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Introduction

Speed monitoring and notifying device using Arduino (ARSPEENO) is device used to measure the speed of the armature and to give the update to the mobile connected to the device. THE device is mainly constructed to find the speed of the dc machine. The device measures the speed in terms of rotation per minute(rpm). Usually people use tachometer to find the speed of the dc machine, i.e. man-handled hence accuracy is less compared to machine handling. Therefore, to reduce manhandling and increase accuracy the device is constructed. The device directly reports the data received to the mobile connected to it.

The dc machines are very expensive, and as it is expensive so is its spare parts and maintenance. So, it should be used very efficiently and try maintaining its life spam this can done by controlling voltage and current supplied in it or generated in it. Operators of the dc machines can make sure that the dc machine never exceeds its rated speed and maintain it that way. In thought to that perspective this device is set up and used. As DC machine is most frequently used for a motor. The main benefits of this machine include torque regulation as well as easy speed. The applications of the DC machine are limited to trains, mills, and mines. As examples, underground subway cars, as well as trolleys, may utilize DC motors. In the past, automobiles were designed with DC dynamos for charging their batteries.

The project covers most of the useful concepts of electrical and electronics engineering with some computer languages also. This project shall give information and applicative use of the embedded system (Arduino), IR concepts and its uses, sensors as well. The device programming, circuit diagram and implementation can be used to understand automation system used.

What an Arduino has in it? What does a Bluetooth module do? How are remotes, mobiles, laptops, etc. connected to the home appliance and many more electronic devices we use? What are infrared radiations? How efficiently we can use this radiation to a better cause? How can we reduce the wear and tear of the heavy-duty machines like dc machines? What is the maximum voltage and current a dc machine can sustain and work efficiently? What is the maximum speed it can move with?

This project will be the answers to all the questions above and many more. The speed monitoring and notifying device, the concept behind this will give us the complete knowledge of the electronics in our day to day life.

Theory

Basically, all electric vitality is produced in a pivoting machine, the coordinated generator, and its majority is consumed by electric engines. From numerous points of view, the world's whole innovation depends on these gadgets. The investigation of the conduct of electricmachines depends on three essential standards: Ampere's law, Faraday's law and Newton's Law. Different configurations result and are grouped for the most part by the sort of electrical system to which the machine is associated: direct current(dc) machines or substituting flow (air conditioning) machines. Machines with a dc gracefully are additionally isolated into perpetual magnet and wound field types. The wound motors are additionally grouped by the connections used. The field and armature may have separate sources (independently energized), they might be associated in equal (shunt connected), or they might be (arrangement connected). Machines that have air conditioning are typically single-stage or three stage machines and might be simultaneous or asynchronous. There after segments state quickly raised the fundamental principles on which all standard electric machines work and afterward, for the most regular gadgets, clarify the standards of operation and the parameters for anticipating and comprehension their behaviour.

These machines are heavy working and frequently in use. They more expensive hence we need to carefully handle these machines. Thus, we need to have a control over the speed of the armature in it. The rotational misfortunes of the machine are essentially fixed, expecting the speed of the machine is steady. At whatever point the machine is running, they are present. The copper and brush misfortunes, be that as it may, are an element of the machine load and are proportionate to the current squared. In general, the most extreme productivity of an electrical machine (or transformer) happens when the variable (I^2R) misfortunes are equivalent to the fixed misfortunes. In this way, to run the dc machine at most extreme effectiveness we have to run the machine at appraised speed.

A dc machine can work up to 125% of its of its rated speed, i.e. it can run at a speed of 25% more of its rated speed and further increase in speed will damage the dc machine. On the basis of this theory we are going to build a device that will monitor the speed of the armature and it will send a notification to our mobiles. This can help in controlling the speed in dc machine. Once we control the speed of the dc machine, we can get maximum efficiency with maximum life span. The device uses this phenomenon of the dc machine for avoiding wear and tear in the machine. The infrared radiation will be used to read the rpm of the armature. The output is transmitted to mobile phone by means of wireless serial communication.

An app is developed to connect the device to the mobile it will be done directly through android ide. The operator can mention the speed as input to the app and give the output in rpm. The online android ide can design as per the operator's choice. Or to be on a safer side use android studio to develop this app. But to use android studio it is necessary to learn java coding language. Usually the java codes are used to develop android app in smartphones. Before designing the app make a list of input and output required. The Arduino used is also coded with c or c++ language. As IR transmits IR rays which reflect back to IR receiver and then IR Module generates an output or pulse which is detected by the Arduino controller

when press start button. It counts continuously for 5 seconds. After 5 seconds Arduino calculate RPM for a minute using given formula.

RPM= Count x 12 for only one object rotating body.

Bluetooth is a remote innovation standard utilized for trading information among fixed and cell phones over short separations utilizing short-frequency UHF radio waves in the modern, logical and clinical radio groups, from 2.402 GHz to 2.480 GHz, and building individual zone systems (PANs). It was initially considered as a remote option in contrast to RS-232 information links. The IEEE normalized Bluetooth as IEEE 802.15.1.A ace BR/EDR Bluetooth gadget can speak with a limit of seven gadgets in a piconet (an impromptu PC organize utilizing Bluetooth innovation), however not all gadgets arrive at this greatest. The gadgets can switch jobs, by understanding, and the slave can turn into the ace (for instance, a headset starting an association with a telephone essentially starts as ace—as an initiator of the association—however may accordingly work as the slave).The Bluetooth Core Specification accommodates the association of at least two piconets to frame a dissipate net, in which certain gadgets at the same time assume the ace job in one piconet and the slave job in another. At any given time, information can be moved between the ace and one other gadget (aside from the little-utilized communicate mode). The ace picks which slave gadget to address; normally, it switches quickly starting with one gadget then onto the next in a cooperative design. Since the ace picks which slave to address, though a slave is (in principle) expected to tune in each get opening, being an ace is a lighter weight than being a slave. Being an ace of seven slaves is conceivable; being a captive of more than one ace is conceivable. The detail is ambiguous as to required conduct in dissipate nets.

Sequential port Bluetooth module is completely qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio handset and baseband. It utilizes CSR Blue center 04-External single chip Bluetooth framework with CMOS innovation and with AFH (Adaptive Frequency Hopping Feature). It has the impression as little as 12.7mmx27mm. Expectation it will disentangle your general plan/advancement cycle.

Infrared waves are utilized to gauge the speed of the armature. Infrared waves are not obvious to the natural eye. In the electromagnetic range, infrared radiation can be found between the obvious and microwave districts. The infrared waves commonly have frequencies somewhere in the range of 0.75 and 1000µm.The infrared range can be part into close to IR, mid IR and far IR. The frequency locale from 0.75 to 3µm is known as the close to infrared area. The district somewhere in the range of 3 and 6µm is known as the mid-infrared area, and infrared radiation which has a frequency more prominent higher than 6µm is known as far infrared. The material science behind infrared sensors is represented by three laws:

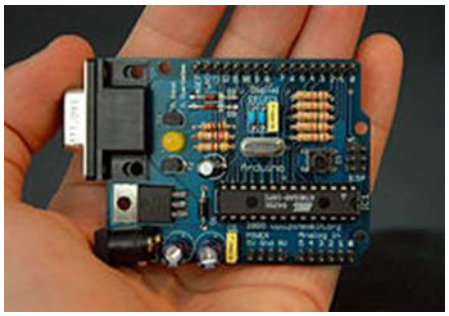
- Planck's radiation law: Every object at a temperature T not equal to 0 K emits radiation
- Stephan Boltzmann Law: The total energy emitted at all wavelengths by a black body is related to the absolute temperature
- Wein's Displacement Law: Objects of different temperature emit spectra that peak at different wavelengths

Components

- Arduino UNO or Genuino UNO
- IR Sensor (containing receiver and transmitter)
- Bluetooth module (HC-05)
- Jumpers (male-female)
- Breadboard
- Mobile (android app build in it)
- USB-A to mini-USB cable
- 5V battery

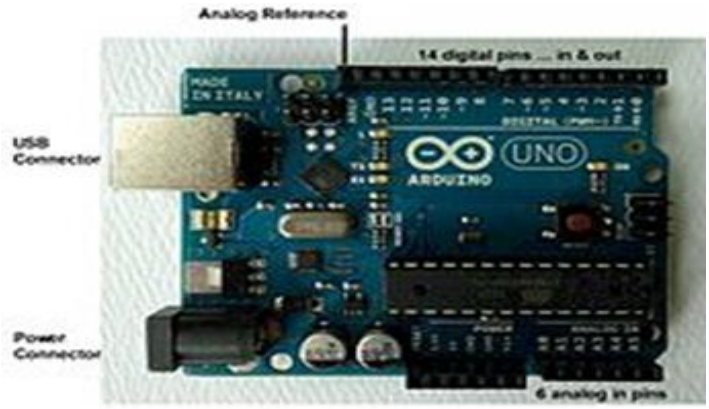
Components Description

ARDUINO



Arduino is an open-source hardware and software company, project and user community that designs and manufactures single-board microcontrollers and microcontroller kits for building digital devices. Its products are licensed under the GNU Lesser General Public License (LGPL) or the GNU General Public License (GPL), permitting the manufacture of Arduino boards and software distribution by anyone. Arduino boards are available commercially in preassembled form or as do-it-yourself (DIY) kits.

Arduino board designs use a variety of microprocessors and controllers. The boards are equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards ('shields') or breadboards (For prototyping) and other circuits. The boards feature serial communications interfaces, including Universal Serial Bus (USB) on some models, which are also used for loading programs from personal computers. The microcontrollers can be programmed using C and C++ programming languages. In addition to using traditional compiler toolchains, the Arduino project provides an integrated development environment (IDE) based on the Processing language project.



Casey Reas is known for co-creating, with Ben Fry, the Processing development platform. The project goal was to create simple, low cost tools for creating digital projects by non-engineers. The Wiring platform consisted of a printed circuit board (PCB) with an ATmega168 microcontroller, an IDE based on Processing and library functions to easily program the microcontroller. Arduino is open-source hardware. The hardware reference designs are distributed under a Creative Commons Attribution Share-Alike 2.5 license and are available on the Arduino website. Layout and production files for some versions of the hardware are also available.

An early Arduino board with an RS-232 serial interface (upper left) and an Atmel ATmega8 microcontroller chip (black, lower right); the 14 digital I/O pins are at the top, the 6 analog input pins at the lower right, and the power connector at the lower left.

Most Arduino boards consist of an Atmel 8-bit AVR microcontroller (ATmega8,[24] ATmega168, ATmega328, ATmega1280, or ATmega2560) with varying amounts of flash memory, pins, and features. The 32-bit Arduino Due, based on the Atmel SAM3X8E was introduced in 2012. The boards use single or double-row pins or female headers that facilitate connections for programming and incorporation into other circuits. These may connect with add-on modules termed shields. Multiple and possibly stacked shields may be individually addressable via an I²C serial bus. Most boards include a 5 V linear regulator and a 16 MHz crystal oscillator or ceramic resonator. Some designs, such as the LilyPad, run at 8 MHz and dispense with the onboard voltage regulator due to specific form-factor restrictions.

Arduino microcontrollers are pre-programmed with a boot loader that simplifies uploading of programs to the on-chip flash memory. The default bootloader of the Arduino Uno is the Opti boot bootloader. Boards are loaded with program code via a serial connection to another computer. Some serial Arduino boards contain a level shifter circuit to convert between RS-232 logic levels and transistor–transistor logic (TTL) level signals. Current Arduino boards are programmed via Universal Serial Bus (USB), implemented using USB-to-serial adapter chips such as the FTDI FT232. Some boards, such as later-model Uno boards, substitute the FTDI chip with a separate AVR chip containing USB-to-serial firmware, which is reprogrammable via its own ICSP header. Other variants, such as the Arduino Mini and the unofficial Boarduino, use a detachable USB-to-serial adapter board or cable, Bluetooth or other methods. When used with traditional microcontroller tools, instead of the Arduino IDE, standard AVR in-system programming (ISP) programming is used. An official Arduino Uno R2 with descriptions of the I/O locations. The Arduino board exposes most of the microcontroller's I/O pins for use by other circuits. The Diecimila, [a] Duemilanove, [b] and current Uno[c] provide 14 digital I/O pins, six of which can produce pulse-width modulated signals, and six analog inputs, which can also be used as six digital I/O pins. These pins are on the top of the board, via female 0.1-inch (2.54 mm) headers. Several plug-in application shields are also commercially available. The Arduino Nano, and Arduino-compatible Bare Bones Board and Boarduino boards may provide male header pins on the underside of the board that can plug into solderless breadboards.

Many Arduino-compatible and Arduino-derived boards exist. Some are functionally equivalent to an Arduino and can be used interchangeably. Many enhance the basic Arduino

by adding output drivers, often for use in school-level education, to simplify making buggies and small robots. Others are electrically equivalent, but change the form factor, sometimes retaining compatibility with shields, sometimes not. Some variants use different processors, of varying compatibility instead of continuing the work on Wiring, they forked the project and renamed it Arduino.

IDE

The Arduino integrated development environment (IDE) is a cross-platform application (for Windows, macOS, and Linux) that is written in the programming language Java. It originated from the IDE for the languages Processing and Wiring. It includes a code editor with features such as text cutting and pasting, searching and replacing text, automatic indenting, brace matching, and syntax highlighting, and provides simple one-click mechanisms to compile and upload programs to an Arduino board. It also contains a message area, a text console, a toolbar with buttons for common functions and a hierarchy of operation menus. The source code for the IDE is released under the GNU General Public License, version 2.

The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. User-written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub main () into an executable cyclic executive program with the GNU toolchain, also included with the IDE distribution. The Arduino IDE employs the program argued to convert the executable code into a text file in hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's firmware.

Pro IDE

The system still uses Arduino CLI (Command Line Interface), but improvements include a more professional development environment, autocompletion support, and Git integration. The main features available in the alpha release are:

- Modern, fully featured development environment
- Dual Mode, Classic Mode (identical to the Classic Arduino IDE) and Pro Mode (File System view)
- New Board Manager
- New Library Manager
- Board List
- Basic Auto-Completion (Arm targets only)
- Git Integration
- Serial Monitor

PROXIMITY IR SENSOR

This IR Proximity Sensor is a multipurpose infrared sensor which can be used for obstacle sensing, color detection, fire detection, line sensing, etc. and also as an encoder sensor. The sensor provides a digital output.

The sensor gives the output as logical high when there is an object placed Infront of the sensor and logical 0 or low when there is no object present. IR sensors are highly susceptible to ambient light and the IR sensor on this sensor is suitably covered to reduce effect of ambient light on the sensor. The sensor has a maximum range of around 40-50 cm indoors and around 15-20 cm outdoors.

Features:

- Can be used for obstacle sensing, color detection (between basic contrasting colors)
- Comes with an easy to use digital output
- Can be used for wireless communication and sensing IR remote signals
- Sensor comes with ambient light protection
- The sensor a hole of 3mm diameter for easy mounting

Specification:

- Operational Voltage: 5V
- Ambient Light & RGB Color Sensing
- Proximity Sensing
- Gesture Detection

HC-05 Bluetooth Module

HC-05 module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. The HC-05 Bluetooth Module can be used in a Master or Slave configuration, making it a great solution for wireless communication. This serial port Bluetooth module is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband. It uses CSR Blue core 04-External single chip Bluetooth system with CMOS technology and with AFH (Adaptive Frequency Hopping Feature).

Bluetooth Module 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

Hardware Features

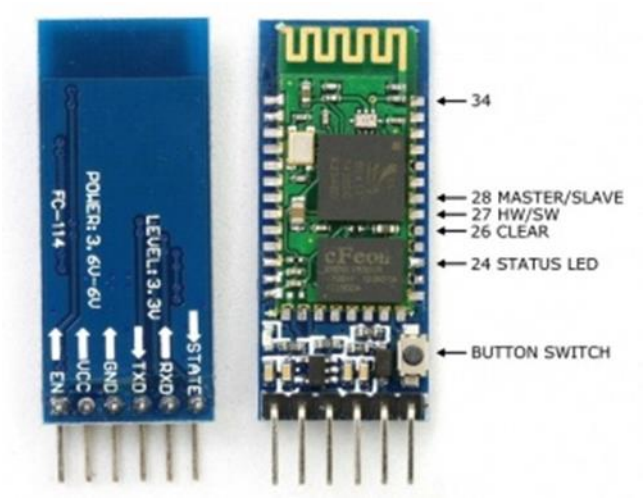
- Typical -80dBm sensitivity.
- Up to +4dBm RF transmit power.
- 3.3 to 5 V I/O.
- PIO (Programmable Input/Output) control.
- UART interface with programmable baud rate.
- With integrated antenna.
- With edge connector.

Software Features

- Slave default Baud rate: 9600, Data bits:8, Stop bit:1, Parity: No parity.
- Auto-connect to the last device on power as default.
- Permit pairing device to connect as default.
- Auto-pairing PINCODE:”1234” as default.

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 act 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 another 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.

How to connect HC05 Bluetooth module with Arduino Uno?

Hardware and Software Required

- HC-05 Bluetooth Module
- Arduino Uno
- Arduino IDE (1.0.6V)

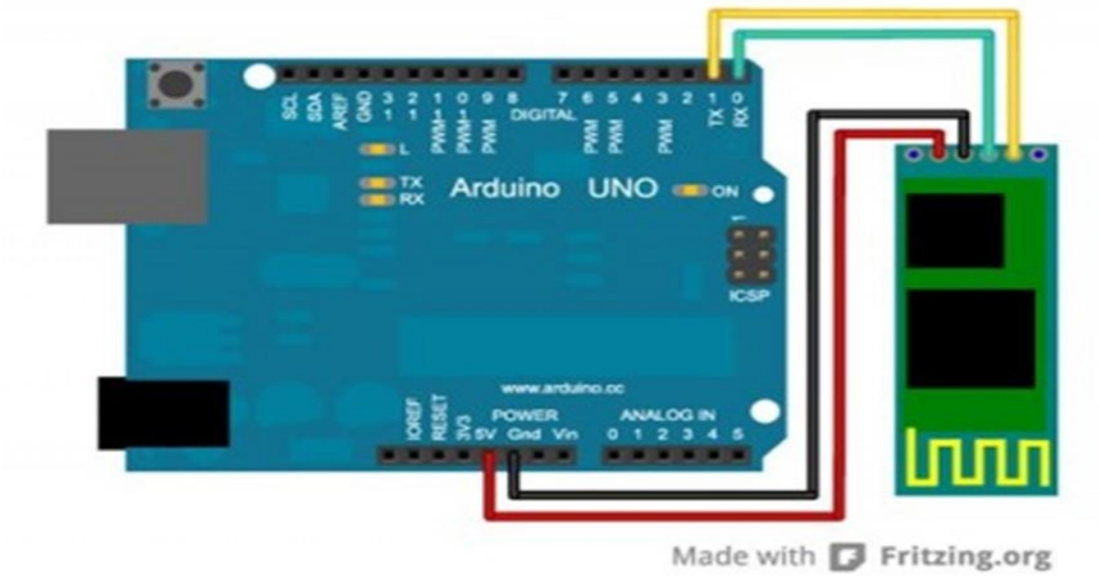
Hardware Connections

Vcc and Gnd of the module goes to Vcc and Gnd of Arduino. The TXD pin goes to RXD pin of Arduino and RXD pin goes to TXD pin of Arduino i.e. (digital pin 0 and 1). The user can use the on board Led. But here, led is connected to digital pin 12 externally for betterment of the process.

Program for HC-05 Bluetooth Module

The program given below is the HC-05 Bluetooth module program. This process is quite different from others since we are going to use android mobile to control and communicate with Arduino. Here the Bluetooth module acts as an interface between our mobile and Arduino board. Before getting into the execution process, follow the given procedure:

- The user should install an application from the play store or develop an application using android studio or online IDE.
- After installation, pair the Bluetooth module to your mobile as like connecting one device to other using Bluetooth.
- Upload the given program to the Arduino Uno board. After uploading the code, unplug the USB from the Arduino.
- Now use external power adapter to power the Uno board.



Working of the Project

The speed monitoring and notifying device using Arduino works on the basis of the concept that speed of the dc machine can be increased up to 125% of its rated speed. The ARSPEENO device measure the speed of the armature of the dc machine. The speed of the armature is to be counted on the basis of rotation per minute (rpm). The IR sensor containing transmitter and receiver will connected to Arduino UNO. This Arduino UNO will be connected to the Bluetooth module to transmit the data to mobile via serial Bluetooth communication.

This device works on three steps, they are:

- Transmission

A small strip of aluminium foil will be tug to the armature of the dc machine. The IR sensor will sense the aluminium foil by transmitting infrared radiation. This will rebound back and the receiver will receive the radiation. This data will be processed as a rotation. The no. of times the sensor will sense the aluminium foil in a minute will be taken as rpm or speed of the armature. Every time the aluminium foil appears a signal is passed to the Arduino UNO by IR sensor. The signal will be passed through the output pin of the IR sensor. The IR sensor works as a data transmitter.

- Processing unit

Once the signal is passed by IR sensor to Arduino UNO the Arduino continuously runs for 5 seconds and takes the input from IR sensor for only 5 seconds therefore the rpm is calculated by multiplying the rotation with 12. This will give us the speed of the armature in terms of rpm. The data from IR sensor is read by Arduino and output on the basis of signals and calculations is generated. The Arduino is programmed to

1. Receive the data
2. Read the data
3. Calculate using the input data
4. Generate the output
5. Transmit the output.

Once the calculation work is done the Arduino Uno will generate the output to be sent. The IR sensor output is connected to the input pin of the Arduino UNO i.e. is pin no. 2. Basically, use of c programming or c++ programming language is done to program the Arduino, even Genuino UNO can be used. The Arduino is called as processing unit because, as listed above it works on the five important aspects of the project. The Arduino UNO is connected should

be programmed using USB cord. Arduino board is connected to other components of the device

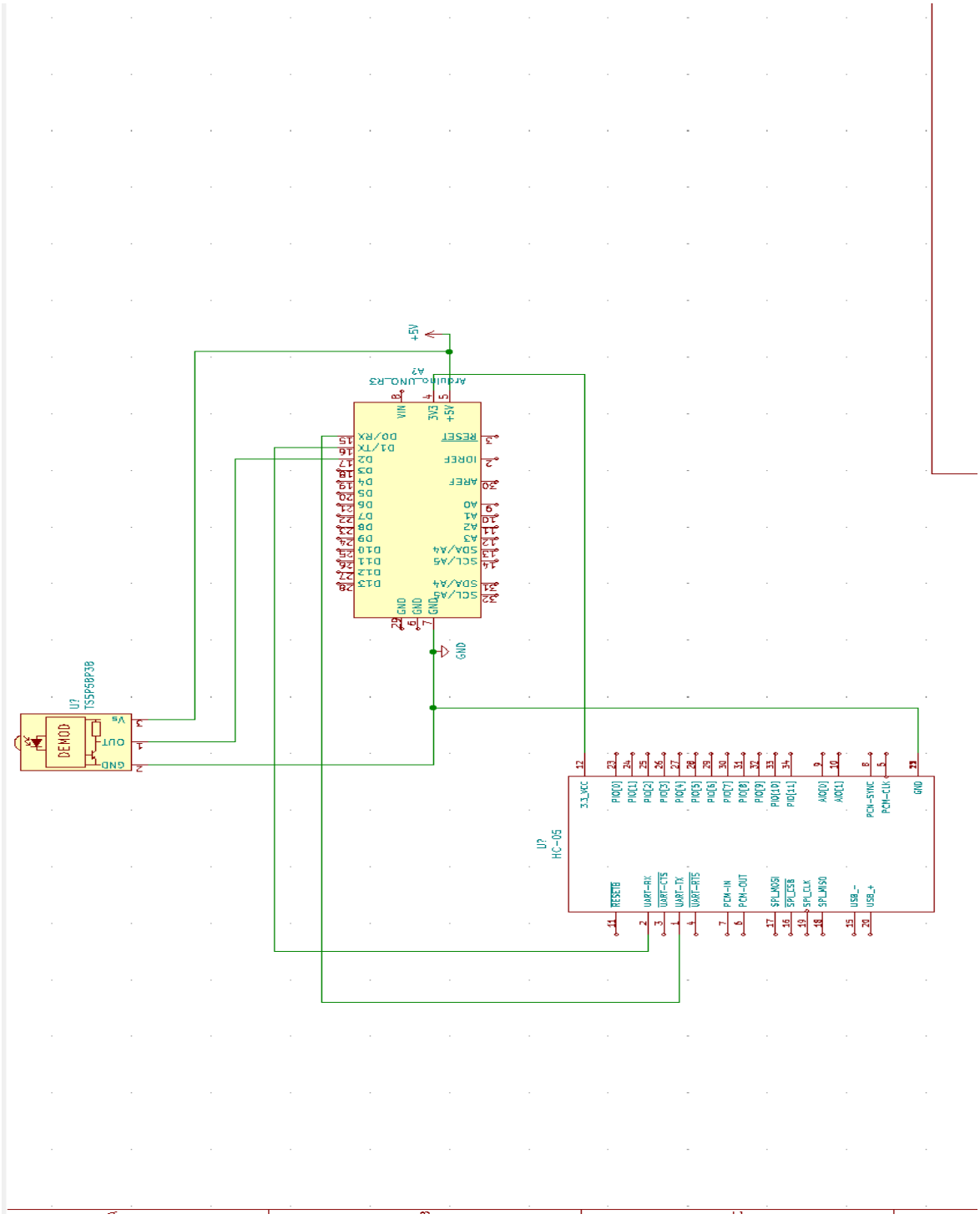
with jumpers. This device is connected to 5V supply.

- Receiver

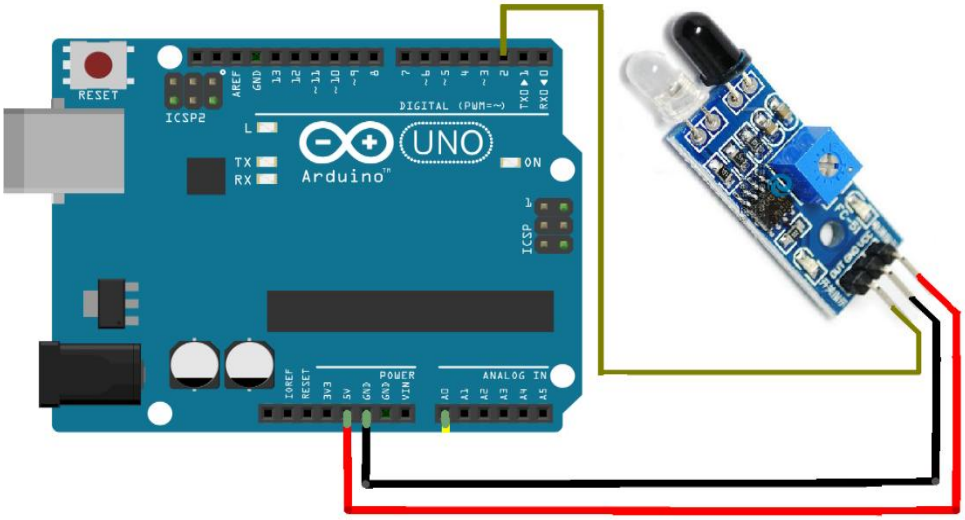
The receiver part is basically unit of two, one is Bluetooth module the other one is mobile. With the help of IDE (we are using MIT app), you can use either same IDE or different one as per your convenience. Or even you can use android studio, but it's necessary to learn java coding build an app. This app will be installed in mobile phone that has to be connected to the device.

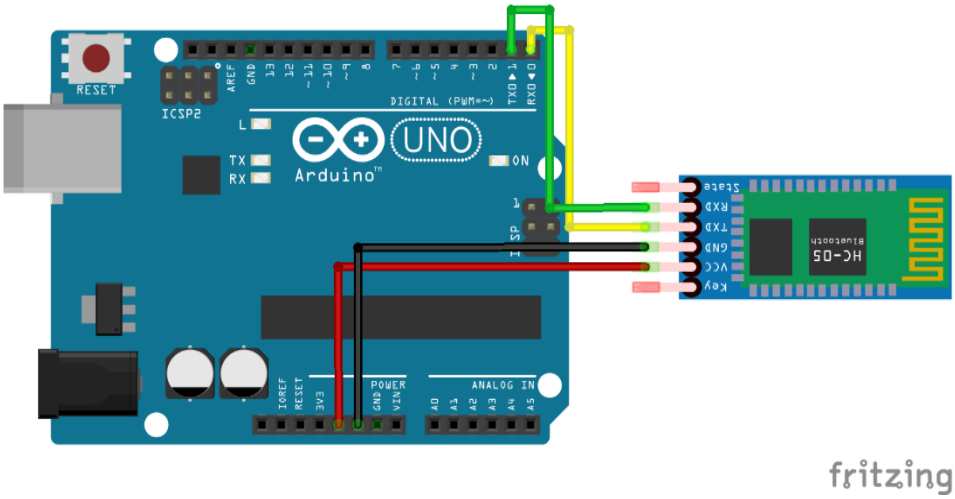
Once the app is developed the next stage is input to the app. The device in whole will work as such; the operator is going to give the required speed in rpm and the rated speed of the dc machine. The device will be placed in front of the rotor of the dc machine. Once the machine starts and reaches the required speed it will indicate or drop a notification to mobile phone the next notification will be given when it will reach the rated speed. The dc machine can work up to 125% of its rated speed, therefore once the machine reaches 110% of its rated speed it will notify on the mobile connected and next when it reaches 120% of its rated speed and finally at 125% it notifies for the last time. This how the device will work on stage. This way our device ARSPEENO works in three steps.

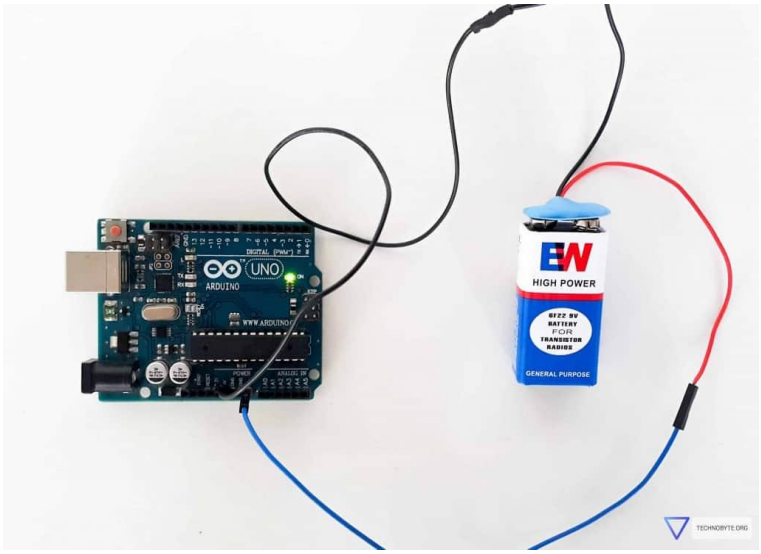
Circuit Diagram



Hardware Pictures






UNO
ARDUINO
HIGH POWER
GENERAL PURPOSE


10:47
ARSEENO
Speed Required
1490
Rated Speed
1500
SUBMIT
1489
RPM

Conclusion

The device is built and its aim is achieved, i.e. it successfully measured the speed of the dc machine. The device measured the speed within an acceptable range of error, and sending that information at a higher update rate then similar projects have done before. Moving time expensive floating-point calculations of the Arduino and performance of that on the base station helped to speed up execution time. The project is a valuable experience in the design, implementation, and testing of device that involved several discrete hardware and software components.

Ultimately the device accomplished its primary goal of presenting speed information of the dc machine in a clear way. This machine will finally read speed of the dc machine and will help the operator to work on machine single headedly. It helps in dc machine maintenance also. The device is really affordable and can be developed in many ways. The working of the device can be used in factories for monitoring large no. of dc machines.

Applications

- Since, man handling accuracy very low, hence by fixing device to the dc machine more precise value of speed can observed.

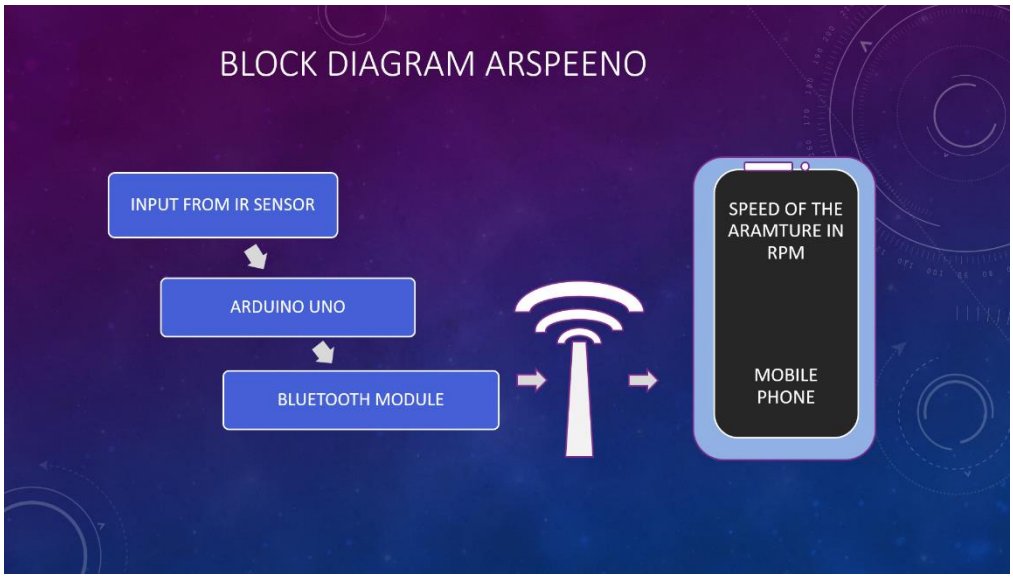
- The work headed by two manpower can be reduced to one since always there required one person to hold the tachometer to record speed.

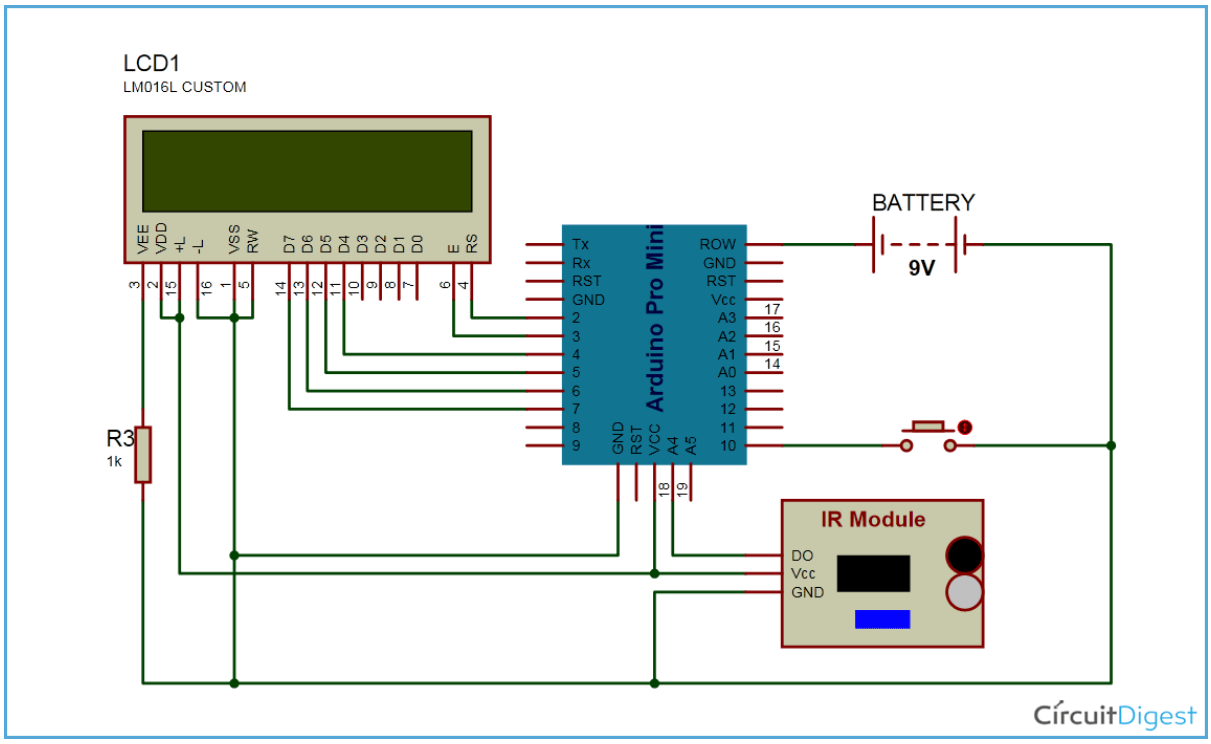
- This device can be used in vehicles to record their efficiency.

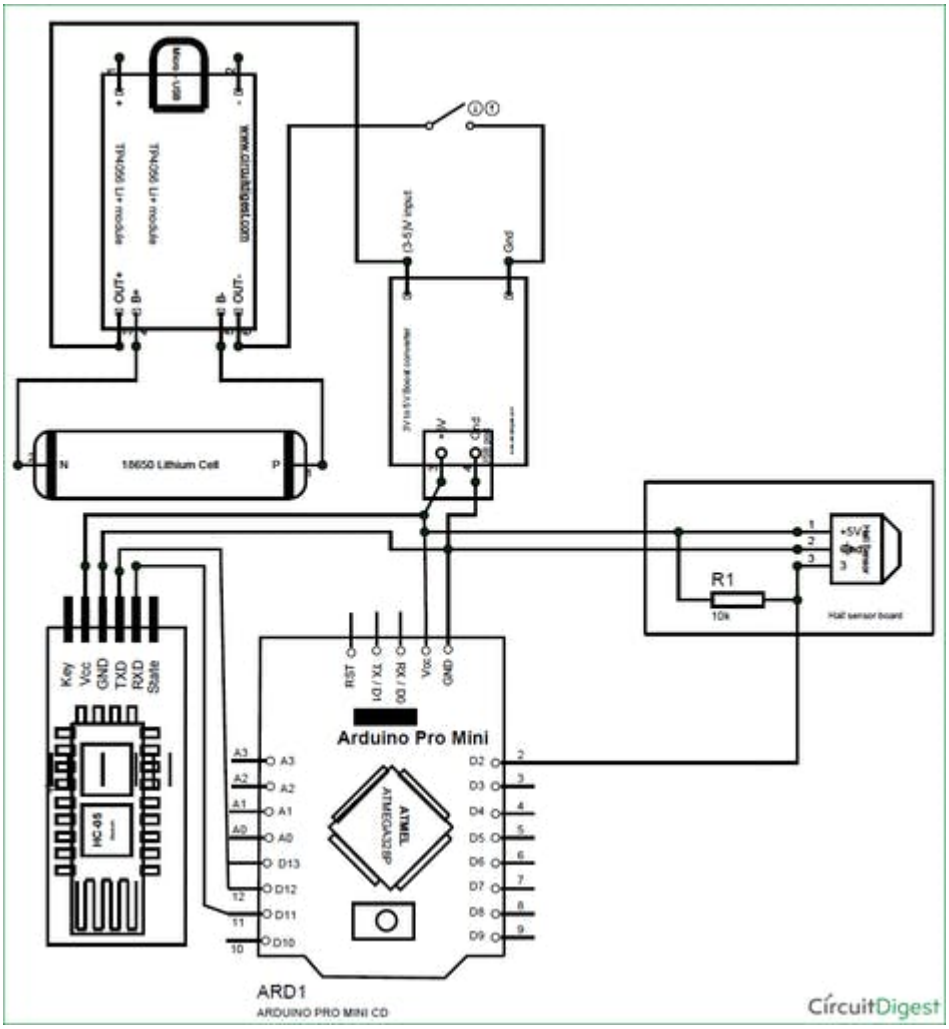
- This device can also be used to monitor speed of any running or rotating machine.

  Since it is wireless notifier, we can use it machine spaces where a person's hand can't reach.

Appendices


BLOCK DIAGRAM ARSPEENO
INPUT FROM IR SENSOR
ARDUINO UNO
BLUETOOTH MODULE
SPEED OF THE ARAMTURE IN RPM
MOBILE PHONE


LCD1
LM016L CUSTOM
VEE VDD +L -L VSS RW D7 D6 D5 D4 D3 D2 D1 D0 E RS
Arduino Pro Mini
Tx Rx RST GND ROW GND RST Vcc A3 A2 A1 A0
BATTERY
9V
R3
1k
IR Module
DO
Vcc
GND
CircuitDigest


18650 Lithium Cell
R1
10k
Arduino Pro Mini
ATMEGA328P
ATMEL
ARD1
ARDUINO PRO MINI CD
CircuitDigest