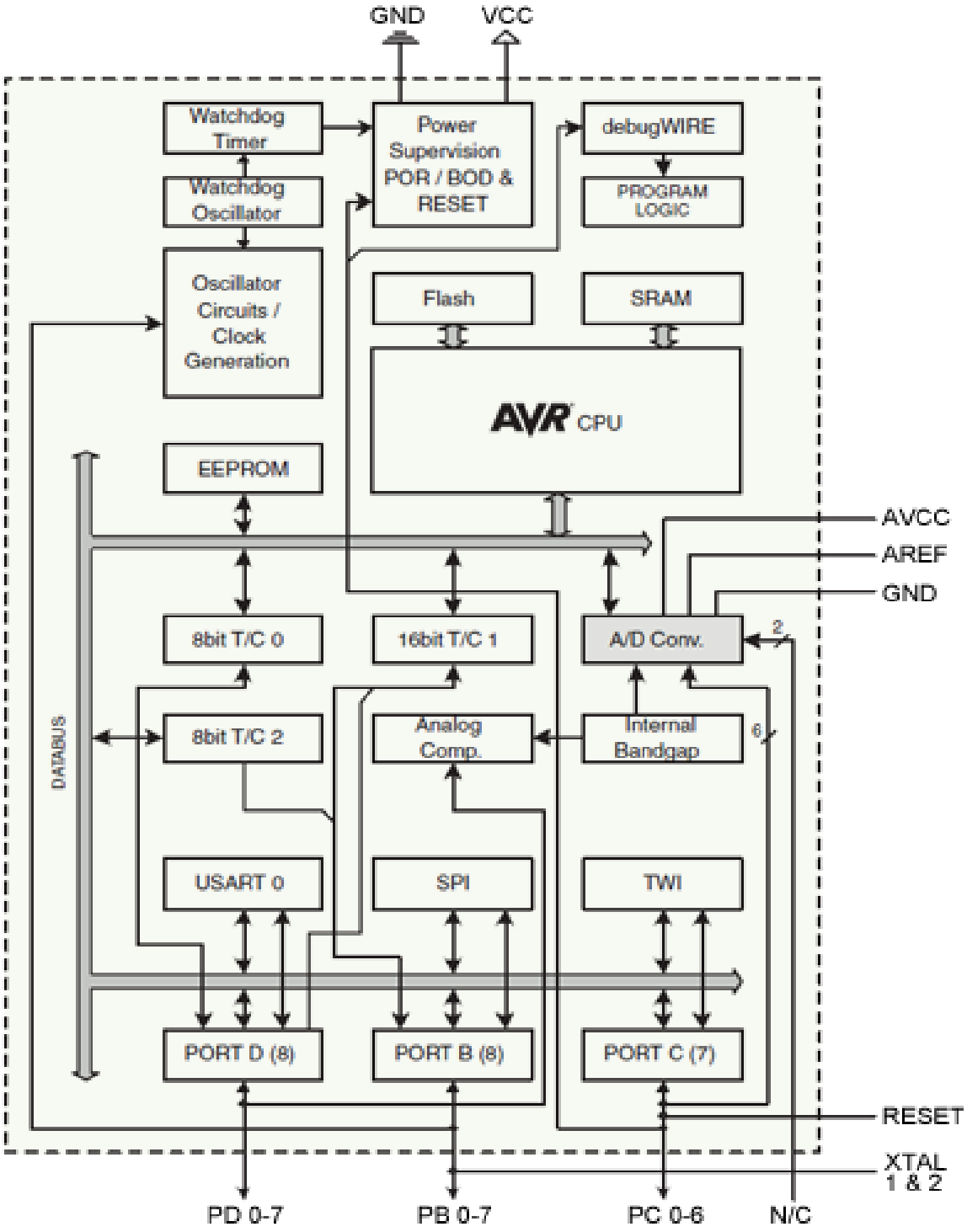
CONTROLLER - ARDUINO UNO

The Arduino UNO is a widely used open-source microcontroller board based on the ATmega328P microcontroller and developed by Arduino.cc. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. The board features 14 Digital pins and 6 Analog pins. It is programmable with the Arduino IDE(Integrated Development Environment) via a type B USB cable. It can be powered by a USB cable or by an external 9 volt battery, though it accepts voltages between 7 and 20 volts. ATmega328 on the Arduino Uno comes pre-programmed with a bootloader that allows to upload new code to it without the use of an external hardware programmer. It communicates using the original STK500 protocol.

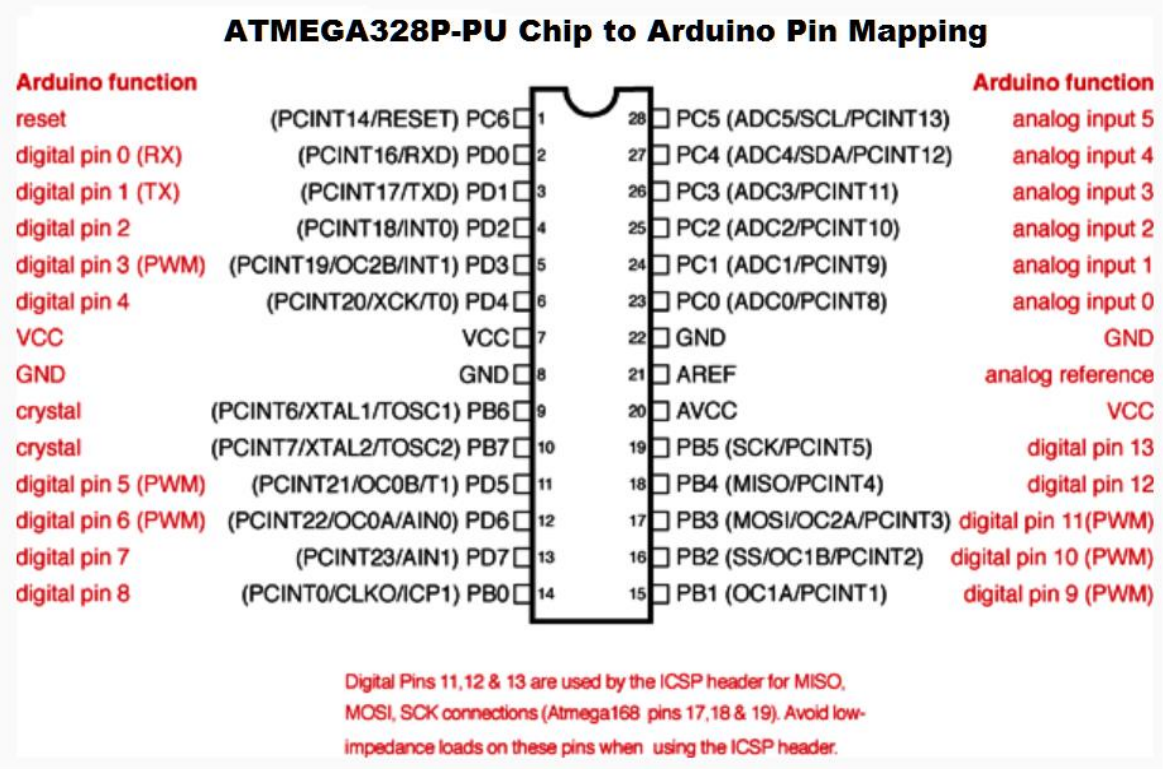
Technical specifications

- Microcontroller: ATmega328P
- Operating Voltage: 5v
- Input Voltage: 7-20v
- 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 +

BLOCK DIAGRAM OF ATMMEGA328 CONTROLLER :-



ARDUINO PIN CONFIGURATIONS:-



GENERAL PIN FUNCTIONS

- **LED**: 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.
- **VIN**: The input voltage to the Arduino/Genuino board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.
- **5V**: This pin outputs a regulated 5V from the regulator on the board. The board can be supplied with power either from the DC power jack (7 - 20V), the USB connector (5V), or the VIN pin of the board (7-20V). Supplying voltage via the 5V or 3.3V pins bypasses the regulator, and can damage the board.
- **3V3**: A 3.3 volt supply generated by the on-board regulator. Maximum current draw is 50 mA.
- **GND**: Ground pins.

- **IOREF**: This pin on the Arduino/Genuino board provides the voltage reference with which the microcontroller operates. A properly configured shield can read the IOREF pin voltage and select the appropriate power source or enable voltage translators on the outputs to work with the 5V or 3.3V.
- **Reset**: Typically used to add a reset button to shields which block the one on the board.

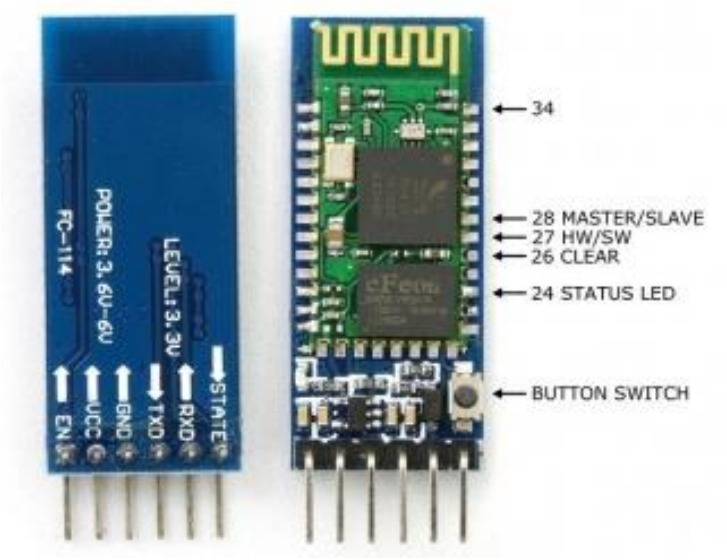
SPECIAL PIN FUNCTIONS

Each of the 14 digital pins and 6 Analog pins on the Uno can be used as an input or output, using pinMode(),digital Write(), and digitalRead() functions. They operate at 5 volts. Each pin can provide or receive 20 mA as recommended operating condition and has an internal pull-up resistor (disconnected by default) of 20-50k ohm. A maximum of 40mA is the value that must not be exceeded on any I/O pin to avoid permanent damage to the microcontroller. The Uno has 6 analog inputs, label led 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 is it possible to change the upper end of their range using the AREF pin and the analog Reference() function.

In addition, some pins have specialized functions:

- **Serial**: pins 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**: pins 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** (**P**ulse **W**idth **M**odulation) 3, 5, 6, 9, 10, and 11 Can provide 8-bit PWM output with the analogWrite() function.
- **SPI** (**S**erial **P**eripheral **I**nterface): 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI communication using the SPI library.
- **TWI** (**T**wo **W**ire **I**nterface): A4 or SDA pin and A5 or SCL pin. Support TWI communication using the Wire library.
- **AREF** (**A**nalog **REF**erence: Reference voltage for the analog inputs.

BLUETOOTH MODULE (HC-05):



PIN DESCRIPTION

The HC-05 Bluetooth Module has 6pins. They are as follows:

ENABLE:

When enable is pulled LOW, the module is disabled which means the module will not turn on and it fails to communicate. When enable is left open or connected to 3.3V, the module is enabled i.e the module remains on and communication also takes place.

VCC:

Supply Voltage 3.3V to 5V

GND:

Ground pin

TXD & RXD:

These two pins acts as an UART interface for communication

STATE:

It acts as a status indicator. When the module is not connected to / paired with any other Bluetooth device, signal goes Low. At this low state, the led flashes continuously which denotes that the module is not paired with other device. When this module is connected to/paired with any other Bluetooth

device, the signal goes High. At this high state, the led blinks with a constant delay say for example 2s delay which indicates that the module is paired.

BUTTON SWITCH:

This is used to switch the module into AT command mode. To enable AT command mode, press the button switch for a second. With the help of AT commands, the user can change the parameters of this module but only when the module is not paired with any other BT device. If the module is connected to any other Bluetooth device, it starts to communicate with that device and fails to work in AT command mode.

BLUETOOTH MODULE DESCRIPTION HC-05

The Bluetooth module HC-05 is a MASTER/SLAVE module. By default the factory setting is SLAVE. The Role of the module (Master or Slave) can be configured only by AT COMMANDS. The slave modules cannot initiate a connection to another Bluetooth device, but can accept connections. Master module can initiate a connection to other devices. The user can use it simply for a serial port replacement to establish connection between MCU and GPS, PC to your embedded project, etc. Just go through the datasheet for more details File:Datasheet.pdf

HC-05 Technical Specifications

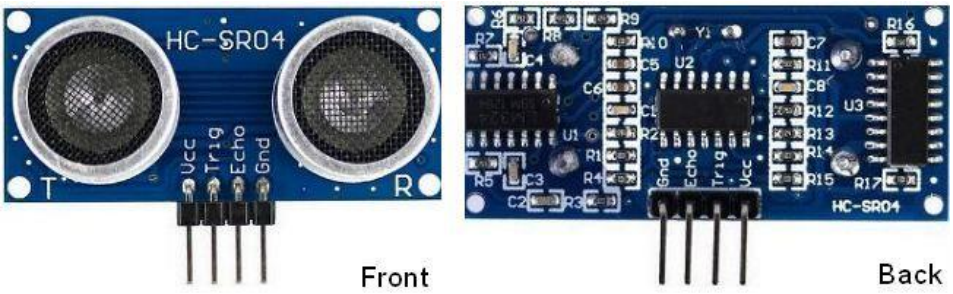
- Serial Bluetooth module for Arduino and other microcontrollers
- Operating Voltage: 4V to 6V (Typically +5V)
- Operating Current: 30mA
- Range: <100m
- Works with Serial communication (USART) and TTL compatible
- Follows IEEE 802.15.1 standardized protocol
- Uses Frequency-Hopping Spread spectrum (FHSS)
- Can operate in Master, Slave or Master/Slave mode
- Can be easily interfaced with Laptop or Mobile phones with Bluetooth

- Supported baud rate: 9600,19200,38400,57600,115200,230400,460800.

Module interface specification (3-wire)

- VCC external 3.3V-5V voltage (can be directly connected to the 5v microcontroller and 3.3v microcontroller)
- GND external GND
- DO-board digital output interface (0 and 1)

ULTRASONIC SENSOR MODULE:-



HC-SR04

ULTRASONIC SENSOR PIN CONFIGURATION

Pin Number	Pin Name	Description
1	Vcc	The Vcc pin powers the sensor, typically with +5V
2	Trigger	Trigger pin is an Input pin. This pin has to be kept high for 10us to initialize measurement by sending US wave.
3	Echo	Echo pin is an Output pin. This pin goes high for a period of time which will be equal to the time taken for the US wave to return back to the sensor.
4	Ground	This pin is connected to the Ground of the system.

HC-SR04 SENSOR FEATURES

- Operating voltage: +5V
- Theoretical Measuring Distance: 2cm to 450cm
- Practical Measuring Distance: 2cm to 80cm
- Accuracy: 3mm
- Measuring angle covered: <15°
- Operating Current: <15mA
- Operating Frequency: 40Hz

HC-SR04 ULTRASONIC SENSOR - WORKING

As shown above the **HC-SR04 Ultrasonic (US) sensor** is a 4 pin module, whose pin names are Vcc, Trigger, Echo and Ground respectively. This sensor is a very popular sensor used in many applications where measuring distance or sensing objects are required. The module has two eyes like projects in the front which forms the Ultrasonic transmitter and Receiver. The sensor works with the simple high school formula that,

Distance = Speed × Time

The Ultrasonic transmitter transmits an ultrasonic wave, this wave travels in air and when it gets objected by any material it gets reflected back toward the sensor this reflected wave is observed by the Ultrasonic receiver module as shown in the picture below

Now, to calculate the distance using the above formulae, we should know the Speed and time. Since we are using the Ultrasonic wave we know the universal speed of US wave at room conditions which is 330m/s. The circuitry inbuilt on the module will calculate the time taken for the US wave to come back and turns on the echo pin high for that same particular amount of time, this way we can also know the time taken. Now simply calculate the distance using a microcontroller or microprocessor.

Servo Motor:

Basics, Theory & Working Principle

A servo motor is an electrical device which can push or rotate an object with great precision. If you want to rotate and object at some specific angles or distance, then you use servo motor. It is just made up of simple motor which run through servo mechanism. If motor is used is DC powered then it is called DC servo motor, and if it is AC powered motor then it is called AC servo motor. We can get a very high torque servo motor in a small and light weight packages. Doe to these features they are being used in many applications like toy car, RC helicopters and planes, Robotics, Machine etc.

Servo motors are rated in kg/cm (kilogram per centimeter) most hobby servo motors are rated at 3kg/cm or 6kg/cm or 12kg/cm. This
kg/cm tells you how much weight your servo motor can lift at a particular distance. For example: A 6kg/cm Servo motor should be able to lift 6kg if the load is suspended 1cm away from the motors shaft, the greater the distance the lesser the weight carrying capacity.

The position of a servo motor is decided by electrical pulse and its circuitry is placed beside the motor.

SERVO MECHANISM

It consists of three parts:

1. Controlled device
2. Output sensor
3. Feedback system

It is a closed loop system where it uses positive feedback system to control motion and final position of the shaft. Here the device is controlled by a feedback signal generated by comparing output signal and reference input signal.

Here reference input signal is compared to reference output signal and the third signal is produces by feedback system. And this third signal acts as input signal to control device. This signal is present as long as feedback signal is generated or there is difference between reference input signal and reference output signal. So the main task of servomechanism is to maintain output of a system at desired value at presence of noises.

WORKING PRINCIPLE OF SERVO MOTORS

A servo consists of a Motor (DC or AC), a potentiometer, gear assembly and a controlling circuit. First of all we use gear assembly to reduce RPM and to increase torque of motor. Say at initial position of servo motor shaft, the position of the potentiometer knob is such that there is no electrical signal generated at the output port of the potentiometer. Now an electrical signal is given to another input terminal of the error detector amplifier. Now difference between these two signals, one comes from potentiometer and another comes from other source, will be processed in feedback mechanism and output will be provided in term of error signal. This error signal acts as the input for motor and motor starts rotating. Now motor shaft is connected with potentiometer and as motor rotates so the potentiometer and it will generate a signal. So as the potentiometer's angular position changes, its output feedback signal changes. After sometime the position of potentiometer reaches at a position that the output of potentiometer is same as external signal provided. At this condition, there will be no output signal from the amplifier to the motor input as there is no difference between external applied signal and the signal generated at potentiometer, and in this situation motor stops rotating.

CONTROLLING SERVO MOTOR:

All motors have three wires coming out of them. Out of which two will be used for Supply (positive and negative) and one will be used for the signal that is to be sent from the MCU.

Servo motor is controlled by PWM (Pulse with Modulation) which is provided by the control wires. There is a minimum pulse, a maximum pulse and a repetition rate. Servo motor can turn 90 degree from either direction form its neutral position. The servo motor expects to see a pulse every 20 milliseconds (ms) and the length of the pulse will determine how far the motor turns. For example, a 1.5ms pulse will make the motor turn to the 90° position, such as if pulse is shorter than 1.5ms shaft moves to 0° and if it is longer than 1.5ms than it will turn the servo to 180°.

Servo motor works on PWM (Pulse width modulation) principle, means its angle of rotation is controlled by the duration of applied pulse to its Control PIN. Basically servo motor is made up of DC motor which is controlled by a variable resistor (potentiometer) and some gears. High speed force of DC motor is converted into torque by Gears. We know that WORK= FORCE X DISTANCE, in DC motor Force is less and distance (speed) is high and in Servo, force is High and distance is less. Potentiometer is connected to the output shaft of the Servo, to calculate the angle and stop the DC motor on required angle.

Servo motor can be rotated from 0 to 180 degree, but it can go up to 210 degree, depending on the manufacturing. This degree of rotation can be controlled by applying the Electrical Pulse of proper width, to its Control pin. Servo checks the pulse in every 20 milliseconds. Pulse of 1 ms (1 millisecond) width can rotate servo to 0 degree, 1.5ms can rotate to 90 degree (neutral position) and 2 ms pulse can rotate it to 180 degree.

All servo motors work directly with your +5V supply rails but we have to be careful on the amount of current the motor would consume, if you are planning to use more than two servo motors a proper servo shield should be designed.

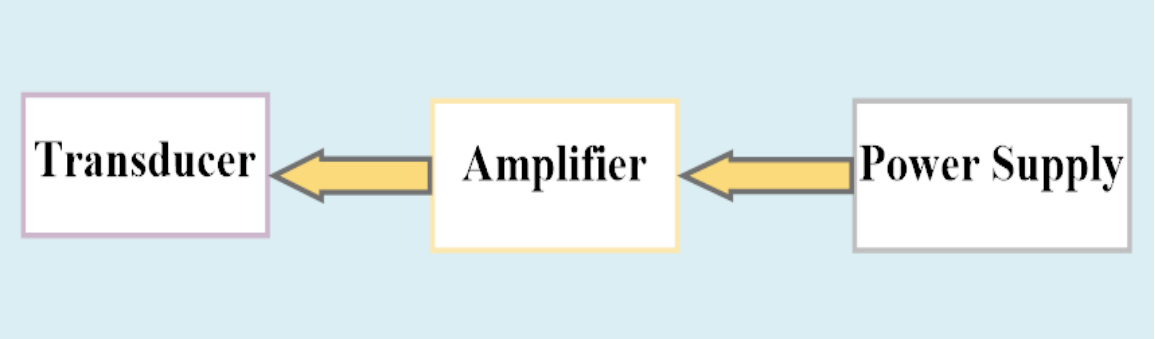
SPECIFICATIONS AND FEATURES :-

- Operating Voltage:3.0-7.2 Volts
- Operating Speed (4.8V no load): 0.10sec/60 degrees
- Dimensions: 22 x 11.5 x 27mm
- Weight: 9 g

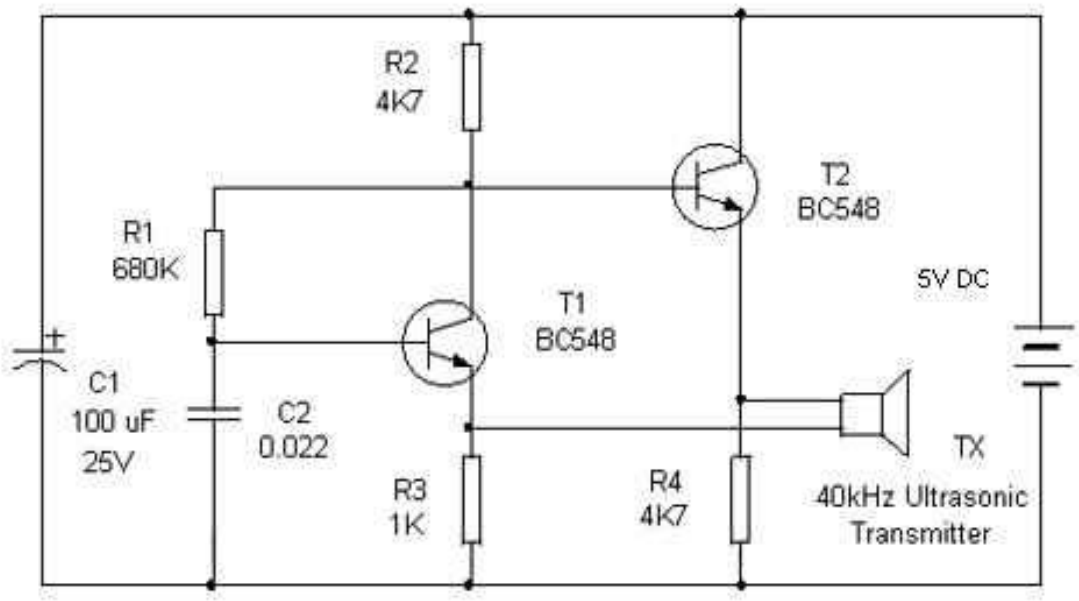
- Stall Torque: 1.2kg / 42.3oz(4.8V); 1.6 kg / 56.4oz (6.0V)
- Temperature Range: -30 to +60 Degree C
- Dead Band Width: 7usec
- All Nylon Gear
- Connector Wire Length 150mm
- Rotational Degree: 180 degree

TRANSMITTING UNIT:-

BLOCK DIAGRAM:-



CIRCUIT DIAGRAM:-



TRANSMITTER:

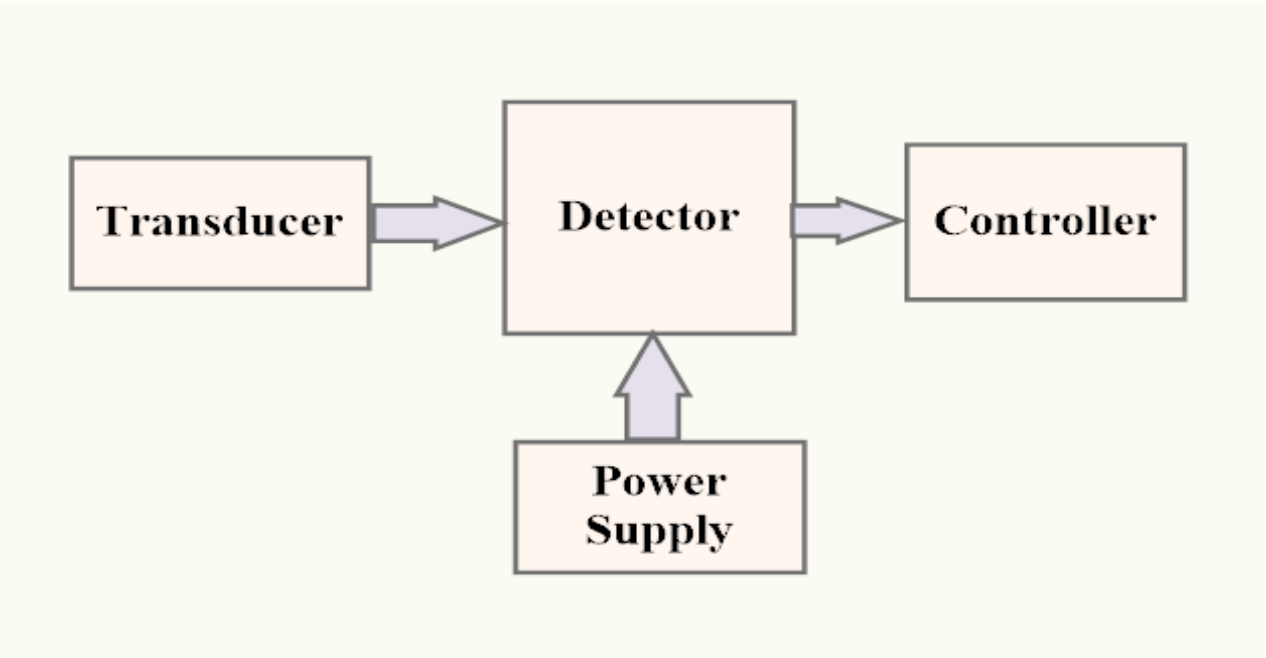
We made some excellent progress using ultrasounds as a transmission method, to create a simple beacon detector. You can read more on it here. The user needs to carry this tiny, low power ultrasonic beacon in the Belt (Behind) which transmits 40khz ultra sound where the receiver beacons should be able to "hear" and use the signal to navigate the receiver beacon, and follow it.

These receiver modules will not only return a signal when ultrasounds are detected, but the output amplitude is directly proportional with the actual distance to the beacon. So, we'll know both where the beacon is, and how far the robot is.

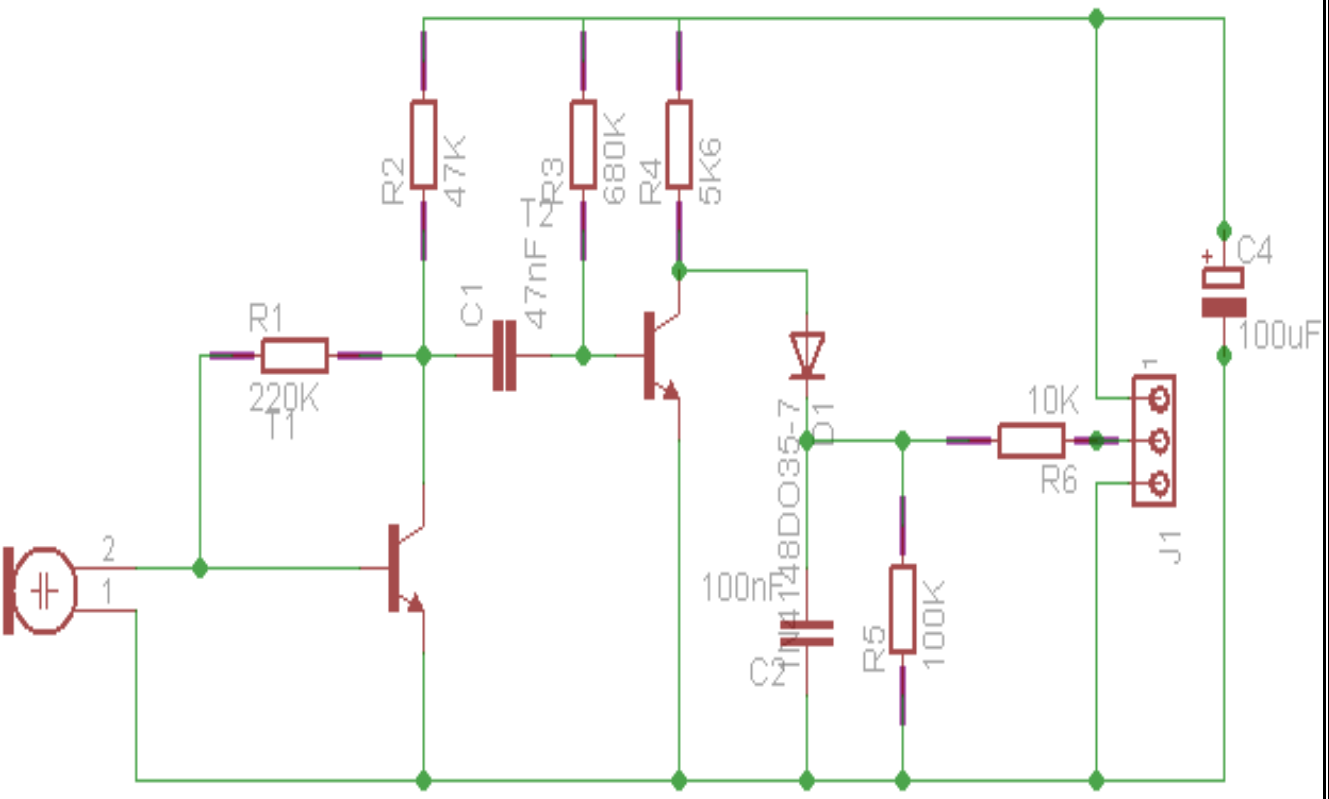
The ultrasonic sensors already return an output signal which is a function of the distance to the beacon / user. This can be used to measure the distance. If greater accuracy is required, we can involve infrared light in the process.
- The beacon sends a set of 40KHz ultra sound which modulated Infrared pulses making moment of time t0.
-The ultrasonic beacon immediately sends out the ultrasonic pulses
- The receiver which is a few meters from the beacon, receives the infrared pulses practically instantaneously and knows the time is t0.
- The receiver registers the incoming ultrasonic pulses at the time t1, where t1>t0. By using the speed of sound in air, we can get the exact distance to the beacon.

RECEIVER UNIT:-

BLOCK DIAGRAM:-



CIRCUIT DIAGRAM:-



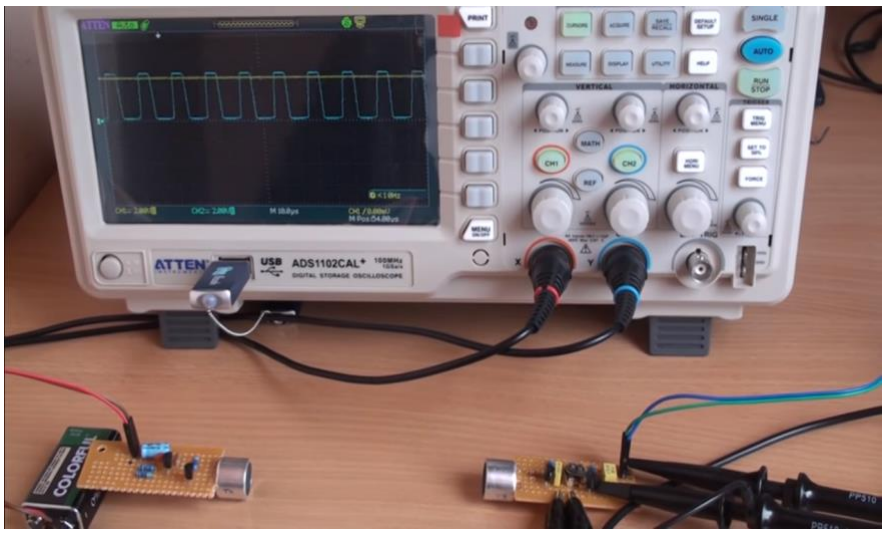
RECEIVER:

a) Using a single ultrasonic receiver, placed in front of the robot: the rover will need to rotate until it detects a maximum level of signal. Then it should move forward until the detected signal reaches a given threshold (so it will not hit the user, but stop right before him/her).

b) Similar to a, but use a servo motor to rotate the ultrasonic sensor instead of rotating the entire robot. When the maximum signal is detected, the robot should turn towards the source, and begin moving forward.

c) Using two ultrasonic receivers, placed some space apart, in the frontal part of the rover. Now we can make differential measurements, so it's easy to know from which part is the signal coming from, as the corresponding sensor will have higher readings. The robot can now directly turn towards the beacon, and follow the forward direction while the two sensors give approximately similar readings. If the right sensor output increases, then it means the robot needs to turn right, to face the beacon and continue moving forward. Same case for left

d) Using more than two sensors, ideally 8, placed at 45 degrees in a radial disposition. This would pinpoint the source more accurately, and reduce the time needed to find the beacon. Still, to simplify, I plan to go for the differential measurements presented at c.



7805 POWER SUPPLYCIRCUIT DIAGRAM

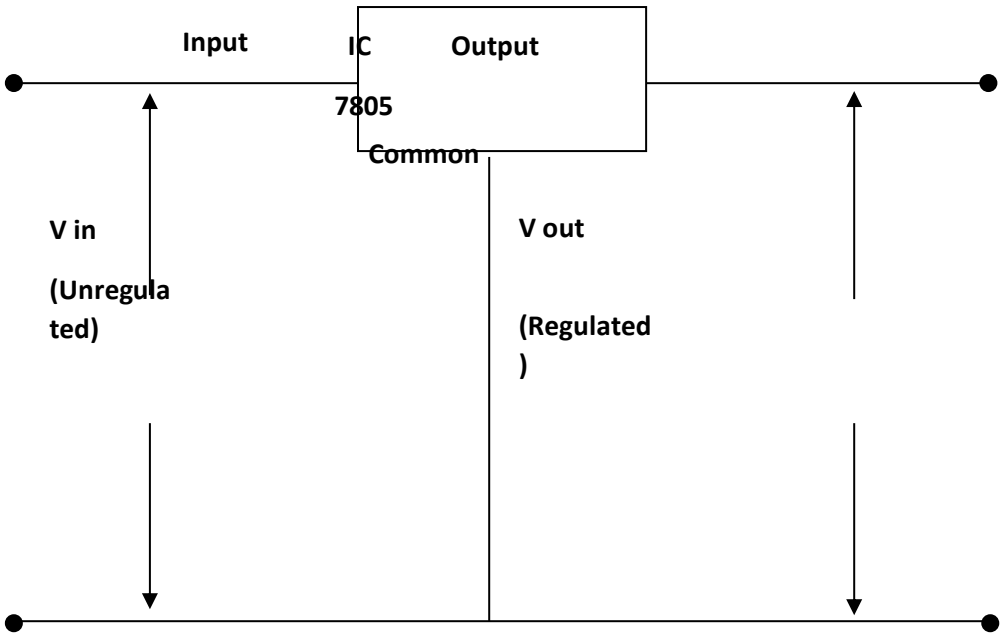


Fig (6) regulated power supply

A **DC** power supply system, which maintains constant voltage irrespective of fluctuations in the main supply or variation in the load, is known as Regulated Power supply. The**7805 IC** referred to fixed positive voltage regulator, which provides fixed voltage 5 volts. The **7805** regulator is known as fixed voltage regulator.

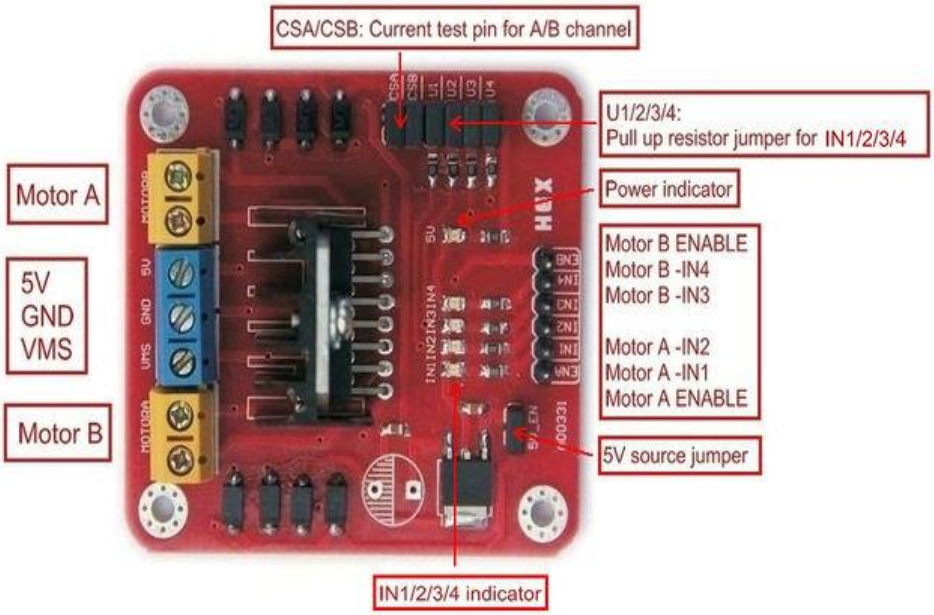
Fixed –Voltage regulator design has been greatly simplified by the introduction of 3-terminal regulator ICs such as the 78xx series of positive regulators and the 79xxx series of negative regulators, which incorporate features such as built-in fold back current limiting and thermal protection, etc. These ICs are available with a variety of current and output voltages ratings, as indicated by the 'xxx' suffix; current ratings are indicated by the first part of the suffix and the voltage ratings by the last two parts of the suffix. Thus, a 7805 device gives a 5V positive output at a 1a rating, and a 79L15 device gives a 15V negative output at a 100mA rating.

3-terminal regulators are very easy to use. The regulators ICs typically give about 60dB of ripple rejection, so 1V of input ripple appears as a mere 1mV of ripple on the regulated output.

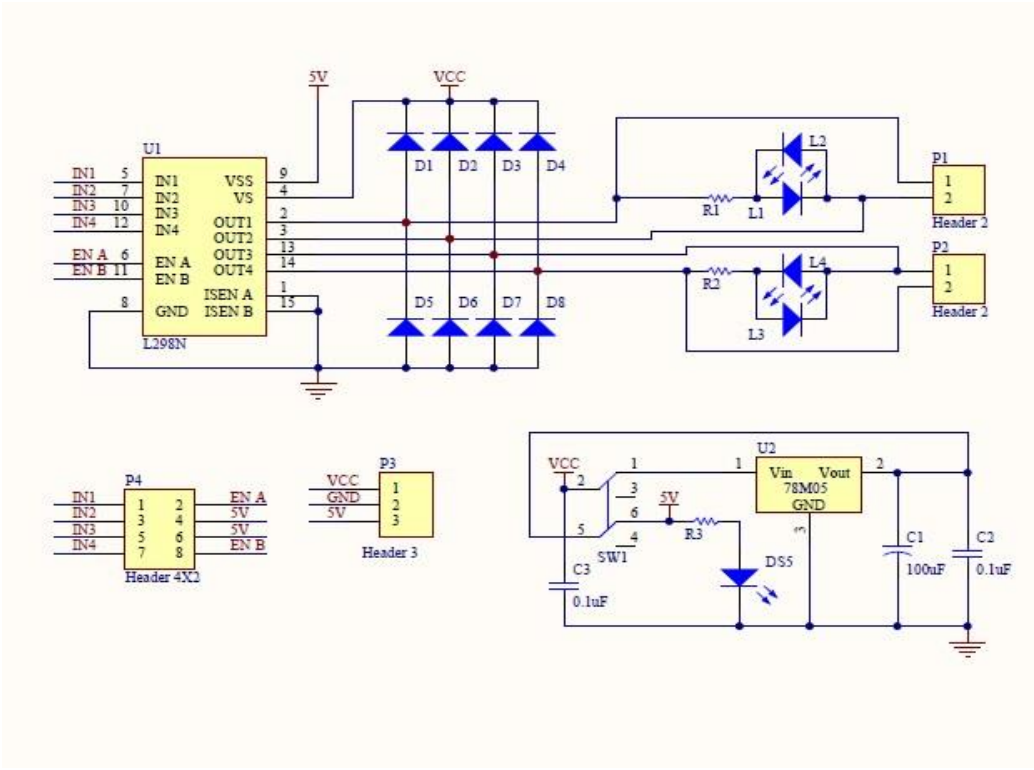
A rectified filter and unregulated **DC** voltage is given to pin of **IC** regulator. A bypass capacitor is connected between input and ground to bypass the ripples and oscillations. The output capacitor is connected between output and ground to improve transient response. The unregulated input is applied to the **IC** must be always more than the regulated output.

This circuit provides supply to the servo motor because the supply from the 12v battery can't be given to this motor, if we provide same supply to both servo and dc motor, then there will be a production of a reverse EMF. It might damage the motor driver circuit, so this type of connection should be avoided and supply must be provided to separate by 5v constant supply. This servo motor can be controlled by Arduino.

MOTOR DRIVER:-



BLOCK DIAGRAM:-



ITS PIN FUNCTIONS ARE AS SHOWN IN TABLE (1):

Pin	Name	Description
1; 15;	Sense A; Sense B;	The sense resistor is connected between this pin and ground to control the current of the load.
2; 3;	Out 1; Out 2;	Outputs of the Bridge A; the current that flows through the load connected between these two pins is monitored at pin 1.
4	Vs	Supply Voltage for the Power Output Stages. A non-inductive 100nF capacitor must be connected between this pin and ground.
5; 7;	Input1 ; Input2;	TTL Compatible Inputs of the Bridge A.
6; 11;	Enable A; Enable B;	TTL Compatible Enable Input: the L state disables the bridge A (enable A) and/or the bridge B (enable B).
8	GND	GND
9	Vss	Supply Voltage for the Logic Blocks. A100nF capacitor must be connected between this pin and ground.
10; 12;	Input3; Input4;	TTL Compatible Inputs of the Bridge B.
13; 14;	Out 3; Out 4;	Outputs of the Bridge B. The current that flows through the load connected between these two pins is monitored at pin 15.

(1) Table for L298N pin functions

PRINCIPLE

The driver module can drive two motors. The enabled terminals ENA and ENB are effective at high level. The control mode and state of motor A are as shown in table (2):

ENA	IN1	IN2	The State of DC Motor A
0	X	X	Stop
1	0	0	Brake
1	0	1	Rotate Clockwise
1	1	0	Rotate Counterclockwise
1	1	1	Brake

(2) Table for control mode and state of motor A

If you want to regulate the speed of motor A by PWM, you need to set IN1 and IN2, confirm the rotational direction of the motor, and then output PWM pulses for enabled terminals. Please note the motor is in the free stop state when the signal of enabled terminal is 0. When the enabled signal is 1, if IN1 and IN2 are 00 or 11, the motor is in brake state, and the motor stops rotating. If IN1 is 0

and IN2 is 1, the motor A rotates clockwise; if IN1 is 1 and IN2 is 0, the motor A rotates counterclockwise. This is the control method for motor A. The control method for motor B is the same as that for motor A.

INTERFACING MOTOR DRIVER WITH ARDUINO:

Motor driver module is interfaced to Arduino Uno controller and allows the robot's mobility. Pins 6 & 11 of Arduino board are connected to EnableA and EnableB of motor driver & Pins 7,8,9 & 10 are connected to control pins of motor driver (input pins). This connection configures the completion of motor driver interfacing with Arduino. According to the processed data Arduino produces the outputs & it can be used by the motor driver which makes the motor to rotate in clockwise or anticlockwise directions.

MOTOR DRIVING(H-BRIDGE)

Geared DC motors can be defined as an extension of DC motor which already had its Insight details demystified. A geared DC Motor has a gear assembly attached to the motor. The speed of motor is counted in terms of rotations of the shaft per minute and is termed as RPM .The gear assembly helps in increasing the torque and reducing the speed. Using the correct combination of gears in a gear motor, its speed can be reduced to any desirable figure. This concept where gears reduce the speed of the vehicle but increase its torque is known as gear reduction. This Insight will explore all the minor and major details that make the gear head and hence the working of geared DC motor.

EXTERNAL STRUCTURE:-

At the first sight, the external structure of a DC geared motor looks as a straight expansion over the simple DC ones.

The lateral view of the motor shows the outer protrudes of the gear head. A nut is placed near the shaft which helps in mounting the motor to the other parts of the assembly

.

FEATURES OF DC GEAR MOTORS:-

- **Gear materials:** Plastic or metal.
- **Motor types:** Wound-field, permanent-magnet, brushless, intermittent and continuous duty motors.
- **Brush-type and brushless motors:** The brushed motor gains torque from the power supplied to the motor using stationary magnets, commutation and rotating electrical magnets. Brushless motors use a soft magnetic core in the rotor or a permanent magnet, as well as stationary magnets in the housing.
- **Uncommutated motors:**Homopolar motors or ball bearing motors.
- **Connection types:** Shunt, series and compound connections.
- **Motor constants:**Kv and Km.
- **Speed control and reversibility:** Smoothly control a speed down to zero without power circuit switching, even after accelerating in the opposite direction.
- **Dynamic braking and regenerative braking:** Ideal for applications that require quick stops so you don't need a mechanical brake.
- **Magnet types:** Rare earth, ceramic or ferrite magnets.
- **Winding resistance:** Choose a motor that doesn't adversely affect the Km.
- **Gear ratios:** Several varieties available, such as 28:1 or 18:1.
- **Environment:** Motors are available for indoor or outdoor use.
- **Torque multiplication:** Generate a large force at a low speed.
- **Custom-built:** You can have a DC gear motor designed and manufactured to suit your size, power, torque and mounting needs.

CIRCUIT PROPERTIES OF THE PCB

Each trace consists of a flat, narrow part of the copper foil that remains after etching. The resistance, determined by width and thickness, of the traces must be sufficiently low for the current the conductor will carry. Power and ground traces may need to be wider than signal traces. In a multi-layer board one entire layer may be mostly solid copper to act as a ground plane for shielding and power return. For microwave circuits, transmission lines can be laid out in the form of stripline and microstrip with carefully controlled dimensions to assure a consistent impedance. In radio-frequency and fast switching circuits the inductance and capacitance of the printed circuit board conductors become significant circuit elements, usually undesired; but they can be used as a deliberate part of the circuit design, obviating the need for additional discrete components.

SILKSCREEN PRINTING:-

Line art and text may be printed onto the outer surfaces of a PCB usually by screen printing epoxy ink in a contrasting color, but can also be done with dry film like the solder resist. When space permits, the legend can indicate component designators, switch setting requirements, test points, and other features helpful in assembling, testing, and servicing the circuit board. Some digital printing solutions are used instead of screen printing. This technology allows printing variable data onto the PCB, including individual serial numbers as text and bar code.

Figure shows the Layout printed on copper clad.

CHEMICAL ETCHING:-

Figure shows the Unwanted copper removed by etching.

Chemical etching is usually done with ammonium persulfate or ferric chloride. For PTH (plated-through holes), additional steps of electroless deposition are done after the holes are drilled, then copper is electroplated to build up the thickness, the boards are screened, and plated with tin/lead. The tin/lead becomes the resist leaving the bare copper to be etched away.

The simplest method, used for small-scale production and often by hobbyists, is immersion etching, in which the board is submerged in etching solution such as ferric chloride. Compared with methods used for mass

production, the etching time is long. Heat and agitation can be applied to the bath to speed the etching rate. In bubble etching, air is passed through the etchant bath to agitate the solution and speed up etching. Splash etching uses a motor-driven paddle to splash boards with etchant; the process has become commercially obsolete since it is not as fast as spray etching. In spray etching, the etchant solution is distributed over the boards by nozzles, and recirculated by pumps. Adjustment of the nozzle pattern, flow rate, temperature, and etchant composition gives predictable control of etching rates and high production rates.

As more copper is consumed from the boards, the etchant becomes saturated and less effective; different etchants have different capacities for copper, with some as high as 150 grams of copper per litre of solution. In commercial use, etchants can be regenerated to restore their activity, and the dissolved copper recovered and sold. Small-scale etching requires attention to disposal of used etchant, which is corrosive and toxic due to its metal content.

The etchant removes copper on all surfaces exposed by the resist. "Undercut" occurs when etchant attacks the thin edge of copper under the resist; this can reduce conductor widths and cause open-circuits. Careful control of etch time is required to prevent undercut. Where metallic plating is used as a resist, it can "overhang" which can cause short-circuits between adjacent traces when closely spaced. Overhang can be removed by wire-brushing the board after etching.

LAMINATION

"Multi-layer" printed circuit boards have trace layers inside the board. One way to make a 4-layer PCB is to use a two-sided copper-clad laminate, etch the circuitry on both sides, then laminate to the top and bottom prepare and copper foil. Lamination is done by placing the stack of materials in a press and applying

pressure and heat for a period of time. This results in an inseparable one piece product. It is then drilled, plated, and etched again to get traces on top and bottom layers. Finally the PCB is covered with solder mask, marking legend, and a surface finish may be applied. Multi-layer PCB's allow for much higher component density.

DRILLING:-

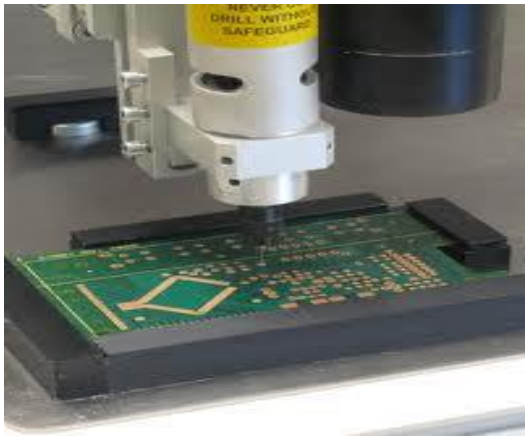


Figure shows the PCB drilling.

Holes through a PCB are typically drilled with small-diameter drill bits made of solid coated tungsten carbide. Coated tungsten carbide is recommended since many board materials are very abrasive and drilling must be high RPM and high feed to be cost effective. Drill bits must also remain sharp so as not to mar or tear the traces. Drilling with high-speed-steel is simply not feasible since the drill bits will dull quickly and thus tear the copper and ruin the boards. The drilling is performed by automateddrilling machines with placement controlled by a *drill tape* or *drill file*. These computer-generated files are also called *numerically controlled drill* (NCD) files or "Excellon files". The drill file describes the location and size of each drilled hole. These holes are often filled with annular rings (hollow rivets) to create vias. Vias allow the electrical and thermal connection of conductors on opposite sides of the PCB.

When very small vias are required, drilling with mechanical bits is costly because of high rates of wear and breakage. In this case, the vias may be evaporated by lasers. Laser-drilled vias typically have an inferior surface finish inside the hole. These holes are called *micro vias*.

It is also possible with *controlled-depth* drilling, laser drilling, or by pre-drilling the individual sheets of the PCB before lamination, to produce holes that connect only some of the copper layers, rather than passing through the entire board. These holes are called *blind vias* when they connect an internal copper layer to an outer layer, or *buried vias* when they connect two or more internal copper layers and no outer layers.

The hole walls for boards with 2 or more layers can be made conductive and then electroplated with copper to form *plated-through holes*. These holes electrically connect the conducting layers of the PCB. For multilayer boards, those with 3 layers or more, drilling typically produces a *smear* of the high temperature decomposition products of bonding agent in the laminate system. Before the holes can be plated through, this smear must be removed by a chemical *de-smear* process, or by *plasma-etch*. The de-smear process ensures that a good connection is made to the copper layers when the hole is plated through. On high reliability boards a process called etch-back is performed chemically with a potassium permanganate based etchant or plasma.

The etch-back removes resin and the glass fibers so that the copper layers extend into the hole and as the hole is plated become integral with the deposited copper.

ADVANTAGES

- **Low Electronic Noise**

When properly laid out, a PCB minimizes electronics noise that could significantly degrade performance. The electrical components on a PCB are organized in such as way that the path lengths of the electrical current between them are minimized, leading to low radiation and pickup of electromagnetic waves. This ensures lower cross-talk between components and between different traces, which is a major concern in electronic circuits.

- **Ease in Diagnostics and Repair**

PCBs are helpful in performing diagnostics for a number of reasons. The components and their polarities on a well-designed PCB are clearly labelled on the board, which is convenient for installation as well as repair. For diagnostics, one often needs to trace signal paths, which would be very difficult to perform if the traces were not exposed and well organized.

- **Compact Size**

A typical PCB contains a large number of electronic components, most of which are very small in size. Without a PCB, it would be nearly impossible to connect such components together with wires. A PCB provides a convenient platform to arrange the electronic components in a compact and efficient way. This compactness allows development of large and complicated electronic circuits in small form factors, taking less space in devices.

- **Immunity to Movement**

Since components on a PCB are held fixed to the board by solder flux, they do not move, irrespective of the movement of the board. This enables the

electronic circuit to be placed in devices that are moving or shaking without worrying about the possibility of component displacement and subsequent electronic short circuits

CHARGING CIRCUIT:-

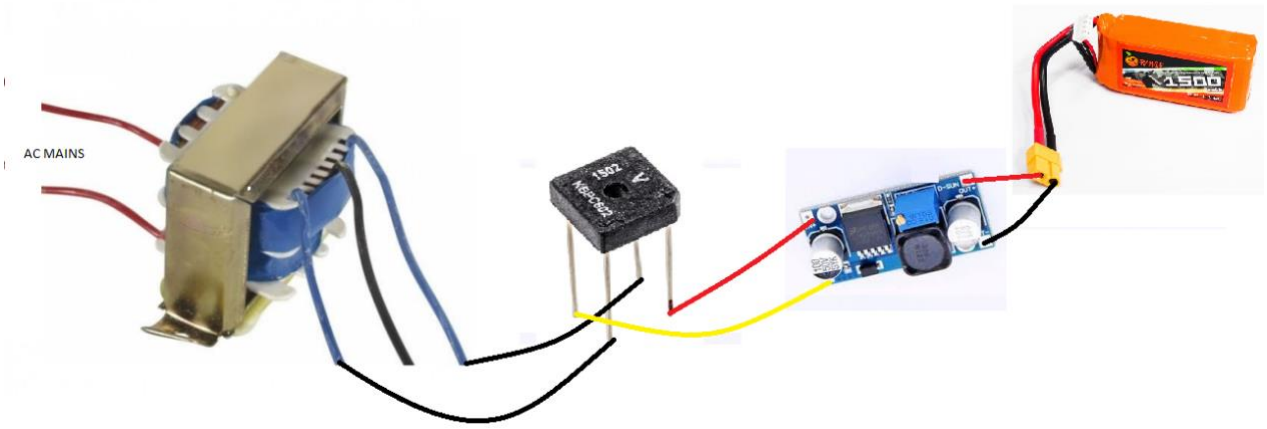


Figure shows the circuit diagram of charging circuit. The input is given from “AC MAINS” to the transformer (12-0-12) it steps down the input voltage from 230 volts to 12v-0-12v. The output of the transformer is given to the bridge rectifier module, which converts the AC supply in to ripple DC voltage and it is given to the buck converter. The buck converter has inbuilt filter circuit and it converts the input DC into variable DC by switching ON and OFF the input voltage continuously. The battery is connected to the output of the buck converter for charging.

11.1 VOLT BATTERY:

ORANGE 11.1V / 1500mAh 3S 30C LiPo battery pack with XT60 connector is equipped with heavy duty discharge leads to minimize resistance and sustain high current loads. The ORANGE 11.1V / 1500mAh 3S 30C LiPo battery pack with XT60 connector have a JST-XH style balance connectors. All Orange Lithium Polymer batteries packs are assembled using IR matched cells. Orange batteries are known for performance, reliability and optimum price also.

It is not surprising to us that Orange Lithium polymer packs are the go-to pack for those in the know. Orange batteries deliver the full rated capacity at a price everyone can afford. The ORANGE 11.1V / 1500mAh 3S 30C LiPo battery pack have a matched resistance and the true balance. These Orange batteries have a good temperature control after high rate discharge.

Features :

1. Product Type: Lithium Polymer Battery Pack
2. The Orange LiPo battery has matched resistance.
3. Good Temperature Control.
4. Minimum weight in Class

Applications:

1.

Future scope: