

Anti - Theft Protection Of Vehicle By GSM & GPS With Fingerprint Verification

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Abstract

As of late vehicle tracking system is getting huge ubiquity in view of the rising number of the taken vehicles. Vehicle burglary is going on leaving and now and again driving in unbound spots. This examination work investigates how to stay away from this sort of taking and gives greater security to the vehicles. The executed system contains single-board inserted system which is furnished with global system for mobile (GSM) and global positioning system (GPS) alongside a microcontroller introduced in the vehicle. The utilization of GSM and GPS advancements enables the system to follow the article and gives the most exceptional data about on-going excursions. Additionally, unique mark confirmation is done in the actualized system to guarantee the driving of right individual. The actualized system is extremely basic with more noteworthy security for vehicle hostile to burglary insurance and minimal effort procedure contrasted with others.

Keywords: Fingerprint recognition, Global Positioning System, GSM, Satellites, Microcontrollers, Receivers, Antennas

INTRODUCTION

A huge number of automobiles are lost every year in the state and a large number of automobiles are likewise recouped by the Police from when they get the offenders or in any event, when the guilty parties leave the vehicles they have taken after they have

utilized them. The standard issue with the recouped vehicles arriving at the genuine proprietors is that the vehicle need not be found in a similar locale as one in which the protest was propelled. Along these lines, when a vehicle is recouped, typically the Police attempt to follow out the genuine proprietor of the vehicle from the RTO dependent on the permit and undercarriage number. Yet, this is an extensive and tedious procedure for the RTO to follow out the real proprietors from the records and educate back to the Police stations. Due to these postponements, vehicles that are recuperated all lengthy timespan to really arrive at their proprietors. A few security and tracking systems are intended to help enterprises with huge number of vehicles and a few utilization purposes. An armada the board system can limit the expense and exertion of representatives to complete street assignments inside an insignificant time.

This task comprises of an android based remote vehicle separating system will give compelling, constant vehicle area, mapping and revealing this data worth and include by improving the degree of administration gave. A vehicle tracking system will advise where your vehicle is and where it has been, to what extent it has been. The system utilizes geographic position and time data from the Global Positioning Satellites. The system has an "On-Board Module" which dwells in the vehicle to be followed and a

"Base Station" that screens information from the different vehicles.

HARDWARE IMPLEMENTATION OF THE PROJECT

It discusses the design and working of the design with the help of block diagram and circuit diagram and explanation of circuit diagram in detail. It explains the features, timer programming, serial communication, interrupts of atmega328 microcontroller. It also explains the various modules used in this project.

Project Design

Hardware implementation deals in drawing the schematic on the plane paper according to the application, testing the schematic design over the breadboard using the various IC's to find if the design meets the objective, carrying out the PCB layout of the schematic tested on breadboard, finally preparing the board and testing the designed hardware.

The project design and principle are explained in this chapter using the block diagram and circuit diagram. The block diagram discusses about the required components of the design and working condition is explained using circuit diagram and system wiring diagram.

INTRODUCTION TO MICROCONTROLLER

Based on the Processor side Embedded Systems is mainly divided into 3 types

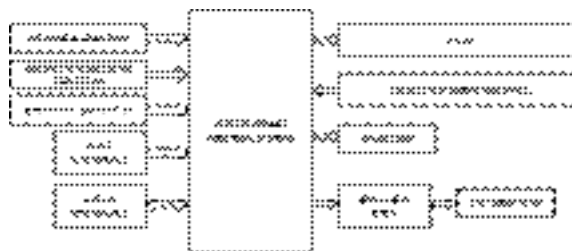
1. **Micro Processor** : - are for general purpose eg: our personal computer
2. **Micro Controller**:- are for specific applications, because of cheaper cost we will go for these
3. **DSP (Digital Signal Processor)**:- are for high and sensitive application purpose

Microprocessor vs. Microcontroller	
Microprocessor	Microcontroller
CPU is stand alone RAM, ROM, I/O, timer are separate	CPU, RAM, ROM, I/O and timer are all on a single chip
Designer can decide on the amount of ROM, RAM and I/O ports.	Fix amount of on chip ROM, RAM, I/O Ports.
Expansive, Versatility	For applications in which cost, power and space are critical
General purpose	Single purpose

Table: Microprocessor vs. Microcontroller

Block Diagram of the Project

The block diagram of the design is as shown in Fig 3.1. It consists of power supply unit, Arduino MEGA, GSM, GPS, Fingerprint module, LCD, motor and buzzer.



BLOCK DIAGRAM

ARDUINO MEGA:

The Arduino Mega 2560 is a microcontroller board based on the ATmega2560 (datasheet). It has 54 digital input/output pins (of which 14 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button.

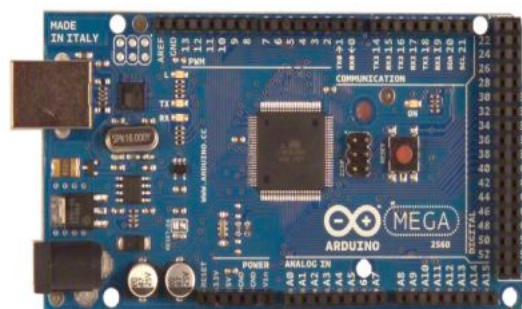
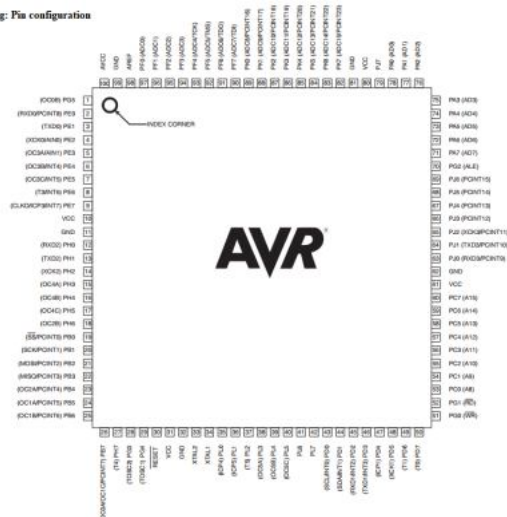


Fig: Arduino Mega

Technical specifications:

Feature	Value
Microcontroller	ATmega2560
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limits)	6-20V
Digital I/O Pins	54 (of which 14 provide PWM output)
Analog Input Pins	16
DC Current per I/O Pin	40mA
DC Current for 3.3V Pin	50mA
Flash Memory	256 KB of which 8 KB used by bootloader
SRAM	8KB
EEPROM	4KB
Clock Speed	16MHz

Fig: Pin configuration



Pin description:

5V & 3.3V: This pin is used to provide output regulated voltage around 5V. This regulated power supply powers up the controller and other components on the board. It can be obtained from Vin of the board or USB cable or another regulated 5V voltage supply. While another voltage regulation is provided by 3.3V pin. Maximum power it can draw is 50mA.

GND: There are 5 ground pins available on the board which makes it useful when more than one ground pins are required for the project.

Vin: It is the input voltage supplied to the board which ranges from 7V to 20V. The voltage provided by the power jack can be accessed through this pin. However, the

output voltage through this pin to the board will be automatically set up to 5V.

Serial Communication: RXD and TXD are the serial pins used to transmit and receive serial data i.e. Rx represents the transmission of data while Tx used to receive data. There are four combinations of these serial pins are used where Serial 0 contains RX(0) and TX(1), Serial 1 contains TX(18) and RX(19), Serial 2 contains TX(16) and RX(17), and Serial 3 contains TX(14) and RX(15).

External Interrupts: Six pins are used for creating external interrupts i.e. interrupt 0(0), interrupt 1(3), interrupt 2(21), interrupt 3(20), interrupt 4(19), interrupt 5(18). These pins produce interrupts by a number of ways i.e. providing LOW value, rising or falling edge or changing value to the interrupt pins.

LED: This board comes with built-in LED connected to digital pin 13. HIGH value at this pin will turn the LED on and LOW value will turn it off. This gives you the change of nursing your programming skills in real time.

Analog Pins: There are 16 analog pins incorporated on the board labeled as A0 to A15. It is important to note that all these analog pins can be used as digital I/O pins. Each analog pin comes with 10-bit resolution. These pins can measure from ground to 5V. However, the upper value can be changed using AREF and analogReference() function.

I2C: Two pins 20 and 21 support I2C communication where 20 represents SDA (Serial Data Line mainly used for holding the data) and 21 represents SCL(Serial Clock Line mainly used for providing data synchronization between the devices)

SPI Communication: SPI stands for Serial Peripheral Interface used for the transmission of data between the controller and other peripherals components. Four pins i.e. 50 (MISO), 51 (MOSI), 52 (SCK), 53 (SS) are used for SPI communication.

Input and output

Each of the 54 digital pins on the Mega can be used as an input or output, using pinMode(), digitalWrite(), and digitalRead() functions. They operate at 5 volts. Each pin can provide or receive a maximum of 40 mA and has an internal pull-up resistor (disconnected by default) of 20-50 kOhms.

In addition, some pins have specialized functions:

- Serial: 0 (RX) and 1 (TX); Serial 1: 19 (RX) and 18 (TX); Serial 2: 17 (RX) and 16 (TX); Serial 3: 15 (RX) and 14 (TX). Used to receive (RX) and transmit (TX) TTL serial data. Pins 0 and 1 are also connected to the corresponding pins of the ATmega8U2 USB-to-TTL Serial chip .

Memory:

The ATmega2560 has 256 KB of flash memory for storing code (of which 8 KB is used for the bootloader), 8 KB of SRAM and 4 KB of EEPROM (which can be read and written with the EEPROM library).

There are a couple of other pins on the board:

- AREF. Reference voltage for the analog inputs. Used with analogReference().
- Reset. Bring this line LOW to reset the microcontroller. Typically used to add a reset button to shields which block the one on the board.

Communication

The Arduino Mega2560 has a number of facilities for communicating with a computer, another Arduino, or other microcontrollers. The ATmega2560 provides four hardware UARTs for TTL (5V) serial communication. An ATmega8U2 on the board channels one of these over USB and provides a virtual com port to software on the computer (Windows machines will need a .inf file, but OSX and Linux machines will recognize the board as a COM port automatically).

Automatic (software reset)

The Arduino software uses this capability to allow you to upload code by simply pressing the upload button in the Arduino environment. This means that the bootloader can have a shorter timeout, as the lowering of DTR can be well-coordinated with the start of the upload. This setup has other implications. When the Mega2560 is connected to either a computer running Mac OS X or Linux, it resets each time a connection is made to it from software (via USB). For the following half-second or so, the bootloader is running on the Mega2560. While it is programmed to ignore malformed data (i.e. anything besides an upload of new code), it will intercept the first few bytes of data sent to the board after a connection is opened. If a sketch running on the board receives one-time configuration or other data when it first starts, make sure that the software with which it communicates waits a second after opening the connection and before sending this data. The Mega contains a trace that can be cut to disable the auto-reset. The pads on either side of the trace can be soldered together to re-enable it. It's labeled "RESET-EN". You may also be able to disable the auto-reset by connecting a 110 ohm resistor from 5V to the reset line.

Physical characteristics and shield compatibility

The maximum length and width of the Mega PCB are 4 and 2.1 inches respectively, with the USB connector and power jack extending beyond the former dimension. Three screw holes allow the board to be attached to a surface or case. Note that the distance between digital pins 7 and 8 is 160 mil (0.16"), not an even multiple of the 100 mil spacing of the other pins.

Further the main UART (serial port) is located on the same pins (0 and 1), as are external interrupts 0 and 1 (pins 2 and 3 respectively). SPI is available through the ICSP header on both the Mega and

Duemilanove / Diecimila. Please note that I2C is not located on the same pins on the Mega (20 and 21) as the Duemilanove / Diecimila (analog inputs 4 and 5).

Choosing the right controller

The table below compares the Arduino Uno, Leonardo, and our A-Star 32U4 Prime controllers. The A-Star Primes are based on the same ATmega32U4 AVR microcontroller as the Leonardo and ship with Arduino-compatible bootloaders. The Primes also offer many advantages, including superior power management that enables efficient operation from 2.7 V to 11.8 V (LV version) or 5 V to 36 V (SV version).

	Arduino Uno R3	Arduino Leonardo	A-Star 32U4 Prime LV	A-Star 32U4 Prime SV
Microcontroller	ATmega328P	ATmega32U4	ATmega32U4	ATmega32U4
Clock	16 MHz resonator	16 MHz crystal	16 MHz crystal	16 MHz crystal
User I/O lines	20	23	23	26
PWM outputs	6	7	7	7
Analog inputs	6	12	12	12
Ground access points	4	4	4	43
User LEDs	1	1	1	1
User pushbuttons	—	—	—	1
Reset button	—	—	—	—
Power switch	—	—	—	—
Buzzer option	—	—	—	—
microSD option	—	—	—	—
LCD option	—	—	—	—
Arduino-compatible bootloader	—	—	—	—
USB connector	B	Micro-B	Micro-B	Micro-B
USB regulator	partial	partial	partial	partial
High-performance reverse voltage protection	—	—	—	—
Recommended input voltage:	7 V to 12 V	7 V to 12 V	2 V to 16 V	5 V to 36 V
Regulator type (5 V)	linear	linear	switching step-up/step-down	switching step-down
Available:	at 3 V in: 0.5 A at 5 V in: 1.5 A at 9 V in: 0.5 A at 11 V in: 0.55 A at 24 V in: 0.5 A ⁽²⁾	at 3 V in: 0.5 A at 5 V in: 1.5 A at 9 V in: 0.5 A at 11 V in: 0.55 A at 24 V in: 0.5 A ⁽²⁾	at 3 V in: 0.5 A at 5 V in: 1.5 A at 9 V in: 0.5 A at 11 V in: 0.55 A at 24 V in: 0.5 A ⁽²⁾	at 3 V in: 0.2 A at 5 V in: 1.0 A at 9 V in: 1.0 A at 11 V in: 1.0 A at 24 V in: 1.9 A ⁽²⁾
Weight	28 g	20 g	13 g to 33 g	13 g to 33 g

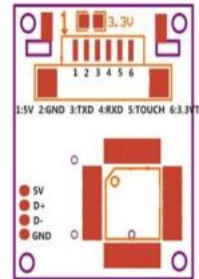
1 There is more available 5 V output current via VREG, see maximum regulator output current graph for details.
2 With sufficient USB power supply.

Fingerprint module R3-07:

R307 fingerprint module is a finger print sensor with TTL UART interface. The user can store the fingerprint data in the module and can configure it in 1:1 or 1: N mode for identifying the person. The FP module can directly interface with 3.3 or 5v Microcontroller. A level converter (like MAX232) is required for interfacing with PC serial port. R307 Fingerprint Module consists of high-speed DSP processor, high-performance fingerprint alignment algorithm, high-capacity FLASH chips and other hardware and software composition, stable performance, simple structure, with fingerprint entry, image processing, fingerprint matching, search and template storage and other functions.

Pin description

Pin Number	Name	Type	Function Description
1	5V	in	Power input (DC4.2V-6V)
2	GND	-	Signal ground. Connected to power ground
3	TXD	Out	Data output, TTL logical level
4	RXD	In	Data input, TTL logical level
5	Touch	Out	Finger detection signal (maximum output current: 50mA)
6	3.3V	In	Finger detection power (DC3.3V-5V, about 5uA)



Working environment:

- Temperature: -20 °C - +40 °C
- Relative humidity: 40% RH-85% RH (no condensation)

Storage environment:

- Temperature: -40 °C - +85 °C
- Relative humidity: <85% H (no condensation)

Working principle:

Fingerprint processing includes two parts, fingerprint enrollment and fingerprint matching (the matching can be 1:1 or 1:N). When enrolling, user needs to enter the finger two times. The system will process the two time finger images, generate a template of the finger based on processing results and store the template.

For 1:1 matching, system will compare the live finger with specific template designated in the Module; for 1:N matching, or searching, system will search the whole finger library for the matching finger. In both circumstances, system will return the matching result, success or failure.

Hardware connection

Via serial interface, the Module may communicate with MCU of 3.3V or 5V power: TXD (pin 3 of P1) connects with RXD (receiving pin of MCU), RXD (pin 4 of P1) connects with TXD (transferring pin of MCU). Should the upper computer (PC) be in RS-232 mode, please add level converting circuit, like MAX232, between the Module and PC.

Mobile Telephony Standards

Standard	Generation	Frequency band	Throughput
GSM	2G	Allows transfer of voice or low-volume digital data.	9.6 kbps
GPRS	2.5G	Allows transfer of voice or moderate-volume digital data.	21.4-171.2 kbps
EDGE	2.75G	Allows simultaneous transfer of voice and digital data.	43.2-345.6 kbps
UMTS	3G	Allows simultaneous transfer of voice and high-speed digital data.	0.144-2 Mbps

1G

The first generation of mobile telephony (written **1G**) operated using analogue communications and portable devices that were relatively large. It used primarily the following standards:

- **AMPS** (Advanced Mobile Phone System), which appeared in 1976 in the United States, was the first cellular network standard. It was used primarily in the Americas, Russia and Asia. This first-generation analogue network had weak security mechanisms which allowed hacking of telephones lines.
- **TACS** (Total Access Communication System) is the European version of the AMPS model. Using the 900 MHz frequency band, this system was largely used in England and then in Asia (Hong-Kong and Japan).
- **ETACS** (Extended Total Access Communication System) is an improved version of the TACS standard developed in the United Kingdom that uses a larger number of communication channels.

The first-generation cellular networks were made obsolete by the appearance of an entirely digital second generation.

The **EDGE** (Enhanced Data Rates for Global Evolution) standard, billed as **2.75G**, quadruples the throughput improvements of GPRS with its theoretical data rate of 384 Kbps, thereby allowing the access for multimedia applications. In reality, the

EDGE standard allows maximum theoretical data rates of 473 Kbit/s, but it has been limited in order to comply with the IMT-2000 (International Mobile Telecommunications-2000) specifications from the ITU (International Telecommunications Union).

3G

The IMT-2000 (International Mobile Telecommunications for the year 2000) specifications from the International Telecommunications Union (ITU) defined the characteristics of **3G** (third generation of mobile telephony). The most important of these characteristics are:

1. High transmission data rate.
2. 144 Kbps with total coverage for mobile use.
3. 384 Kbps with medium coverage for pedestrian use.
4. 2 Mbps with reduced coverage area for stationary use.
5. World compatibility.
6. Compatibility of 3rd generation mobile services with second generation networks.

3G offers data rates of more than 144 Kbit/s, thereby allowing the access to multimedia uses such as video transmission, video-conferencing or high-speed internet access. 3G networks use different frequency bands than the previous networks: 1885-2025 MHz and 2110-2200 MHz.

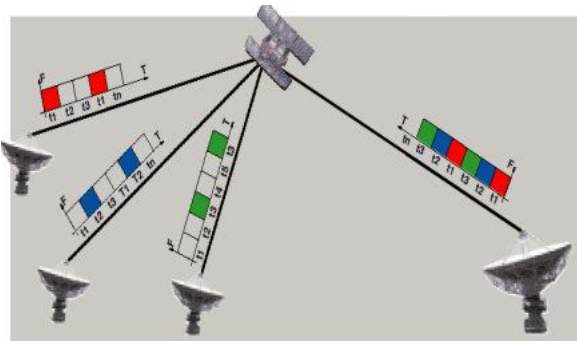
The main 3G standard used in Europe is called **UMTS** (Universal Mobile Telecommunications System) and uses **WCDMA** (Wideband Code Division Multiple Access) encoding. UMTS technology uses 5 MHz bands for transferring voice and data, with data rates that can range from 384 Kbps to 2 Mbps. **HSDPA** (High Speed Downlink Packet Access) is a third generation mobile telephony protocol, (considered as "3.5G"), which is able to reach data rates on the order of 8 to 10 Mbps. HSDPA technology uses

the 5 GHz frequency band and uses WCDMA encoding.

TDMA in brief:

In late 1980's, as a search to convert the existing analog network to digital as a means to improve capacity, the cellular telecommunications industry association chose TDMA over FDMA.

Time Division Multiplex Access is a type of multiplexing where two or more channels of information are transmitted over the same link by allocating a different time interval for the transmission of each channel. The most complex implementation using TDMA principle is of GSM's (Global System for Mobile communication). To reduce the effect of co-channel interference, fading and multipath, the GSM technology can use frequency hopping, where a call jumps from one channel to another channel in a short interval.



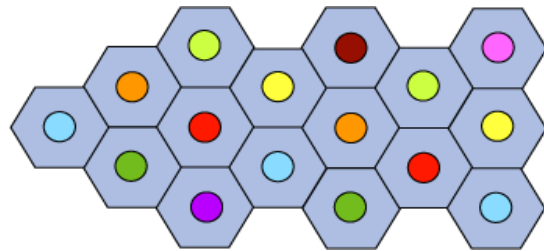
Time Division Multiple Access

TDMA systems still rely on switch to determine when to perform a handoff. Handoff occurs when a call is switched from one cell site to another while travelling. The TDMA handset constantly monitors the signals coming from other sites and reports it to the switch without caller's awareness. The switch then uses this information for making better choices for handoff at appropriate times. TDMA handset performs hard handoff, i.e., whenever the user moves from one site to another, it breaks the connection and then

provides a new connection with the new site.

The concept of cellular network

Mobile telephone networks are based on the concept of **cells**, circular zones that overlap to cover a geographical area.



Cellular networks are based on the use of a central transmitter-receiver in each cell, called a "**base station**" (or Base Transceiver Station, written **BTS**). The smaller the radius of a cell, the higher is the available bandwidth. So, in highly populated urban areas, there are cells with a radius of a few hundred meters, while huge cells of up to 30 kilometers provide coverage in rural areas.

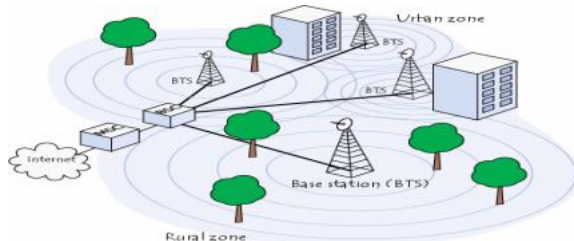
In a cellular network, each cell is surrounded by 6 neighbouring cells (thus a cell is generally drawn as a hexagon). To avoid interference, adjacent cells cannot use the same frequency. In practice, two cells using the same frequency range must be separated by a distance of two to three times the diameter of the cell.

Architecture of the GSM Network

In a GSM network, the user terminal is called a **mobile station**. A mobile station is made up of a **SIM** (Subscriber Identity Module) card allowing the user to be uniquely identified and a mobile terminal.

The terminals (devices) are identified by a unique 15-digit identification number called **IMEI** (International Mobile Equipment Identity). Each SIM card also has a unique (and secret) identification number called **IMSI** (International Mobile Subscriber Identity). This code can be protected using a 4-digit key called a PIN code.

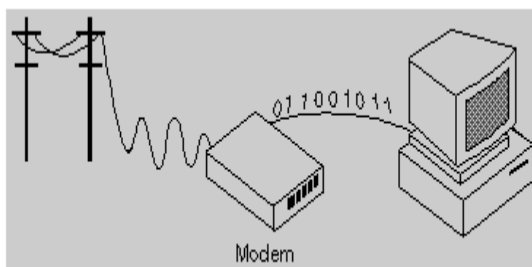
The SIM card therefore allows each user to be identified independently of the terminal used during communication with a base station. Communications occur through a radio link (air interface) between a mobile station and a base station.



All the base stations of a cellular network are connected to a **base station controller (BSC)** which is responsible for managing distribution of the resources. The system consisting of the base station controller and its connected base stations is called the **Base Station Subsystem (BSS)**.

Finally, the base station controllers are themselves physically connected to the **Mobile Switching Centre (MSC)**, managed by the telephone network operator, which connects them to the public telephone network and the Internet. The MSC belongs to a **Network Station Subsystem (NSS)**, which is responsible for managing user identities, their location and establishment of communications with other subscribers. Finally, GSM networks support the concept of **roaming** i.e., movement from one operator network to another.

Introduction to Modem:



Modem stands for modulator-demodulator.

A modem is a device or program that enables a computer to transmit data over

telephone or cable lines. Computer information is stored digitally, whereas information transmitted over telephone lines is transmitted in the form of analog waves. A modem converts between these two forms.

Fortunately, there is one standard interface for connecting external modems to computers called RS-232. Consequently, any external modem can be attached to any computer that has an RS-232 port, which almost all personal computers have. There are also modems that come as an expansion board that can be inserted into a vacant expansion slot. These are sometimes called onboard or internal modems.

While the modem interfaces are standardized, a number of different protocols for formatting data to be transmitted over telephone lines exist. Some, like CCITT V.34 are official standards, while others have been developed by private companies. Most modems have built-in support for the more common protocols at slow data transmission speeds at least, most modems can communicate with each other. At high transmission speeds, however, the protocols are less standardized.

GSM Modem:

A GSM modem is a wireless modem that works with a GSM wireless network. A wireless modem behaves like a dial-up modem. The main difference between them is that a dial-up modem sends and receives data through a fixed telephone line while a wireless modem sends and receives data through radio waves.



A GSM modem can be an external device or a PC Card / PCMCIA Card. Typically, an external GSM modem is connected to a computer through a serial cable or a USB cable. A GSM modem in the form of a PC Card / PCMCIA Card is designed for use with a laptop computer. It should be inserted into one of the PC Card / PCMCIA Card slots of a laptop computer.

Like a GSM mobile phone, a GSM modem requires a SIM card from a wireless carrier in order to operate.

A SIM card contains the following information:

- Subscriber telephone number (MSISDN)
- International subscriber number (IMSI, International Mobile Subscriber Identity)
- State of the SIM card
- Service code (operator)
- Authentication key
- PIN (Personal Identification Code)
- PUK (Personal Unlock Code)

Computers use AT commands to control modems. Both GSM modems and dial-up modems support a common set of standard AT commands. In addition to the standard AT commands, GSM modems support an extended set of AT commands. These extended AT commands are defined in the GSM standards. With the extended AT commands, the following operations can be performed:

- Reading, writing and deleting SMS messages.
- Sending SMS messages.

- Monitoring the signal strength.
- Monitoring the charging status and charge level of the battery.
- Reading, writing and searching phone book entries.

Establishing connection between PC and GSM modem



The number of SMS messages that can be processed by a GSM modem per minute is very low i.e., about 6 to 10 SMS messages per minute.

Introduction to AT Commands

AT commands are instructions used to control a modem. AT is the abbreviation of ATtention. Every command line starts with "AT" or "at". That's the reason, modem commands are called AT commands. Many of the commands that are used to control wired dial-up modems, such as ATD (Dial), ATA (Answer), ATH (Hook control) and ATO (Return to online data state) are also supported by GSM modems and mobile phones.

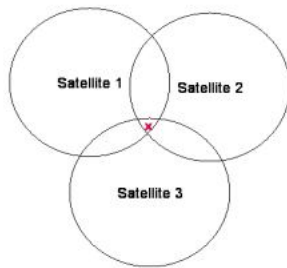
User Segment-Receiver

These receivers read the available satellite signals to determine a user's position, velocity and time. Underlying how these components work together is the clock and the satellites' orbit. To get an accurate position fix, a receiver "sees" at least four satellites. The receiver uses the time stamp from the satellite to determine the transmission delay. Getting this information simultaneously from a minimum of four different satellites is what enables the calculation of a user's 3-D position.

Determining Position:

Upon taking in all available satellite signals, the receiver compares the time that the satellite sent the signal to the time it was received for each of the available signals. Trilateralization (similar to triangulation) then calculates the position by comparing the difference among the signals.

A 2-D Calculation Illustration



x Marks the spot because the user must be somewhere on the satellite 1 circle, satellite 2 circle and satellite 3 circle, plus or minus 100meters

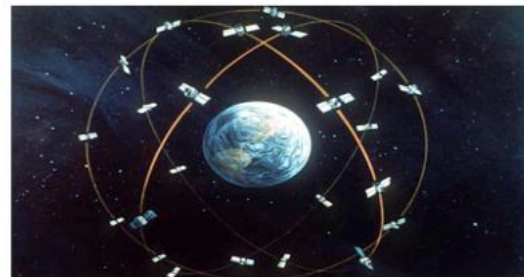
Goal of the Global Positioning System

The Global Positioning System (GPS) includes 24 satellites, in circular orbits around Earth with orbital period of 12 hours, distributed in six orbital planes equally spaced in angle. Each satellite carries an operating atomic clock (along with several backup clocks) and emits timed signals that include a code telling its location. By analyzing signals from at least four of these satellites, a receiver on the surface of Earth with a built-in microprocessor can display the location of the receiver (latitude, longitude and altitude).

The goal of the Global Positioning System (GPS) is to determine the position of a person or any object on Earth in three dimensions: east-west, north-south and vertical (longitude, latitude and altitude). Signals from three overhead satellites provide this information. Each satellite sends a signal that codes where the satellite is and the time of emission of the signal. The receiver clock times the reception of each signal, then subtracts the emission time to determine the time lapse and hence how

far the signal has traveled (at the speed of light).

This is the distance the satellite was from the object when it emitted the signal. In effect, three spheres are constructed from these distances, one sphere centered on each satellite. Thus, the object is located at the single point at which the three spheres intersect.



Artist's concept of the GPS satellite constellation

Operating Principles:

The basis of the GPS technology is a set of 24 satellites that are continuously orbiting the earth. These satellites are equipped with atomic clocks and send out radio signals as to the exact time and their location. These radio signals from the satellites are picked up by the GPS receiver. Once the GPS receiver locks on to four or more of these satellites, it can triangulate its location from the known positions of the satellites.

The functionality of a receiver is dependent on the ability to receive signals from the satellites. Certain locations such as under very thick foliage or down in the bottom of a slot canyon will preclude the receiver from getting a good signal from enough satellites to determine the user location. With many of the newer receivers however, these problems are minimal. All receivers have warning messages when they are not getting sufficient signal to properly navigate.

Accuracy of GPS :

The accuracy of GPS depends on a number of factors, number of channels on the receiver, number of satellites in view, and signal interference caused by buildings,

mountains and ionospheric disturbances. Accuracy should be within 15 meters (without SA) provided the receiver has a clear shot at a minimum of four satellites.

There are several methods that can improve GPS accuracy. Two commonly discussed are Differential GPS (DGPS) and Wide Area Augmentations System (WAAS). These improve accuracy to within 1 to 3 meters. DGPS uses fixed, mounted GPS receivers to calculate the difference between their actual known position and the calculated GPS position. This difference is then broadcast over a local FM signal. GPS units within range of the local FM signal can improve their position accuracy to within 1cm over short distances (but more typically 3-5 meters).

Position Fix vs. Waypoints:

When a reading on GPS is taken, it gives a real-time position fix. The memory on the receiver decides whether to store that information so that the user can return to that exact location and can be saved in memory as a waypoint. Obviously, the number of waypoints to be stored depends on how much available memory the receiver has.

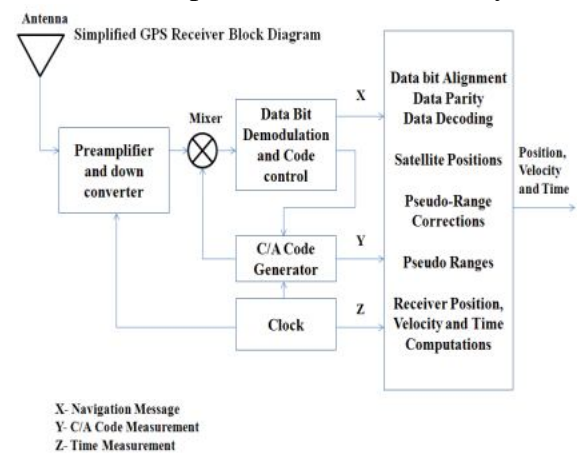
GPS Receiver Set-Up:

To be able to properly use a GPS receiver, it needs to be set-up and initialized. Set-up establishes the basic information about the units of distance, speed, Map Datum, Navigation Grid system, time difference from Greenwich England or UTC time, and other basics.

GPS Receiver:

When people talk about "a GPS," they usually mean a **GPS receiver**. The **Global Positioning System** (GPS) is actually a **constellation** of 27 Earth-orbiting satellites (24 in operation and three extras in case one fails).

A GPS receiver's job is to locate four or more of these satellites, figure out the distance to each, and use this information to deduce its own location. This operation is based on a simple mathematical principle called **trilateration**. Trilateration in three-dimensional space can be a little tricky.



Trilateration in GPS

Global Positioning System (GPS) navigators use the mathematical technique of trilateration to determine user position, speed, and elevation. GPS navigators constantly receive and analyze radio signals from GPS satellites, calculating precise distance (range) to each satellite being tracked.

The data from a single satellite narrows position down to a large area of the earth's surface. Adding data from a second satellite narrows position down to the region where two spheres overlap. Adding data from a third satellite (see illustration) provides relatively accurate position. Data from a fourth satellite (or more) enhances precision and also the ability to determine accurate elevation or altitude (in the case of aircraft). GPS receivers routinely track 4 to 7 or more satellites simultaneously.

GPS Calculations

At a particular time (let's say midnight), the satellite begins transmitting a long, digital pattern called a **pseudo-random code**. The receiver begins running the same digital pattern also exactly at midnight. When the satellite's signal reaches the receiver, its

transmission of the pattern will lag a bit behind the receiver's playing of the pattern.



A GPS Satellite

The length of the delay is equal to the signal's travel time. The receiver multiplies this time by the speed of light to determine how far the signal travelled. Assuming the signal travelled in a straight line, this is the distance from receiver to satellite. **The** Global Positioning System has a clever, effective solution to this problem. Every satellite contains an expensive atomic clock, but the receiver itself uses an ordinary quartz clock, which it constantly resets. In a nutshell, the receiver looks at incoming signals from four or more satellites and gauges its own inaccuracy. In other words, there is only one value for the current time that the receiver can use. The correct time value will cause all of the signals that the receiver is receiving to align at a single point in space. That time value is the time value held by the atomic clocks in all of the satellites. So the receiver sets its clock to that time value and thus has the same time value that all the atomic clocks in all of the satellites have. The GPS receiver gets atomic clock accuracy for free.

GPS Applications

One of the most significant and unique features of the Global Positioning Systems is the fact that the positioning signal is available to users in any position worldwide at any time. With a fully operational GPS system, it can be generated to a large community of likely to grow as there are multiple applications, ranging from surveying, mapping and navigation to GIS data capture. The GPS will soon be a part of

the overall utility of technology. There are countless GPS applications, a few important ones are covered in the following section.

Surveying and Mapping

The high precision of GPS carrier phase measurements, together with appropriate adjustment algorithms, provides an adequate tool for a variety of tasks for surveying and mapping. Using DGPS methods, accurate and timely mapping of almost anything can be carried out. The GPS is used to map cut blocks, road alignments, and environmental hazards such as landslides, forest fires, and oil spills. Applications, such as cadastral mapping, needing a high degree of accuracy also can be carried out using high grade GPS receivers. Continuous kinematic techniques can be used for topographic surveys and accurate linear mapping.

Navigation

Navigation using GPS can save countless hours in the field. Any feature, even if it is under water, can be located up to one hundred meters simply by scaling coordinates from a map, entering waypoints and going directly to the site. Examples include road intersections, corner posts, plot centers, accident sites, geological formations etc. GPS navigation in helicopters, in vehicles, or in a ship can provide an easy means of navigation with substantial savings.

Remote Sensing and GIS

It is also possible to integrate GPS positioning into remote-sensing methods such as photogrammetry and aerial scanning, magnetometry and video technology. Using DGPS or kinematic techniques, depending upon the accuracy required, real time or post-processing will provide positions for the sensor which can be projected to the ground, instead of having ground control projected to an

image. GPS are becoming very effective tools for GIS data capture.

The GIS user community benefits from the use of GPS for locational data capture in various GIS applications. The GPS can easily be linked to a laptop computer in the field, and, with appropriate software, users can also have all their data on a common base with every little distortion. Thus GPS can help in several aspects of construction of accurate and timely GIS databases.

Geodesy

Geodetic mapping and other control surveys can be carried out effectively using high-grade GPS equipment. Especially when helicopters were used or when the line of sight is not possible, GPS can set new standards of accuracy and productivity.

Military

The GPS was primarily developed for real time military positioning. Military applications include airborne, marine, and land navigation.

Future of GPS Technology

Barring significant new complications due to S/A (Selective Availability) from DOD, the GPS industry is likely to continue to develop in the civilian community. There are currently more than 50 manufacturers of GPS receivers, with the trend continuing to be towards smaller, less expensive, and more easily operated devices. While highly accurate, portable (hand-held) receivers are already available, current speculation envisions inexpensive and equally accurate 'wristwatch locators' and navigational guidance systems for automobiles. However, there is one future trend that will be very relevant to the GIS user community, namely, community base stations and regional receive networks, as GPS management and technological innovations that will make GPS surveying easier and more accurate.

LIQUID CRYSTAL DISPLAY:

LCD stands for Liquid Crystal Display. LCD is finding wide spread use replacing LEDs (seven segment LEDs or other multi segment LEDs) because of the following reasons:

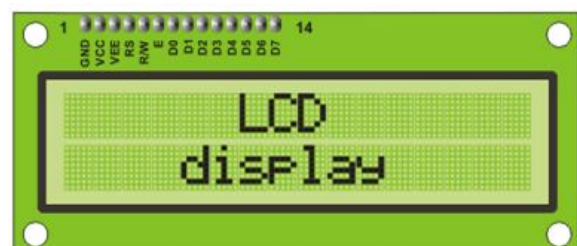
1. The declining prices of LCDs.
2. The ability to display numbers, characters and graphics. This is in contrast to LEDs, which are limited to numbers and a few characters.
3. Incorporation of a refreshing controller into the LCD, thereby relieving the CPU of the task of refreshing the LCD. In contrast, the LED must be refreshed by the CPU to keep displaying the data.
4. Ease of programming for characters and graphics.

These components are "specialized" for being used with the microcontrollers, which means that they cannot be activated by standard IC circuits. They are used for writing different messages on a miniature LCD.

A model described here is for its low price and great possibilities most frequently used in practice. It is based on the HD44780 microcontroller (Hitachi) and can display messages in two lines with 16 characters each.

Pins Functions

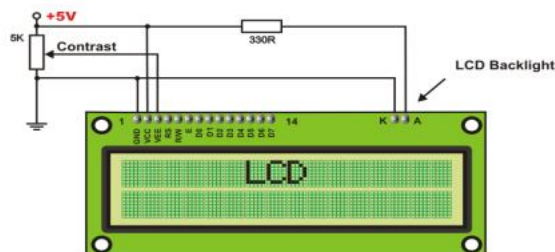
There are pins along one side of the small printed board used for connection to the microcontroller. There are total of 14 pins marked with numbers (16 in case the background light is built in). Their function is described in the table below:



Function	Pin Number	Name		Description
Ground	1	Vss	-	0V
Power supply	2	Vdd	-	+5V
Contrast	3	Vee	-	0 - Vdd
Control operating	4	RS	0	D0 - D7 are interpreted as commands
			1	D0 - D7 are interpreted as data
	5	R/W	0	Write data (from controller to LCD)
			1	Read data (from LCD to controller)
	6	E	0	Access to LCD disabled
			1	operating
Data / commands			From 1 to 0	Data/commands are transferred to LCD
	7	D0	0/1	Bit 0 LSB
	8	D1	0/1	Bit 1
	9	D2	0/1	Bit 2
	10	D3	0/1	Bit 3
	11	D4	0/1	Bit 4
	12	D5	0/1	Bit 5
	13	D6	0/1	Bit 6
	14	D7	0/1	Bit 7 MSB

LCD screen:

LCD screen consists of two lines with 16 characters each. Each character consists of 5x7 dot matrix. Contrast on display depends on the power supply voltage and whether messages are displayed in one or two lines. For that reason, variable voltage 0-Vdd is applied on pin marked as Vee. Trimmer potentiometer is usually used for that purpose. Some versions of displays have built in backlight (blue or green diodes). When used during operating, a resistor for current limitation should be used (like with any LE diode).



LCD Basic Commands

All data transferred to LCD through outputs D0-D7 will be interpreted as commands or as data, which depends on logic state on pin RS:

RS = 1 - Bits D0 - D7 are addresses of characters that should be displayed. Built in processor addresses built in "map of characters" and displays corresponding symbols. Displaying position is determined by DDRAM address. This address is either previously defined or the address of previously transferred character is automatically incremented.

RS = 0 - Bits D0 - D7 are commands which determine display mode. List of

commands which LCD recognizes are given in the table below:

Command	RS	RW	D7	D6	D5	D4	D3	D2	D1	D0	Execution Time
Clear display	0	0	0	0	0	0	0	0	0	1	1.64ms
Cursor home	0	0	0	0	0	0	0	0	0	1	1.64ms
Entry mode set	0	0	0	0	0	0	0	0	1	I/D	40uS
Display on/off control	0	0	0	0	0	0	0	1	D	U/B	40uS
Cursor/Display Shift	0	0	0	0	0	0	1	D/C	R/L	x	40uS
Function set	0	0	0	0	0	1	D/L	N	F	x	40uS
Set CGRAM address	0	0	0	0	1	CGRAM address					40uS
Set DDRAM address	0	0	0	1	DDRAM address					40uS	
Read "BUSY" flag (BF)	0	1	BF	DDRAM address							-
Write to CGRAM or DDRAM	1	0	D7	D6	D5	D4	D3	D2	D1	D0	40uS
Read from CGRAM or DDRAM	1	1	D7	D6	D5	D4	D3	D2	D1	D0	40uS

LCD Initialization:

Once the power supply is turned on, LCD is automatically cleared. This process lasts for approximately 15mS. After that, display is ready to operate. The mode of operating is set by default. This means that:

Automatic reset is mainly performed without any problems. Mainly but not always! If for any reason power supply voltage does not reach full value in the course of 10mS, display will start perform completely unpredictably. If voltage supply unit can not meet this condition or if it is needed to provide completely safe operating, the process of initialization by which a new reset enabling display to operate normally must be applied.

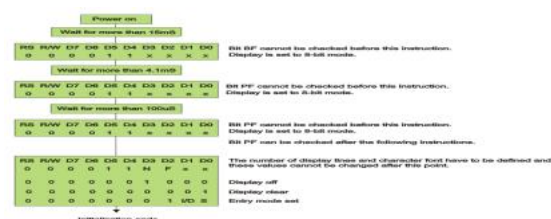


Fig: Procedure on 8-bit initialization.

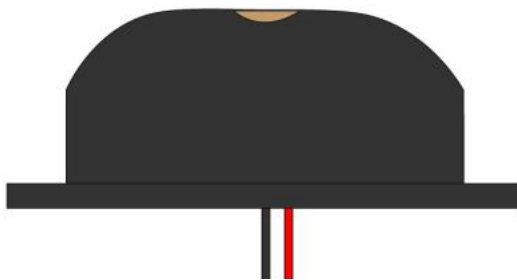
Buzzer:

The piezo buzzer produces sound based on reverse of the piezoelectric effect. The generation of pressure variation or strain by the application of electric potential across a piezoelectric material is the underlying principle. These buzzers can be used alert a user of an event corresponding to a switching action, counter signal or sensor input. They are also used in alarm circuits.

The buzzer produces a same noisy sound irrespective of the voltage variation applied

to it. It consists of piezo crystals between two conductors. When a potential is applied across these crystals, they push on one conductor and pull on the other. This, push and pull action, results in a sound wave. Most buzzers produce sound in the range of 2 to 4 kHz.

The Red lead is connected to the Input and the Black lead is connected to Ground.



Switch

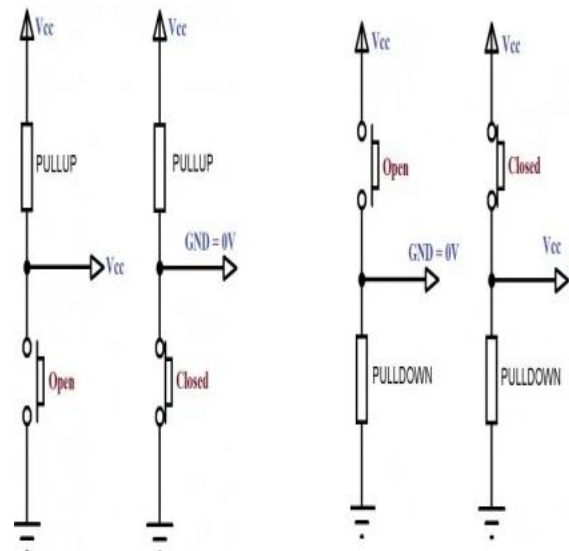
Switch is an electrical component which can make or break electrical circuit automatically or manually. Switch is mainly works with ON (open) and OFF (closed) mechanism. Numerous circuits hold switches that control how the circuit works or actuate different characteristics of the circuit.

The classification of switches depends on the connection they make. Two vital components that confirm what sorts of connections a switch makes are pole and throw. These are classified on based the connections they make.

Pole: The amount of circuits controlled by the switch is indicated by poles. Single pole (SP) switch controls only one electrical circuit. Double pole (DP) switch controls two independent circuits.

Throw: The number of throws indicates how many different output connections every switch pole can connect its input. A single throw (ST) switch is a simple on/off switch. When the switch is ON, the two terminals of switch are connected and current flows between them. When the

switch is OFF the terminals are not connected, so current does not flow.



If we haven't use PULL-UP or PULL-DOWN resistors, there will be an **UNDETERMINED STATE** (neither LOW nor HIGH) when the switch is OPEN.

FIRMWARE IMPLEMENTATION OF THE PROJECT DESIGN

Software Tool Required

Arduino 1.0.6 software tools used to program microcontroller. The working of software tool is explained below in detail.

PROGRAMMING ARDUINO MEGA:

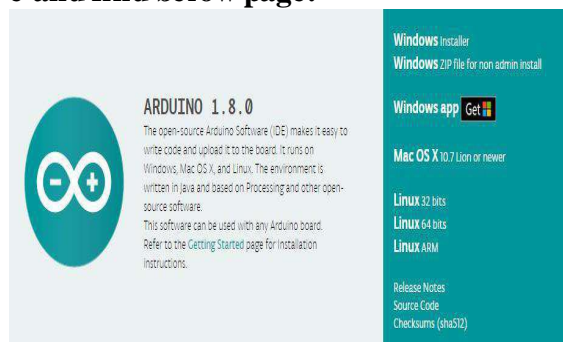
- Arduino Mega 2560 can be programmed using Arduino Software called IDE which supports C programming.
- The code you make on the software is called sketch which is burned in the software and then transferred to the board through USB cable.
- This board comes with a built-in bootloader which rules out the usage of an external burner for burning the code into the board.
- The bootloader communicates using STK500 protocol.
- Once you compile and burn the program on the board, you can unplug the USB cable which eventually removes

the power from the board. When you intend to incorporate the board into your project, you can power it up using power jack or Vin of the board.

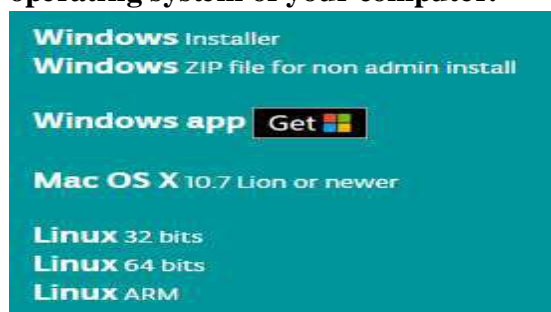
- Multitasking is another feature where Arduino mega comes handy. However, Arduino IDE Software doesn't support multitasking feature but you can use other operating systems like FreeRTOS and RTX to write C program for this purpose. This gives you the flexibility of using your own custom build program using ISP connector.

The Arduino Integrated Development Environment (IDE) is the software side of the Arduino platform. In this lesson, you will learn how to setup your computer to use Arduino and how to set about the lessons that follow.

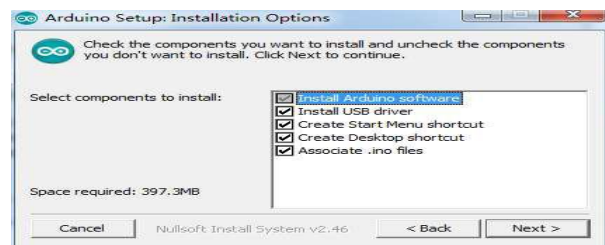
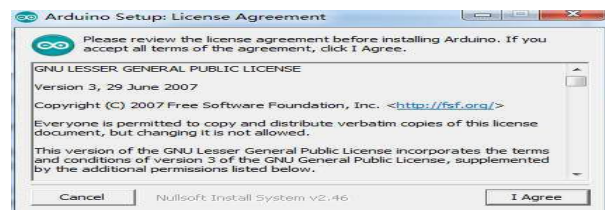
STEP 1: Go to <https://www.arduino.cc/en/Main/Software> and find below page.



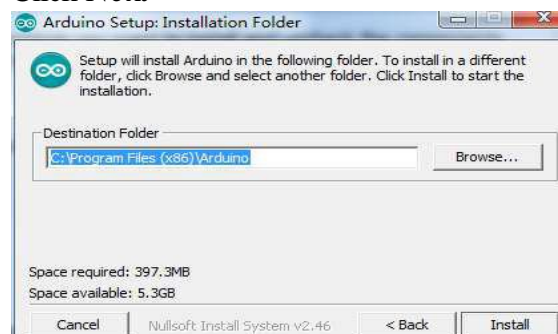
STEP2: Download the development software that is compatible with the operating system of your computer.



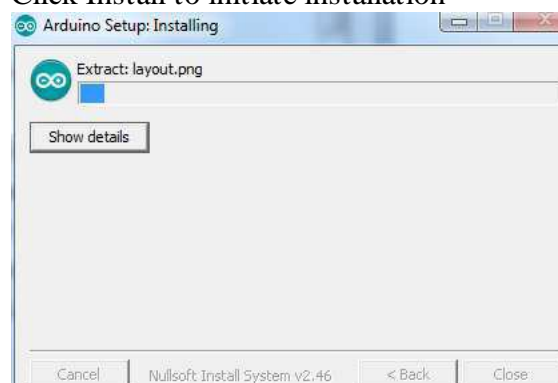
Install Arduino with the exe. Installation package.



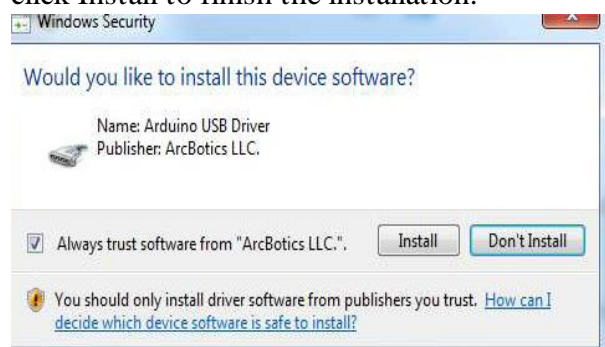
Click Next



Click Install to initiate installation



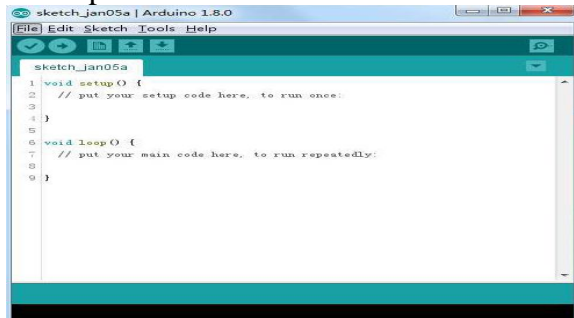
Finally, the following interface appears, click Install to finish the installation.



Next, the following icon appears on the desktop



Double-click to enter the desired development environment



You may directly choose the installation package for installation and skip the contents below and jump to the next section. But if you want to learn some methods other than the installation package, please continue to read the section.

Unzip the zip file downloaded, Double-click to open the program and enter the desired development environment.

However, this installation method needs separate installation of driver.

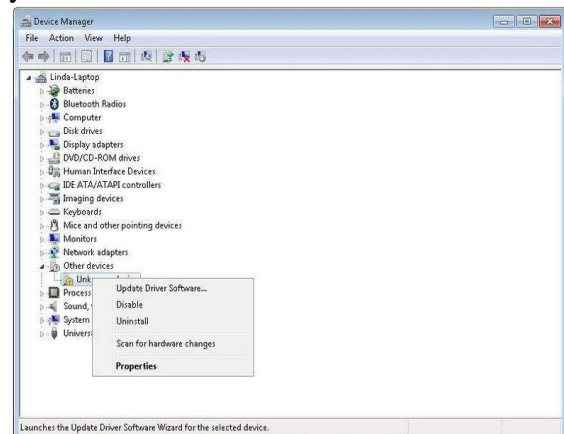
The Arduino folder contains both the Arduino program itself and the drivers that allow the Arduino to be connected to your computer by a USB cable. Before we launch the Arduino software, you are going to install the USB drivers.

Plug one end of your USB cable into the Arduino and the other into a USB socket on your computer. The power light on the LED will light up and you may get a 'Found New Hardware' message from Windows. Ignore this message and cancel any attempts that Windows makes to try and install drivers automatically for you.

The most reliable method of installing the USB drivers is to use the Device Manager. This is accessed in different ways

depending on your version of Windows. In Windows 7, you first have to open the Control Panel, then select the option to view Icons, and you should find the Device Manager in the list.

Under 'Other Devices', you should see an icon for 'unknown device' with a little yellow warning triangle next to it. This is your Arduino.



Right-click on the device and select the top menu option (Update Driver Software...). You will then be prompted to either 'Search Automatically for updated driver software' or 'Browse my computer for driver software'. Select the option to browse and navigate to the X\arduino1.8.0\drivers.



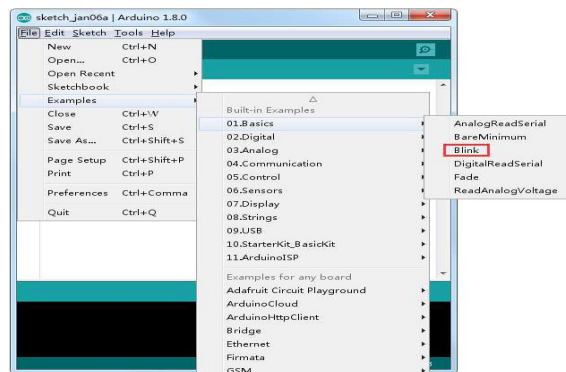
Click 'Next' and you may get a security warning, if so, allow the software to be installed. Once the software has been installed, you will get a confirmation message.



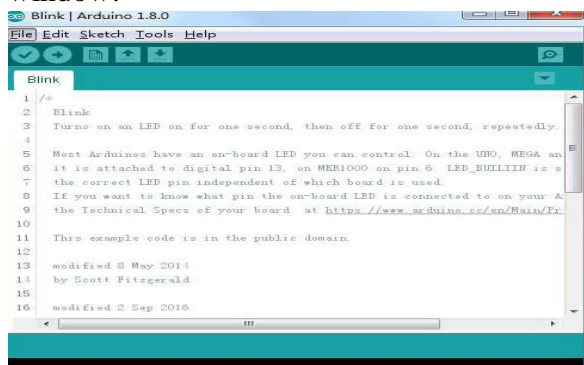
Blink

Principle

The MEGA2560 R3 board has rows of connectors along both sides that are used to connect to several electronic devices and plug-in 'shields' that extends its capability. It also has a single LED that you can control from your sketches. This LED is built onto the MEGA2560 R3 board and is often referred to as the 'L' LED as this is how it is labeled on the board.



When the sketch window opens, enlarge it so that you can see the entire sketch in the window.

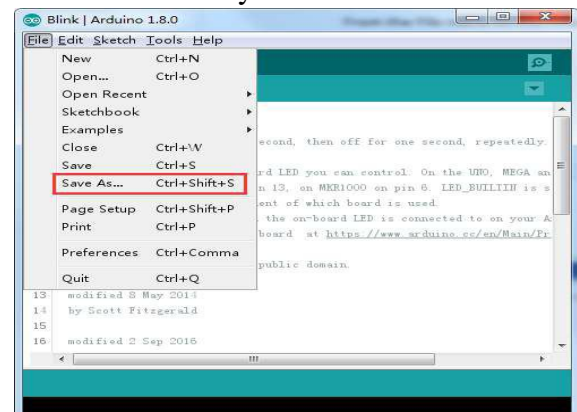


The example sketches included with the Arduino IDE are 'read-only'. That is, you

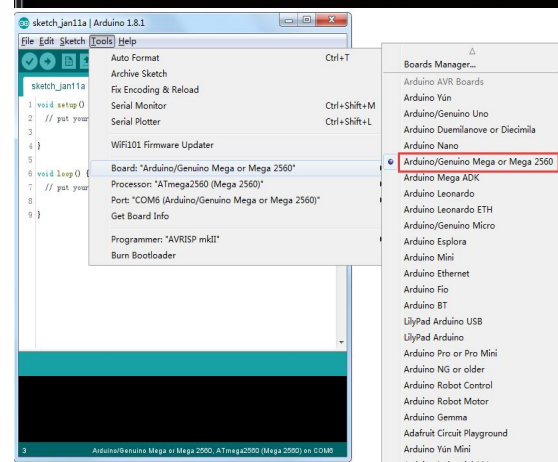
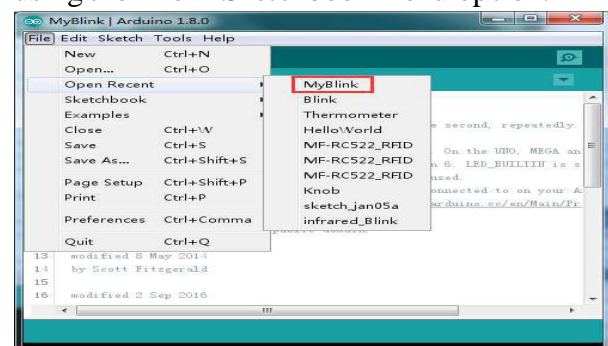
can upload them to an MEGA2560 R3 board, but if you change them, you cannot save them as the same file.

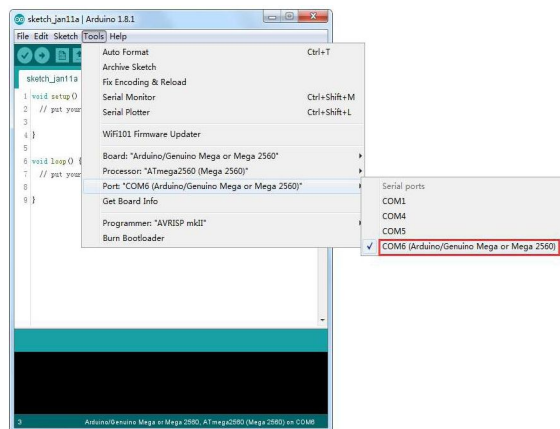
Since we are going to change this sketch, the first thing you need to do is save your own copy.

From the File menu on the Arduino IDE, select 'Save As..' and then save the sketch with the name 'MyBlink'.



You have saved your copy of 'Blink' in your sketchbook. This means that if you ever want to find it again, you can just open it using the File > Sketchbook menu option.





Note: The Board Type and Serial Port here are not necessarily the same as shown in picture. If you are using 2560, then you will have to choose Mega 2560 as the Board Type and other choices can be made in the same manner. And the Serial Port displayed for everyone is different, despite COM 26 chosen here, it could be COM3 or COM4 on your computer. A right COM port is supposed to be COMX (Arduino XXX), which is by the certification criteria.

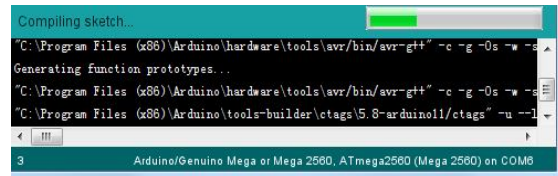
The Arduino IDE will show you the current settings for board at the bottom of the window.



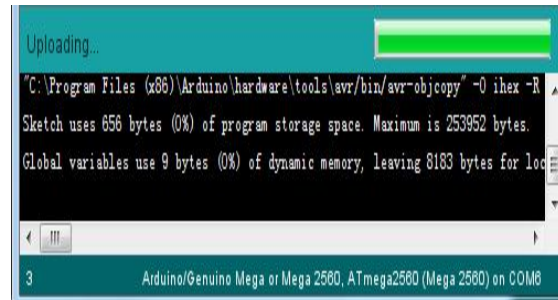
Click on the 'Upload' button, the second button from the left on the toolbar.



If you watch the status area of the IDE, you will see a progress bar and a series of messages. At first, it will say 'Compiling Sketch...'. This converts the sketch into a format suitable for uploading to the board.



Next, the status will change to 'Uploading'. At this point, the LEDs on the Arduino should start to flicker as the sketch is transferred.



Finally, the status will change to 'Done'.



Working procedure

Design of Anti-theft protection of vehicle using Arduino is implemented. The user fingerprint enrollment and identification information are collected by the Arduino by using different modules and vehicle protection is successfully done where it stores the information in database and display it on LCD that is user friendly.

The design consists of GSM to send the information to the predefined mobile number, GPS to track the vehicle location, fingerprint module for the user fingerprint enrollment and identification, buzzer for audio indication whenever the fingerprint is not matched with the user fingerprint, DC motor to start or stop the vehicle engine and LCD to display the messages.

The working of the project begins like this: The system first asks for the fingerprint of

the user for the enrollment for the first time. When the user puts his finger on the fingerprint module and presses the enrollment switch, his fingerprint will be saved in the database. Then the GSM module will be initialized and asks to enter any message so as to save the mobile number and the enrolled fingerprint with this mobile number.

Now, when the user gives his fingerprint for the second time and presses the identify switch, the system will compare this fingerprint with the saved ones and if both match, the system sends a message with the vehicle coordinates to the saved mobile number and the vehicle engine starts automatically. GPS module will continuously give the vehicle coordinates.

If the fingerprint does not match with the stored values, then the buzzer will be alerted immediately and the vehicle engine will stop avoiding the person to start the vehicle. LCD is used to display the introductory and authentication messages.

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