# AN IOT CLOUD SYSTEM FOR TRAFFIC MONITORING AND VEHICULAR ACCIDENT PREVENTION

**A PROJECT REPORT**

**Submitted in partial fulfillment of requirements**

**For the award of the degree**

**Bachelor of Technology**
**in**
**COMPUTER SCIENCE AND ENGINEERING**

**By**

**SAKHAMURI NAGAMEDHA(Y15CS943)**
**VEMULA OMKARINI(Y15CS973)**
**VEMULAPALLI CHANDANAPRIYA(Y15CS974)**
**RAMINENI PARDHASARADHI(Y15CS931)**


**APRIL,2019**

**R.V.R & J.C COLLEGE OF ENGINEERING**(Autonomous)
(Affiliated to AcharyaNagarjunaUniversity)
**Chandramoulipuram :: Chowdavaram**
**GUNTUR- 522 019**

**R.V.R & J.C COLLEGE OF ENGINEERING**

(Autonomous)

**DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING**

## CERTIFICATE


This is to certify that project work titled **"AN IOT CLOUD SYSTEM FOR TRAFFIC MONITORING AND VEHICULAR ACCIDENT PREVENTION"** is the work done by **Sakhamuri Nagamedha(Y15CS943),Vemula Omkarini(Y15CS973),Vemulapalli ChandanaPriya(Y15CS974) and Ramineni PardhaSaradhi(Y15CS931)**under my supervision, and submitted in partial fulfillment of the requirements for the award of the degree Bachelor Of Technology in Computer Science & Engineering, during the academic year 2018-2019.

| | | |
|---|---|---|
| **Dr.B.Vara Prasad Rao** | **Dr.Ch.Aparna** | **Dr.M.Sreelatha** |
| Project Guide | Project Incharge | Prof & HOD,CSE |

## ACKNOWLEDGEMENT

First and foremost,we are grateful to all the factors that helped us in preparing this Project report on **"An IOT Cloud System for Traffic Monitoring and Vehicular Accident Prevention"**.

We are very glad to express our special thanks to **Dr.B.Vara Prasad Rao**, Associate Professor and Project Guide,who helped us to understand the topic,and also for his valuable advices in preparing this project report.We would like to express our special thanks of gratitude to **Dr.Ch.Aparna**,Associate Professor and Project Incharge who helped us with her ideas and her support.

We express our sincere thanks to **Dr.M.Sreelatha**,Head of the Department of Computer Science and Engineering for her encouragement and support to carry out this project work successfully.We are very much thankful to **Dr.K.Srinivasu**,Principal of RVR & JC College Of Engineering,Guntur for providing the supportive environment.

Finally we thank the **Programmers in Department of Computer Science and Engineering** and to all our **friends** for their cooperation.

**Sakhamuri Nagamedha(Y15CS943)**
**Vemula Omkarini(Y15CS973)**
**Vemulapalli ChandanaPriya(Y15CS974)**
**Ramineni PardhaSaradhi(Y15CS931)**

**Abstract**

Traffic sensors installed on road side can help in reducing traffic accidents but all roads are not equipped with such type of sensors.An IoT cloud system for traffic monitoring and alert notification when there is sudden traffic slow down using Ultra sonic sensor equipped in vehicle.The main objective is to address this issue considering traffic sensors directly installed in private and/or public transportation and volunteer vehicles.

Road accidents and traffic congestion are the major problems in urban areas.Currently there is no technology for accident detection. Also due to the delay in reaching of the ambulance to the accident location and the traffic congestion in between accident location and hospital increases the chances of the death of victim. There is a need of introducing a system to reduce the loss of life due to accidents and the time taken by the ambulance to reach the hospital. To overcome the drawback of existing system we will implement the new system in which there is an automatic detection of accident through sensors provided in the vehicle. A main server unit houses the database of all hospitals in the city. A GPS and GSM module in the concerned vehicle will send the location of the accident to the main server which will rush an ambulance from a nearest hospital to the accident spot.

Our IOT Cloud system, besides for private drivers, it is very useful for drivers of critical rescue vehicles such as ambulances.Experiments prove that our system provides acceptable response times that allows drivers to receive alert messages in useful time so as to avoid the risk of possible accidents.

## Contents

## List of Tables

## List of Figures

## List of Abbreviations

1. IOT : Internet of Things
2. GPS : Global Positioning System
3. GTS : GPS Tracking System
4. ITS : Intelligent Transport System
5. V2V : Vehicle to Vehicle Communication
6. V2I : Vehicle to Infrastructure Communication
7. I2V : Infrastructure to Vehicle Communication
8. TMS : Traffic Management System
9. VCC : Vehicle Cloud Computing
10. UID : Unique Identifiers
11. LCD : Liquid Crystal Display
12. ISP : In System Programmer
13. IDE : Integrated Development Environment
14. CD : Compact Disc
15. ROM : Read-Only Memory
16. IC : Integrated Circuit
17. DC : Direct Current
18. AC : Alternating Current
19. RAM : Random Access Memory
20. PIC : Peripheral Interface Controller
21. SMS : Short Message Service
22. LAN : Local Area Network
23. GPRS : General Packet Radio Services
24. PC : Personal Computer
25. WAP : Wireless Apllication Protocol
26. EEPROM : Electrically Erasable Programmable Read-Only Memory
27. SVM : Support Vector Machine

# 1. Introduction

## 1.1. Introduction to Domain.

### Internet of Things

The internet of things, or IoT, is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers (UIDs) and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction.

Motorized vehicular accidents are among the major causes of human injury or death and damage of goods with fi-nancial consequences. According to 2016 real time traffic accident statistics, all over the world, 853.849 was the number of people Killed in vehicular accidents, 24.100.573 was the number of injured people in traffic accidents, and $356.688.482.686 was the total cost of traffic accidents. Only in USA, the National Safety Council (NSC) estimated that roughly 40.000 people died in motorized vehicles crashes in 2016, a 6% rise with respect to 2015 with a 14% increase in deaths with respect to 2014, the biggest two-year jump in more than five decades. In this panorama, all over the world, the total number of vehicles passed from roughly 921.642.000 in 2006 to 1.282.270.000 in 2015 registering a meaningful growth of cars and this number is set to double by 2040.According to such a trend even the number of expected vehicular accidents is destined to increase.

In most cases, vehicular accidents are caused by avoidable human errors and improper driving practices. With recent advances in sensing technologies, self-driving, connected cars and autonomous vehicles are becoming more and more prac-ticable. A distributed system sharing sensor data coming from vehicles can reduce the accidents by the use of direct or indirect vehicle to vehicle (V2V), vehicle to infrastructure (V2I) and infrastructure to vehicle (I2V) interactions. Sensor technology connected with cars allows drivers to improve their driving experience. This enables warnings and precautions from a network of roadside units, functioning as stationary way points. Such information is particularly beneficial for drivers in remote areas where roads cannot be equipped with traffic sensors.

The sudden traffic slowdown especially in fast scrolling roads and highways characterized by a scarce visibility is one of the major causes of accidents among

vehicles. It can be caused by other accidents, work-in-progress on roads, peaks of traffic, and so on. An insufficient visibility of drivers can be due to different reasons including tight corners, fog, tunnels with scarce lighting, and so on. Typically, solutions such as Google Maps collecting traffic data coming from sensors installed on roads and sending alert messages to users' mobile apps through the 4G network can mitigate such a problem, but unfortunately not all the roads are equipped with such traffic sensors. In this context, a great progress of technologies makes Intelligent Transportation System (ITS) services more and more desirable.

## 1.2. **Background.**

Total car traffic control is the primary objective of any traffic authority. Considering an urban context, the idea of traffic control raises many application scenarios. Traffic regulation has a subsequent positive impact in terms of environment, accident prevention, speeding up vehicular circulation, opti-mizing public transportation, and social aspects.

Traffic congestion is a severe problem on European high-ways. According to a study of the European Commission, its impact will increase even up to 2% every year . Since building new infrastructure is no longer an appropriate op-tion in most (western) countries, there are many approaches towards a more effective road usage and a more intelligent way of increasing the capacity of the road network. Examples of advanced traffic control systems are, e.g., intelligent speed limits, adaptive ramp metering, or dynamic routing. These examples are based on a centralized traffic management, which controls the operation and the response according to a given traffic situation.

A local strategy based on autonomous vehicles, which are equipped with adaptive cruise control (ACC) systems is discussed in [6] and [7]. The basic idea is that a jam-avoiding driving strategy of automated vehicles might also help to increase the road capacity and thus decrease the traffic congestion. Moreover, ACC systems become commercially available to an increasing number of vehicle types. Recently some car makers have equipped, vehicles, with communication capabilities that enable inter-vehicle communication (IVC). Distance ranging principles are based on flight time. Once flight is known, the distance is computed by means of sound speed in the air. Detecting distance influences the choice of operating frequency that is over 40 kHz and less than 500 kHz to avoid absorption, using for instance beamforming that is one of most important techniques used in car traffic control and accident prevention.

## 1.3. **Exsisting Techniques.**

Various forms of technologies have been proposed so far for vehicular traffic monitoring. UHF and VHF wireless communications have been widely used for short and/or long-range data transmission in ITS. In particular, short-range communications can be accomplished using IEEE 802.11, whereas long-range communications can be achieved through WiMAX (IEEE 802.16), Global System for Mobile Communications (GSM), 3G and 4G. In this context, a typical example of fixed traffic monitoring system includes a gantry with a dish antenna installed in the roadbed. Other fixed traffic monitoring systems are based on Radio Frequency Identification (RFID) and on the beacon sensing technology. Inductive loops can be placed in a roadbed to detect vehicles as they pass through the loop's magnetic field. Similarly, sensing devices spread along the road can detect passing vehicles through bluetooth. Fixed audio detection devices can measure the vehicular traffic density on the road analysing cumulative sounds coming from tire, engine, engine-idling, honks and air turbulence noises. Other traffic-flow measurement and automatic incident detection systems are based on fixed cameras installed in specific points of roads. Data fusion based approaches combine the road side collected acoustic, image and sensor data in order to take the advantages of different technologies. The disadvantage of the aforementioned approaches is that they require fixed sensing devices installed on the road.

We focus on a mobile sensing GPS-based approach consisting of an IoT Cloud system collecting big traffic data coming from mobile sensors, installed on public/private transportation buses and other volunteer vehicles, and that sends warning messages to drivers' mobile apps. This approach presents several advantages such as: it is inexpensive to be developed because it does not need the installation of fixed traffic sensors on roads; it does not require a private network for sensor data exchange because it can use the 4G network; installing mobile traffic sensors on private and/or public transportation vehicles, it is possible to cover a wide area of the city, even the peripheral zones characterized by little traffic; the system is flexible and scalable because traffic sensors can be installed on other volunteer vehicles.

## 1.4. **Problem Definition.**

Motorized vehicular accidents are among the major causes of human injury or death and damage of goods with financial consequences. According to 2016 real time traffic accident statistics, all over the world, 8,53,849 was the number of people Killed in vehicular accidents, 24,100,573 was the number of injured people in traffic accidents, and $356.688.482.686 was the total cost of traffic accidents. Only in USA, the National Safety Council (NSC) estimated that roughly 40.000 people died in motorized vehicles crashes in 2016, a 6% rise with respect to 2015 with a 14% increase in deaths with respect to 2014, the biggest two-year jump in more than five decades. In this panorama, all over the world, the total number of vehicles passed from roughly 921.642.000 in 2006 to 1.282.270.000 in 2015 registering a meaningful growth of cars and this number is set to double by 2040 According to such a trend even the number of expected vehicular accidents is destined to increase. In most cases, vehicular accidents are caused by avoidable human errors and improper driving practices. With recent advances in sensing technologies, self-driving, connected cars and autonomous vehicles are becoming more and more practicable.

In this,we focus on a mobile sensing GPS-based approach consisting of an IoT Cloud system collecting big traffic data coming from mobile sensors, installed on public/private transportation buses and other volunteer vehicles, and that sends warning messages.We design a IOT based kit for traffic monitoring and alert notification.The notifications are sent to registered users and the accident location data is stored on server.

A distributed system sharing sensor data coming from vehicles can reduce the accidents by the use of direct or indirect vehicle to vehicle (V2V), vehicle to infrastructure (V2I) and infrastructure to vehicle (I2V) interactions. Sensor technology connected with cars allows drivers to improve their driving experience. This enables warnings and precautions from a network of roadside units, functioning as stationary way points. Such information is particularly beneficial for drivers in remote areas where roads cannot be equipped with traffic sensors. The sudden traffic slowdown especially in fast scrolling roads and highways characterized by a scarce visibility is one

of the major causes of accidents among vehicles. It can be caused by other accidents, work-in-progress on roads, peaks of traffic, and so on. An insufficient visibility of drivers can be due to different reasons including tight corners, fog, tunnels with scarce lighting, and so on. Typically, solutions such as Google Maps collecting traffic data coming from sensors installed on roads and sending alert messages to users' mobile apps through the 4G network can mitigate such a problem, but unfortunately not all the roads are equipped with such traffic sensors. In this context, a great progress of technologies makes Intelligent Transportation System (ITS) services more and more desirable.

## 1.5. **Significance of the work.**

The Internet of Things (IoT) is the interconnection of uniquely identifiable embedded computing devices within the existing Internet infrastructure. Typically, IoT offers advanced connectivity of devices, systems, and services that goes beyond machine-to-machine communications and covers a variety of protocols, domains, and applications. The interconnection of these embedded devices (including smart objects), is implemented in nearly all fields of automation enabling advanced applications like a Smart Grid. The term things in the IoT refers to a wide variety of devices such as heart monitoring implants, biochip transponders on farm animals, electric clams in coastal waters, automobiles with built-in sensors, orfield operation devices that assist fire-fighters in search and rescue. Current market examples include thermostat systems and washer/dryers that utilize WiFi for remote monitoring.

Road accident is most unwanted thing to happen to a road user, though they happen quite often. Delays in detecting and providing care for those involved in a road traffic crash increase the severity of injuries. Care of injuries after a crash has occurred is extremely time-sensitive: delays of minutes can make the difference between life and death. Hence, it is necessary to develop a system that would reduce the action time after an accident. The system we have proposed has the capability of saving many lives by quickly detecting and reporting the accidents. In this system, the Vibration and fire sensors are used to detect any accidents while driving. The data from the sensors are transmitted to the Smartphone through Bluetooth communication. A microcontroller is used to interface the hardware components with the smartphone. An application is developed which performs all the tasks such as sending emergency notifications along with their GPS location and sending the patient's medical record to the hospital and blood bank as well as their companions. A separate database is designed, where the medical reports are stored. The system has the capability of ensuring the driver's safety and can easily be integrated with the car.

# 2. **Literature Review**

## 2.1. **Review of Internet of Things.**

The contributions of various scholars are studied for survey and analyzing the merits and demerits in order to enhance the consequences for making the system work better.

[1] Sadhana B have explained Smart helmet-intelligent safety for motorcyclist using raspberry pi and open CV. The idea is obtained after knowing that there is increased number of fatal road accidents over the years. This project is designed to introduce safety systems for the motorcyclist to wear the helmet properly.

[2] Sarika R. Gujar explained advanced Embedded System of Vehicle Accident Detection and Tracking System. The main objective of this system is to first detect the accident location and call for the emergency services. Vehicle accident detection is possible with the help of sensors. A GPS and GSM module helps to trace the vehicle.

[3] Shailesh Bhavthankar explained Wireless System for Vehicle Accident Detection and Reporting using Accelerometer and GPS. In this paper, Accelerometer sensor is used to detect crash and GPS give location of vehicle. In case of any accident, the system send automated message to the preprogrammed number such as family member or emergency medical services via GSM.

[4] Jagdish A.Patel explained Microcontroller based smart home. This paper aims at designing a basic home automation application on Raspberry Pi through Interfacing camera as security purpose and the algorithm for the same is implemented in developed in python environment which is the default programming environment provided by Microcontroller.

[5] The authors Antonio Celesti, Antonino Galletta, Lorenzo Carnevale, Maria Fazio, AimelayEkuakille and Massimo Villari, discussed a possible alternative solution for addressing the traffic issue considering mobile traffic sensors directly installed in private and/or public transportation and volunteer vehicles. The system consists of an IoT Cloud system for traffic monitoring and alerts the users to avoid the risk of possible accidents based on OpenGTS and MongoDB. This system is very useful for drivers of critical rescue vehicles such as ambulances.Though, this system provides

an acceptable response time, the driver would get disturbed by the repeated alert messages and not all roads can be equipped with fixed traffic sensors especially in peripherals areas of a city.

[6] The authors Boon Giin Lee, JaeHeePark,Chuan Chin Pu and Wan-Young Chung,presents a novel approach to measure the ECG from the driver palms while holding on the steering wheel. In addition, photoplethysmograms sensor attached on a driver finger can also measure the similar heart rate pattern, known as pulse rate variability. Furthermore, this paper is also focusing on the integration of age and gender as vigilance measurement parameter as each individual exhibits distinct signal pattern. The vigilance monitoring application is developed in smartwatch, able to perform the features extraction, and then predict the driver vigilance class based on the Kernel Fuzzy-C-Mean trained model. A vibration warning will be triggered to the driver if the driver is estimated as drowsy in five consecutive time frames.The main issue in this paper is that since many sensors are used, the system is found to be complex and the processing time will be more.

[7] The authors Boon-Leng Lee, Boon-Giin Lee and Wan-Young Chung, proposed a completely standalone, distraction-free, and wearable system for driver drowsiness detection by incorporating the system in a smartwatch. It detects the driver's drowsiness level based on the motion data collected from the built-in motion sensors in the smartwatch, such as the accelerometer and the gyroscope. For this purpose, the magnitudes of hand movements are extracted from the motion data and are used to calculate the time, spectral, and phase domain features. Eight features serve as an input to a support vector machine (SVM) classifier. The main issue is that a large number of features have to be processed which would affect the processing time of the smartwatch and the accuracy and reliability of the system.

[8] The authors Daxin Tian, Chao Lin,XuitingDuan, Zhenggun Sheng, Qiang Ni, Min Chen,Victor C.M.Leung, proposed an improved positionbased protocol to disseminate emergency messages among a large scale vehicle networks. Specifically, defined by the proposed protocol, messages are only broadcasted along their regions of interest, and a rebroadcast of a message depends on the information including in the message it has received. The simulation results demonstrate that the proposed protocol can reduce unnecessary rebroadcasts considerably, and the collisions of broadcast

can be effectively mitigated. But VANET, being a wireless ad hoc network, serves this purpose completely but is prone to security attacks. Highly dynamic connections, sensitive information sharing and time sensitivity of this network, make it an eye-catching field for attackers.

[9] The authors Chen Chen Lei Lei, Tie Qui, Zhiyan Ren, Tunna Hu, Fang Ti, proposed a cooperative driving scheme for vehicles at intersections in the IoV. The driver's intention is modelled by the BP neural network trained with driving dataset. Then, the identified intention is used as the control matrix of the Kalman filter model, by which the vehicle trajectory can be predicted. Finally, by collecting the information of vehicles trajectories at the intersections, we develop a collision probability evaluation model to reflect the conflict level among vehicles at intersections. It is applicable to the intersections where vehicles are usually driving slowly and not to all circumstances. Only the conflict of trajectories precisely on the same occasion can be realized as a potential collision and not all complex collisions can be solved in this approach.

[10] The authors Javir Rivas, Ralf Wunderlich, Stefan J.Heinen, presented a study that provides the bases to develop a 2-D sensor network using MEMS accelerometers placed on the width and length of the road surface to monitor continuously the traffic flow.In this paper, piezoelectric acceleration sensors, based on the same measuring principle as MEMS accelerometers, are used with the objective to analyse in detail the amplitudes and frequency ranges in which vibrations occur. From this information, the system determines the presence of vehicles, their travel direction, and speed of different types of vehicles. The major issue in this system is that it be will not be efficient on different roads and weather conditions. The algorithms must be improved with more advanced techniques, and it uses a wiredprotocol to communicate with the nodes.

[11] The authors Lih-Jen Kau, Chih-Sheng Chen, proposed a system to detect abnormal driving by analyzing normalized driving behavior. Serving as the virtual driver, a personalized driver model is established for the speed control purpose by using the locally designed neural network and the real-world vehicle test data. Three typical abnormal driving behaviors are characterized and simulated, namely, the fatigue/drunk, the reckless and the phone use while driving. An abnormality index

is proposed based on the analysis of normalized driving behaviors and is applied to quantitatively evaluate the abnormity. But the numerical experiments convey that the effectiveness of the proposed scheme is not very accurate and can often misinterpret the driver's behavior.

All these systems mentioned above are used for accident prevention but there are no system which would efficiently detect accidents and reduce the action time after an accident. In order to overcome these disadvantages we propose the following system.

## 2.2. **Limitations of Exsisting Techniques.**

1.The disadvantage of the aforementioned approaches is that they require fixed sensing devices installed on the road.
2.Poor environmental conditions.
3.It is expensive to maintain and needs large data storage.
4.Checking mobile notifications while driving.
5.Network is must.

# 3. **System Analysis**

## 3.1. **Functional Requirements.**

* The system should send messages to registered users whenever an accident occurs.

* Isolates both GSM and GPS signal.

* Network is very essential.

## 3.2. **Non-Functional Requirements.**

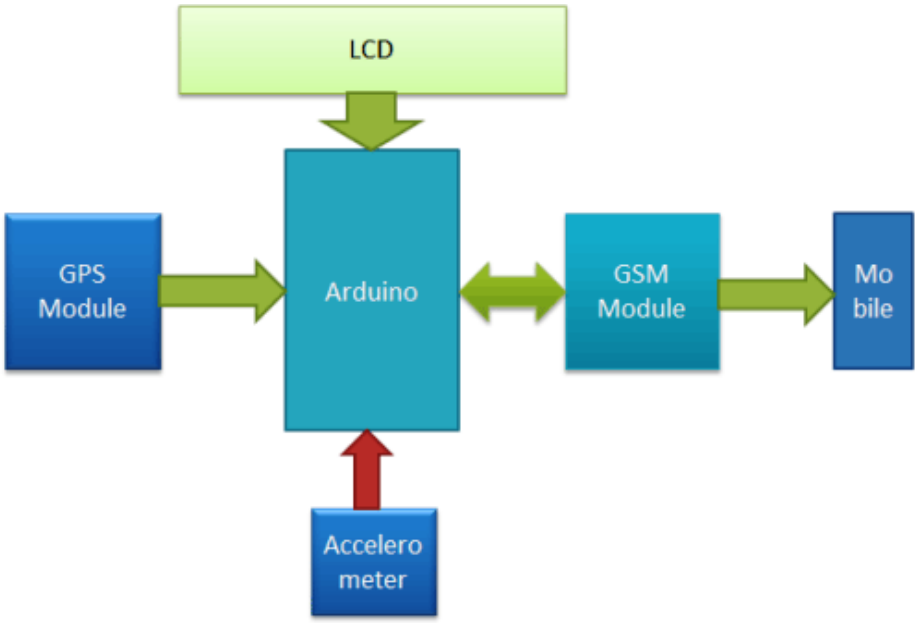
* The system should respond with in milliseconds in order to prevent accidents.

* The system should be easy to operate.

* The system should provide security.

## 4. System Design

### 4.1. Architecture of the proposed system.




The Architecture of proposed system consists of following components.

1. AT89S52 Microcontroller
2. GSM/GPRS module
3. Ultrasonic Distance Sensor Module - HC-SR04
4. DC Motor
5. Buzzer Beeper Alarm
6. LCD
7. Accident Sensor
8. RESET
9. Relay
10. Power Supply

## 4.2. **Workflow of the proposed system.**

The prototype model of an automatic vehicle accident detection and messaging using GSM and GPS modem using Microcontroller working will be made in the following steps:

* Complete layout of the whole set up will be drawn in form of a block diagram.
* A piezoelectric sensor will first sense the occurrence of an accident and give its output to the microcontroller.
* The GPS detects the latitude and longitudinal position of a vehicle.
* The latitudes and longitude position of the vehicle is sent as message through the GSM.
* The phone number is pre-saved in the EEPROM.
* Whenever an accident has occurred the position is detected and a message has been sent to the pre-saved number.

4.3. **Module Description.**

## MICROCONTROLLER

### Microprocessors vs. Microcontrollers:

• Microprocessors are single-chip CPUs used in microcomputers.
• Microcontrollers and microprocessors are different in three main aspects: hardwarearchitecture, applications, and instruction set features.
• Hardware architecture: A microprocessor is a single chip CPU while a microcontroller is a single IC contains a CPU and much of remaining circuitry of a complete computer (e.g., RAM, ROM, serial interface, parallel interface, timer, interrupt handling circuit).
• Applications: Microprocessors are commonly used as a CPU in computers while microcontrollers are found in small, minimum component designs performing control oriented activities.
• Microprocessor instruction sets are processing Intensive.
• Their instructions operate on nibbles, bytes, words, or even double words.
• Addressing modes provide access to large arrays of data using pointers and offsets.
• They have instructions to set and clear individual bits and perform bit operations.
• They have instructions for input/output operations, event timing, enabling and setting priority levels for interrupts caused by external stimuli.
• Processing power of a microcontroller is much less than a microprocessor.

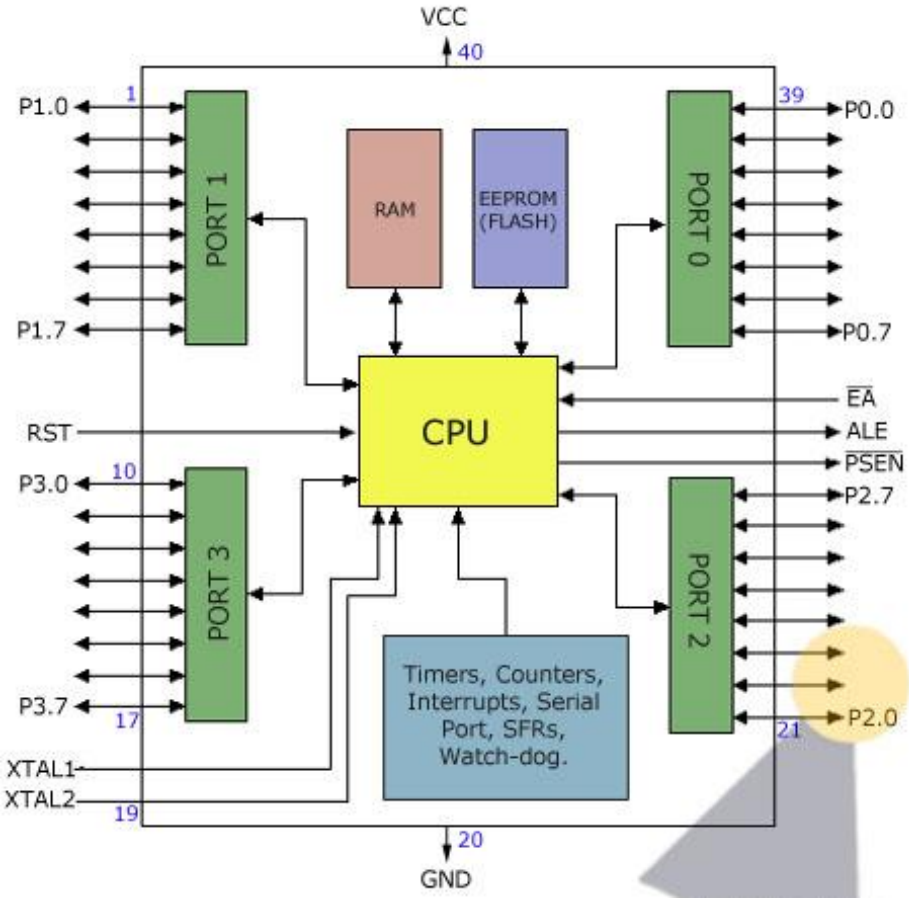
### AT89S52:

Features:
• Compatible with MCS-51 Products
• 8K Bytes of In-System Programmable (ISP) Flash Memory– Endurance: 1000 Write/Erase Cycles
• 4.0V to 5.5V Operating Range
• Fully Static Operation: 0 Hz to 33 MHz
• Three-level Program Memory Lock

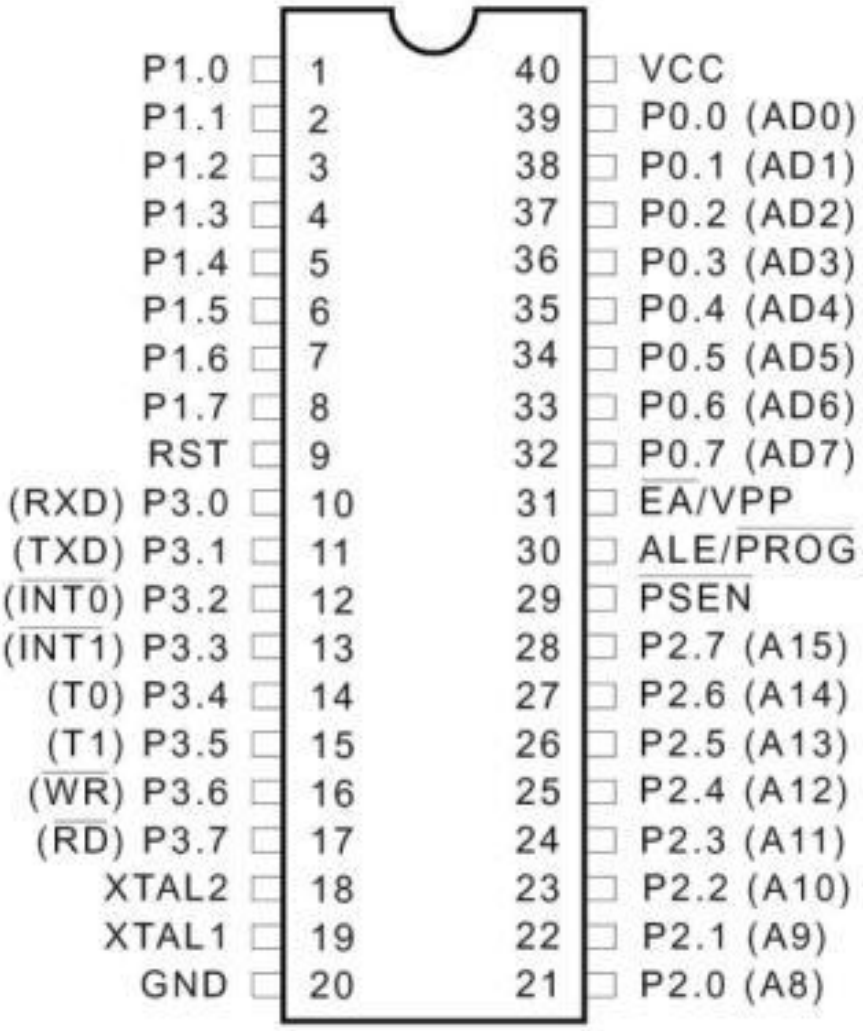
- 256K Internal RAM
- 32 Programmable I/O Lines
- 3 16-bit Timer/Counters
- Eight Interrupt Sources
- Full Duplex UART Serial Channel
- Low-power Idle and Power-down Modes
- Interrupt Recovery from Power-down Mode
- Watchdog Timer
- Dual Data Pointer
- Power-off Flag

## DESCRIPTION OF MICROCONTROLLER 89S52:

The AT89S52 is a low-power, high-performance CMOS 8-bit micro controller with 8Kbytes of in-system programmable Flash memory. The device is manufactured using Atmel's high-density nonvolatile memory technology and is compatible with the industry-standard 80C51 micro controller. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional nonvolatile memory programmer. By combining a versatile 8-bit CPU with in-system programmable flash one monolithic chip; the Atmel AT89S52 is a powerful micro controller, which provides a highly flexible and cost-effective solution to many embedded control applications.


VCC
40
P1.0
1
PORT 1
P1.7
RAM
EEPROM
(FLASH)
PORT 0
39
P0.0
P0.7
CPU
RST
EA
ALE
PSEN
P3.0
10
PORT 3
P3.7
17
PORT 2
P2.7
P2.0
21
Timers, Counters,
Interrupts, Serial
Port, SFRs,
Watch-dog.
XTAL1
XTAL2
19
20
GND

**Pin Configurations:**




The AT89S52 provides the following standard features: 8K bytes of Flash, 256 bytes of RAM, 32 I/O lines, Watchdog timer, two data pointers, three 16-bit timer/counters, full duplex serial port, on-chip oscillator, and clock circuitry. In addition, the AT89S52 is designed with static logic for perationdown to zero frequency and supports two software selectable power saving modes. The Idle Mode stops the CPU while allowing the RAM timer/counters, serial port, and interrupt system to continue functioning. The Power-down mode saves the RAM contents but freezes the oscillator, disabling all other chip functions until the next interrupt Or hardware

reset.

**Pin Description:**

*VCC:* Supply voltage.

*GND:* Ground.

*Port 0:*

Port 0 is an 8-bit open drain bi-directional I/O port. As an output port, each pin can sink eight TTL inputs. When 1sare written to port 0 pins, the pins can be used as high impedance inputs. Port 0 can also be configured to be the multiplexed low order address/data bus during accesses to external program and data memory. In this mode, P0 has internal pull-ups. Port 0 also receives the code bytes during Flash programming and outputs the code bytes during program verification. External pull-ups are required during program verification

*Port 1:*

Port 1 is an 8-bit bi-directional I/O port with internal pull-ups. The Port 1 Output buffers can sink/source four TTL inputs. When 1s are written to Port 1 pins, they are pulled high by the internal pull-ups and can be used as inputs. In addition, P1.0 and P1.1 can be configured to be the timer/counter 2 external count input

(P1.0/T2) and the timer/counter 2 trigger input P1.1/T2EX), respectively, as shown in the following table. Port 1 also receives the low-order address bytes during Flash programming and verification.

*Port 2:*

Port 2 is an 8-bit bi-directional I/O port with internal pull-ups. The Port 2 output buffers can sink/source four TTL inputs. When 1s are written to Port 2 pins, they are pulled high by the internal pull-ups and can be used as inputs. Port 2 emits the high-order address byte during fetches from external program memory and

during accesses to external data memory that use 16-bit addresses (MOVX @DPTR). In this application, Port 2 uses strong internal pull-ups when emitting 1s. During accesses to external data memory that use 8-bit addresses (MOVX @ RI), Port 2emits the contents of the P2 Special Function Register. Port 2 also receives the high-order address bits and some control signals during Flash programming and verification.

*Port 3:*

Port 3 is an 8-bit bi-directional I/O port with internal pull-ups. The Port 3 output buffers can sink/source four TTL inputs. When 1s are writt 1s are written to Port 3 pins, they are pulled high by the internal pull-ups and can be used as inputs. As inputs, Port 3 pins that are externally being pulled low will source current (IIL) because of the pull-ups. Port 3 also serves the functions of various special features of the AT89S52, as shown in the following table.Port 3 also receives some control signals for Flash programming and verification.

*RST:*

Reset input. A high on this pin for two machine cycles while the oscillator is running resets the device.

*ALE/PROG:*

Address Latch Enable (ALE) is an output pulse for latching the low byte of the address during accesses to external memory. This pin is also the program pulse input (PROG) during Flash programming. In normal operation, ALE is emitted at a constant rate of1/6 the oscillator frequency and may be used for external timing or clocking purposes. Note, however, that one ALE pulse is skipped during each access to external data Memory. If desired, ALE operation can be disabled by setting bit 0 of SFR location 8EH. With the bit set, ALE is active only during a MOVX or MOVC instruction. Otherwise, the pin is weakly pulled high. Setting the ALE-disable bit has no effect if the micro controller is in external execution mode.

*PSEN:*

Program Store Enable (PSEN) is the read strobe to external program memory. When the AT89S52 is executing code from external program memory, PSEN is

activated twice each machine cycle, except that two PSEN activations are skipped during each access to external data memory.

*EA/VPP:*

External Access Enable. EA must be strapped to GND in order to enable the device to fetch code from external program memory locations starting at 0000H up to FFFFH.Note, however, that if lock bit 1 is programmed, EA will be internally latched on reset. A should be strapped to VCC for internal program executions. This pin also receives the 12-voltProgramming enables voltage (VPP) during Flash programming.

*XTAL1:*

Input to the inverting oscillator amplifier and input to the internal clock operating circuit.

*XTAL2:*

Output from the inverting oscillator amplifier.

*Special Function Register (SFR) Memory:*

Special Function Registers (SFR s) are areas of memory that control specific functionality of the 8051 processor. For example, four SFRs permit access to the 8051's 32 input/output lines. Another SFR allows the user to set the serial baud rate, control and access timers, and configure the 8051's interrupt system.

*The Accumulator:-*

The Accumulator, as its name suggests is used as a general register to accumulate the results of a large number of instructions. It can hold 8-bit (1-byte) value and is the most versatile register.

*The "R" registers:-*

The "R" registers are a set of eight registers that are named R0, R1. Etc up to R7. These registers are used as auxiliary registers in many operations.

*The "B" registers:-*

The "B" register is very similar to the accumulator in the sense that it may hold an 8-bit (1-byte) value. Two only uses the "B" register 8051 instructions: MUL AB and DIV AB.

*The Data Pointer:-*

The Data pointer (DPTR) is the 8051's only user accessible 16-bit (2Bytes) register. The accumulator, "R" registers are all 1-Byte values. DPTR, as the name suggests, is used to point to data. It is used by a number of commands, which allow the 8051 to access external memory.

*THE PROGRAM COUNTER AND STACK POINTER:-*

The program counter (PC) is a 2-byte address, which tells the 8051 where the next instruction to execute is found in memory. The stack pointer like all registers except DPTR and PC may hold an 8-bit (1-Byte) value

*ADDRESSING MODES:-*

An "addressing mode" refers that you are addressing a given memory location.

Each of these addressing modes provides important flexibility.

. Immediate Addressing
. Direct Addressing
. Indirect Addressing
. Indexed Addressing
a. External Direct
b. Code In direct

## GSM module

### Introduction:

GSM module is used to establish communication between a computer and a GSM-GPRS system. Global System for Mobile communication (GSM) is an architecture used for mobile communication in most of the countries. Global Packet Radio Service (GPRS) is an extension of GSM that enables higher data transmission rate.

The Global Positioning System (GPS) is the only fully functional Global Navigation Satellite System (GNSS). The GPS uses a constellation of between 24 and 32 Medium Earth Orbit satellites that transmit precise microwave signals, which enable GPS receivers to determine their location, speed,. GPS was developed by the United States Department of Defense. Its official name is NAVSTAR-GPS. Although NAVSTAR-GPS is not an acronym, a few backronyms have been created for it. The GPS satellite constellation is managed by the United States Air Force 50th Space Wing.

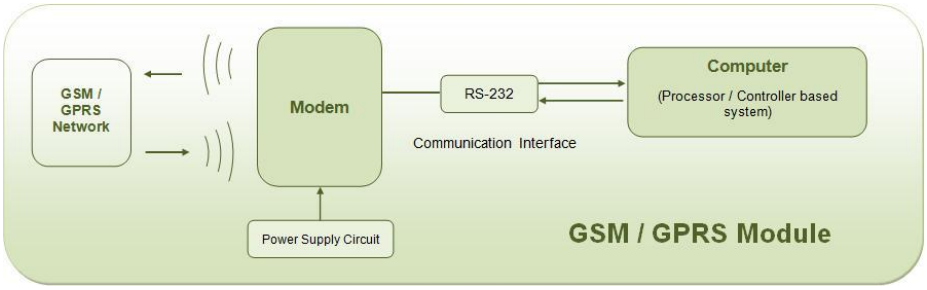
Global Positioning System is an earth-orbiting-satellite based system that provides signals available anywhere on or above the earth, twenty-four hours a day, which can be used to determine precise time and the position of a GPS receiver in three dimensions. GPS is increasingly used as an input for Geographic Information Systems particularly for precise positioning of geospatial data and the collection of data in the field. Precise positioning is possible using GPS receivers at reference locations providing corrections and relative positioning data for remote receivers. Time and frequency dissemination, based on the precise clocks on board the SVs and controlled by the monitor stations, is another, use for GPS. Astronomical observatories telecommunications facilities and laboratory standards can be set to precise time signals or controlled to accurate frequencies by special purpose GPS receivers.

Similar satellite navigation systems include the Russian GLONASS (incomplete as of 2008), the upcoming European Galileo positioning system, the proposed COMPASS navigation system of China, and IRNSS of India.

Following the shooting down of Korean Air Lines Flight 007 in 1983, President Ronald Reagan issued a directive making the system available free for civilian use as a common good. Since then, GPS has become a widely used aid to navigation

worldwide, and a useful tool for map-making, land surveying, commerce, scientific uses, and hobbies such as geocaching. GPS also provides a precise time reference used in many applications including scientific study of earthquakes, and synchronization of telecommunications networks.

**GSM Architecture:**




A GSM network consists of the following components:

A Mobile Station: It is the mobile phone which consists of the transceiver, the display and the processor and is controlled by a SIM card operating over the network.

Base Station Subsystem: It acts as an interface between the mobile station and the network subsystem. It consists of the Base Transceiver Station which contains the radio transceivers and handles the protocols for communication with mobiles. It also consists of the Base Station Controller which controls the Base Transceiver station and acts as a interface between the mobile station and mobile switching centre.

Network Subsystem: It provides the basic network connection to the mobile stations. The basic part of the Network Subsystem is the Mobile Service Switching Centre which provides access to different networks like ISDN, PSTN etc. It also consists of the Home Location Register and the Visitor Location Register which provides the call routing and roaming capabilities of GSM. It also contains the Equipment Identity Register which maintains an account of all the mobile equipments wherein each mobile is identified by its own IMEI number. IMEI stands for International Mobile Equipment Identity.

The GSM network architecture as defined in the GSM specifications can be grouped into four main areas:

* Network and Switching Subsystem (NSS)
* Base-Station Subsystem (BSS)
* Mobile station (MS)
* Operation and Support Subsystem (OSS)
* The different elements of the GSM network operate together and the user is not aware of the different entities within the system.

**Features of GSM Module:**

* Improved spectrum efficiency
* International roaming
* Compatibility with integrated services digital network (ISDN)
* Support for new services.
* SIM phonebook management
* Fixed dialing number (FDN)
* Real time clock with alarm management
* High-quality speech
* Uses encryption to make phone calls more secure
* Short message service (SMS)

The security strategies standardized for the GSM system make it the most secure telecommunications standard currently accessible. Although the confidentiality of a call and secrecy of the GSM subscriber is just ensured on the radio channel, this is a major step in achieving end-to- end security.

## GPRS module

### Introduction:

A GPRS modem is a GSM modem that additionally supports the GPRS technology for data transmission. GPRS stands for General Packet Radio Service. It is a packet-switched technology that is an extension of GSM. (GSM is a circuit-switched technology.) A key advantage of GPRS over GSM is that GPRS has a higher data transmission speed.

GPRS can be used as the bearer of SMS. If SMS over GPRS is used, an SMS transmission speed of about 30 SMS messages per minute may be achieved. This is much faster than using the ordinary SMS over GSM, whose SMS transmission speed is about 6 to 10 SMS messages per minute. A GPRS modem is needed to send and receive SMS over GPRS. Note that some wireless carriers do not support the sending and receiving of SMS over GPRS.

If you need to send or receive MMS messages, a GPRS modem is typically needed.

### GPRS System Architecture:

The GPRS is an enhancement over the GSM and adds some nodes in the network to provide the packet switched services. These network nodes are called GSNs (GPRS Support Nodes) and are responsible for the routing and delivery of the data packets to and form the MS and external packet data networks (PDN). The figure 2.2 below shows the architecture of the GPRS system.

The most important network nodes added to the existing GSM networks are:
* SGSN (Serving GPRS Support Node).
* GGSN (Gateway GPRS Support Node).

The serving GPRS support node (SGSN) is responsible for routing the packet switched data to and from the mobile stations (MS) within its area of responsibility. The main functions of SGSN are packet routing and transfer, mobile attach and detach procedure (Mobility Management (MM)), location management, assigning channels and time slots (Logical Link Management (LLM)), authentication and charging for

calls. It stores the location information of the user (like the current location, current VLR) and user profile (like IMSI addresses used in packet data networks) of registered users in its location register.

The gateway GPRS support node (GGSN) acts as interface between the GPRS backbone and the external packet data network (PDN). It converts the GPRS packet coming from the SGSN into proper packet data protocol (PDP) format (i.e. X.25 or IP) before sending to the outside data network. Similarly it converts the external PDP addresses to the GSM address of the destination user. It sends these packets to proper SGSN. For this purpose the GGSN stores the current SGSN address of the user and his profile in its location register.The GGSN also performs the authentication and charging functions. In general there may be a many to many relationship between the SGSN and GGSN. However a service provider may have only one GGSN and few SGSNs due to cost constraints. A GGSN proved the interface to several SGSNs to the external PDN.

**Working Principle of GPRS Module:**

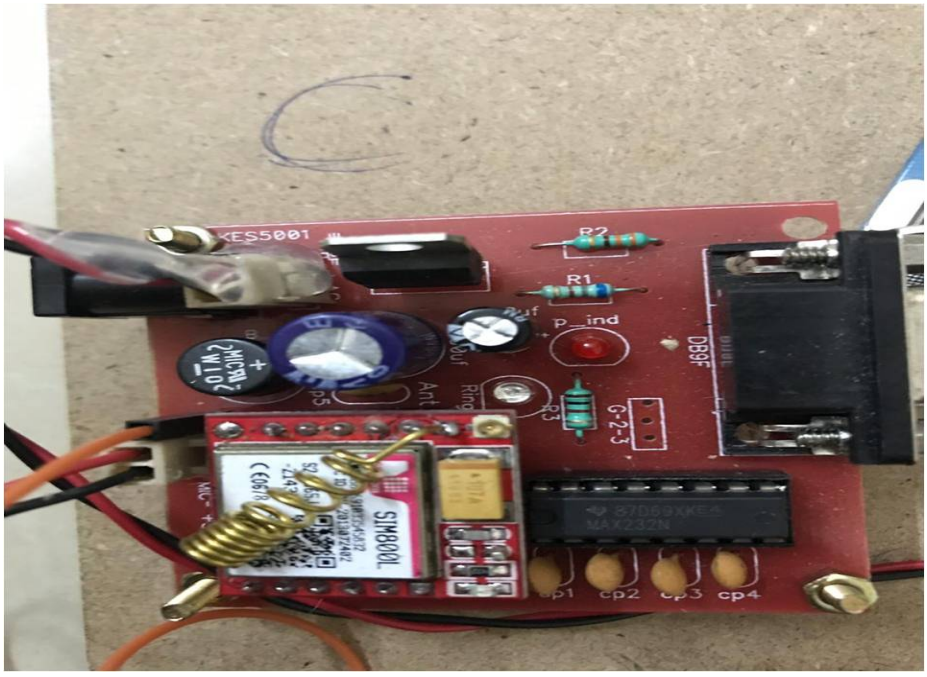
GPRS module is the main application part of GPRS Modem. It is an industrial wireless data transmission device.

USR IOT Serial GPRS module is aimed to realize data transmission between serial and GPRS network. GPRS module is based on industrial MTK chip, which has multiple working modes to fit in different applications. USR GPRS module supports network connection in max 4 channel. It is a perfect industrial serial GPRS module.

| AT Command | The Functions of AT Command |
|---|---|
| ATD | Dial |
| AT+CGMS | Send SMS Message |
| AT+CMSS | Send SMS Message from storage |
| AT+CMGL | List SMS Messages |
| AT+CMGR | Read SMS Messages |
| AT+CSCA? | Service Centre Address |
| AT+CPMS | To choose storage from ME or SM |
| AT+IPR=0 | To choose auto baud rate |
| AT+CMGF= | To choose PDU Mode or Text Mode |

In order to meet the needs of customers, USR IOT will launch a minimum GPRS module USR-GM3.

**GPS Working:**



A GPS receiver calculates its position by carefully timing the signals sent by the constellation of GPS satellites high above the Earth. Each satellite continually transmits messages containing the time the message was sent, a precise orbit for the satellite sending the message (the ephemeris), and the general system health and rough orbits of all GPS satellites (the almanac). These signals travel at the speed of light through outer space, and slightly slower through the atmosphere. The receiver uses the arrival time of each message to measure the distance to each satellite, from which it determines the position of the receiver (conceptually the intersection of spheres - see trilateration ) The resulting coordinates are converted to more user-friendly forms such as latitude and longitude, or location on a map, then displayed to the user.

**Features of GPRS:**

GPRS facilitates instant connections whereby information can be sent or received immediately as the need arises, subject to radio coverage. No dial-up modem connection is necessary. This is why GPRS users are sometimes referred to be as being "always connected". Immediacy is one of the advantages of GPRS (and SMS) when compared to Circuit Switched Data. High immediacy is a very important feature for time critical applications such as remote credit card authorization where it would be unacceptable to keep the customer waiting for even thirty extra seconds.

To use GPRS, users specifically need:

* a mobile phone or terminal that supports GPRS (existing GSM phones do NOT support GPRS);
* a subscription to a mobile telephone network that supports GPRS;
* use of GPRS must be enabled for that user. Automatic access to the GPRS may be allowed by some mobile network operators, others will require a specific opt-in;
* knowledge of how to send and/or receive GPRS information using their specific model of mobile phone, including software and hardware configuration (this creates a customer service requirement);
* a destination to send or receive information through GPRS. Whereas with SMS

this was often another mobile phone, in the case of GPRS, it is likely to be an Internet address, since GPRS is designed to make the Internet fully available to mobile users for the first time. From day one, GPRS users can access any web page or other Internet applications- providing an immediate critical mass of uses;
* Having looked at the key user features of GPRS, lets look at the key features from a network operator perspective.

**Limitations of GPRS:**

It should already be clear that GPRS is an important new enabling mobile data service which offers a major improvement in spectrum efficiency, capability and functionality compared with today's nonvoice mobile services.

GPRS does impact a network's existing cell capacity. There are only limited radio resources that can be deployed for different uses - use for one purpose precludes simultaneous use for another. For example, voice and GPRS calls both use the same network resources. The extent of the impact depends upon the number of timeslots, if any, that are reserved for exclusive use of GPRS. However, GPRS does dynamically manage channel allocation and allow a reduction in peak time signalling channel loading by sending short messages over GPRS channels instead.

At the time of writing, there has been no confirmation from any handset vendors that mobile terminated GPRS calls (i.e. receipt of GPRS calls on the mobile phone) will be supported by the initial GPRS terminals. Availability or not of GPRS MT is a central question with critical impact on the GPRS business case such as application migration from other nonvoice bearers.

By originating the GPRS session, users confirm their agreement to pay for the delivery of content from that service. This origination may well be performed using a Wireless Application Protocol (WAP) session using the WAP microbrowser that will be built into GHPRS terminals. However, mobile terminated IP traffic might allow unsolicited information to reach the terminal. Internet sources originating such unsolicited content may not be chargeable. A possible worse case scenario would be that mobile users would have to pay for receiving unsolicited junk content. This is

a potential reason for a mobile vendor NOT to support GPRS Mobile Terminate in their GPRS terminals.

However, there is always the possibility of unsolicited or unwanted information being communicated through any media, but that does not mean that we would wish to preclude the possibility of any kind of communication through that means altogether. A network side solution such as GGSN or charging platform policing would be preferable rather than a non-flexible limitation built into all the GPRS handsets.

When we asked Nokia about this issue, it commented: "Details of the Nokia GPRS terminals are not available at this time. It is too early to confirm whether MT will be supported in the first Nokia GPRS terminals". The company's policy is not to make details available about products before they are announced. Readers should contact the GSM Association, Mobile Streams Limited and/or the vendors directly to encourage them to incorporate support for GPRS MT in their initial terminals.

GPRS is based on a modulation technique known as Gaussian minimum-shift keying (GMSK). EDGE is based on a new modulation scheme that allows a much higher bit rate across the air interface - this is called eight-phase-shift keying (8 PSK) modulation. Since 8 PSK will also be used for UMTS, network operators will need to incorporate it at some stage to make the transition to third generation mobile phone systems.

**Applications for GPRS:**

A wide range of corporate and consumer applications are enabled by nonvoice mobile services such as SMS and GPRS. This section will introduce those that are particularly suited to GPRS.

Chat can be distinguished from general information services because the source of the information is a person with chat whereas it tends to be from an Internet site for information services. The "information intensity" - the amount of information transferred per message tends to be lower with chat, where people are more likely to state opinions than factual data. In the same way as Internet chat groups have proven a very popular application of the Internet, groups of like-minded people - so called

communities of interest - have begun to use nonvoice mobile services as a means to chat and communicate and discuss.

Because of its synergy with the Internet, GPRS would allow mobile users to participate fully in existing Internet chat groups rather than needing to set up their own groups that are dedicated to mobile users. Since the number of participants is an important factor determining the value of participation in the newsgroup, the use of GPRS here would be advantageous. GPRS will not however support point to multipoint services in its first phase, hindering the distribution of a single message to a group of people. As such, given the installed base of SMS capable devices, we would expect SMS to remain the primary bearer for chat applications in the foreseeable future, although experimentation with using GPRS is likely to commence sooner rather than later.

Upon receiving a new email, most Internet email users do not currently get notified of this fact on their mobile phone. When they are out of the office, they have to dial in speculatively and periodically to check their mailbox contents. However, by linking Internet email with an alert mechanism such as SMS or GPRS, users can be notified when a new email is received.

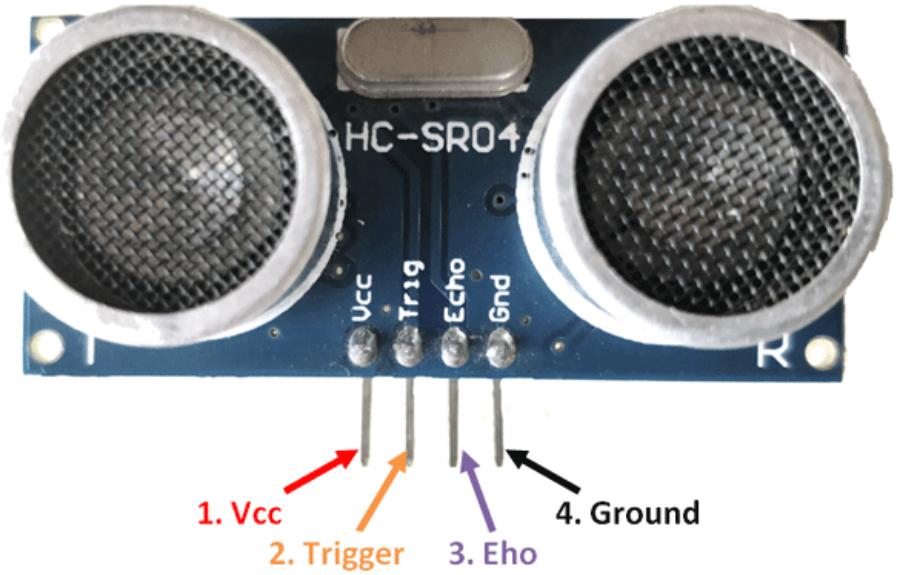
## Ultrasonic Distance Sensor Module - HC-SR04

### Description:

This ultrasonic sensor module can be used for measuring distance, object sensor, motion sensors etc. High sensitive module can be used with microcontroller to integrate with motion circuits to make robotic projects and other distance, position & motion sensitive products.The module sends eight 40Khz square wave pulses and automatically detects whether it receives the returning signal. If there is a signal returning, a high level pulse is sent on the echo pin. The length of this pulse is the time it took the signal from first triggering to the return echo.

### Features:

* Operating voltage: +5V
* Theoretical Measuring Distance: 2cm to 450cm
* Practical Measuring Distance: 2cm to 80cm
* Accuracy: 3mm
* Operating Frequency: 40Hz



**Pin Configuration:**

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.

**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 is speed multiplied with 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.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.

**Use:**

HC-SR04 distance sensor is commonly used with both microcontroller and microprocessor platforms like Arduino, ARM, PIC, Raspberry Pie etc. The following

guide is universally since it has to be followed irrespective of the type of computational device used.

Power the Sensor using a regulated +5V through the Vcc ad Ground pins of the sensor. The current consumed by the sensor is less than 15mA and hence can be directly powered by the on board 5V pins (If available). The Trigger and the Echo pins are both I/O pins and hence they can be connected to I/O pins of the microcontroller. To start the measurement, the trigger pin has to be made high for 10uS and then turned off. This action will trigger an ultrasonic wave at frequency of 40Hz from the transmitter and the receiver will wait for the wave to return. Once the wave is returned after it getting reflected by any object the Echo pin goes high for a particular amount of time which will be equal to the time taken for the wave to return back to the sensor.

The amount of time during which the Echo pin stays high is measured by the MCU/MPU as it gives the information about the time taken for the wave to return back to the Sensor. Using this information the distance is measured as explained in the above heading.

**Applications:**

* Used to avoid and detect obstacles with robots like biped robot, obstacle avoider robot, path finding robot etc.
* Used to measure the distance within a wide range of 2cm to 400cm
* Can be used to map the objects surrounding the sensor by rotating it
* Depth of certain places like wells, pits etc can be measured since the waves can penetrate through water

## DC Motor

### Introduction:

A DC motor is designed to run on DC electric power. Two examples of pure DC designs are Michael Faraday's homopolar motor (which is uncommon), and the ball bearin motor, which is (so far) a novelty. By far the most common DC motor types are the brushed and brushless types, which use internal and external commutation respectively to create an oscillating AC current from the DC source – so they are not purely DC machines in a strict sense.

DC motors are rarely utilized in normal applications as a result of all electrical supply firms furnish electrical energy but, for special applications like in steel mills, mines and electric traction, it's advantageous to convert AC into DC so as to use DC motors. The rationale is that speed/torque characteristics of DC motors are much more superior thereto of AC motors. Therefore, it's not stunning to notice that for industrial drives, DC motors are as common as 3-phase induction motors. Similar to DC generators, DC motors are also classified into 3 kinds; they are series-wound, shunt-wound and compound- wound. The employment of a specific motor depends upon the mechanical load it's to drive.

### Types of dcmotors:

* Brushed DC Motors
* Brushless DC motors
* Coreless DC motors

*Brushed DC motors:*

The classic DC motor design generates an oscillating current in a wound rotor with a split ring commutator, and either a wound or permanent magnet stator. A rotor consists of a coil wound around a rotor which is then powered by any type of battery.

Many of the limitations of the classic commutator DC motor are due to the need for brushes to press against the commutator. This creates friction. At higher speeds, brushes have increasing difficulty in maintaining contact. Brushes may bounce off the irregularities in the commutator surface, creating sparks. This limits the maximum speed of the machine. The current density per unit area of the brushes limits the output of the motor. The imperfect electric contact also causes electrical noise. Brushes eventually wear out and require replacement, and the commutator itself is subject to wear and maintenance. The commutator assembly on a large machine is a costly element, requiring precision assembly of many parts. there are three types of dc motor 1. dc series motor 2. dc shunt motor 3. dc compound motor - these are also two type a. cummulative compound b. deffercial compounnd.

*Brushless DC motors:*

Some of the problems of the brushed DC motor are eliminated in the brushless design. In this motor, the mechanical "rotating switch" or commutator/brushgear assembly is replaced by an external electronic switch synchronised to the rotor's position. Brushless motors are typically 85-90% efficient, whereas DC motors with brushgear are typically 75-80% efficient.

Midway between ordinary DC motors and stepper motors lies the realm of the brushless DC motor. Built in a fashion very similar to stepper motors, these often use a permanent magnet external rotor, three phases of driving coils, one or more Hall effect sensors to sense the position of the rotor, and the associated drive electronics. The coils are activated, one phase after the other, by the drive electronics as cued by the signals from the Hall effect sensors. In effect, they act as three-phase synchronous motors containing their own variable-frequency drive electronics. A specialized class of brushless DC motor controllers utilize EMF feedback through the main phase connections instead of Hall effect sensors to determine position and velocity. These motors are used extensively in electric radio-controlled vehicles. When configured with the magnets on the outside, these are referred to by modelists as outrunner motors.

Brushless DC motors are commonly used where precise speed control is necessary, as in computer disk drives or in video cassette recorders, the spindles within CD, CD-ROM (etc.) drives, and mechanisms within office products such as fans, laser printers and photocopiers. They have several advantages over conventional motors:

* Compared to AC fans using shaded-pole motors, they are very efficient, running much cooler than the equivalent AC motors. This cool operation leads to much-improved life of the fan's bearings.

* Without a commutator to wear out, the life of a DC brushless motor can be significantly longer compared to a DC motor using brushes and a commutator. Commutation also tends to cause a great deal of electrical and RF noise; without a commutator or brushes, a brushless motor may be used in electrically sensitive devices like audio equipment or computers.

* The same Hall effect sensors that provide the commutation can also provide a convenient tachometer signal for closed-loop control (servo-controlled) applications. In fans, the tachometer signal can be used to derive a "fan OK" signal.

* The motor can be easily synchronized to an internal or external clock, leading to precise speed control.

* Brushless motors have no chance of sparking, unlike brushed motors, making them better suited to environments with volatile chemicals and fuels. Also, sparking generates ozone which can accumulate in poorly ventilated buildings risking harm to occupants' health.

* Brushless motors are usually used in small equipment such as computers and are generally used to get rid of unwanted heat.

* They are also very quiet motors which is an advantage if being used in equipment that is affected by vibrations. Modern DC brushless motors range in power from a fraction of a watt to many kilowatts. Larger brushless motors up to about 100 kW rating are used in electric vehicles. They also find significant use in high-performance electric model aircraft.

*Coreless DC motors:*

Nothing in the design of any of the motors described above requires that the iron (steel) portions of the rotor actually rotate; torque is exerted only on the windings of the electromagnets. Taking advantage of this fact is the coreless DC motor, a specialized form of a brush or brushless DC motor. Optimized for rapid acceleration, these motors have a rotor that is constructed without any iron core. The rotor can take the form of a winding-filled cylinder inside the stator magnets, a basket surrounding the stator magnets, or a flat pancake (possibly formed on a printed wiring board) running between upper and lower stator magnets. The windings are typically stabilized by being impregnated with Electrical epoxy potting systems. Filled epoxies that have moderate mixed viscosity and a long gel time. These systems are highlighted by low shrinkage and low exotherm. Typically UL 1446 recognized as a potting compound for use up to 180C (Class H) UL File No. E 210549.

Because the rotor is much lighter in weight (mass) than a conventional rotor formed from copper windings on steel laminations, the rotor can accelerate much more rapidly, often achieving a mechanical time constant under 1 ms. This is especially true if the windings use aluminum rather than the heavier copper. But because there is no metal mass in the rotor to act as a heat sink, even small coreless motors must often be cooled by forced air.

These motors were commonly used to drive the capstan(s) of magnetic tape drives and are still widely used in high-performance servo-controlled systems, like radio-controlled vehicles/aircraft, humanoid robotic systems, industrial automation, medical devices, etc.

**Working of DC motor:**

Let's think a part of a multipolar DC motor as shown in Fig. once the terminals of the motor are connected to an external DC supply. Then,The field magnets are excited developing alternate N and S poles;

The armature conductors carry currents. All conductors below N-pole carry currents in one direction whereas all the conductors below S-pole carry currents within the opposite direction.

Assume the conductors below N-pole carry currents into the plane of the paper and those below S-pole carry currents out of the plane of the paper which is shown in Fig. Since each armature conductor is carrying current and is placed within the magnetic field, mechanical force acts on that. Stating to the Fig and applying Fleming's left hand rule, it's clear that force on every conductor is tending to rotate the armature in anticlockwise direction. All these forces add along to provide a driving torsion that sets the armature rotating. Once the conductor interchanges from one side of a brush to the opposite, the current in the conductor is reversed and at identical time it comes below the influence of next pole that is of reverse polarity. Accordingly, the direction of force on the conductor rests identical.

**Buzzer**

A buzzer or beeper is a signaling device, usually electronic, typically used in automobiles, household appliances such as a microwave oven, or game shows.

It most commonly consists of a number of switches or sensors connected to a control unit that determines if and which button was pushed or a preset time has lapsed, and usually illuminates a light on the appropriate button or control panel, and sounds a warning in the form of a continuous or intermittent buzzing or beeping sound. Initially this device was based on an electromechanical system which was identical to an electric bell without the metal gong . Often these units were anchored to a wall or ceiling and used the ceiling or wall as a sounding board. Another implementation with some AC-connected devices was to implement a circuit to make the AC current into a noise loud enough to drive a loudspeaker and hook this circuit up to a cheap 8-ohm speaker. Nowadays, it is more popular to use a ceramic-based piezoelectric sounder like a Son alert which makes a high-pitched tone. Usually these were hooked up to "driver" circuits which varied the pitch of the sound or pulsed the sound on and off.

In game shows it is also known as a "lockout system," because when one person signals ("buzzes in"), all others are locked out from signaling. Several game shows have large buzzer buttons which are identified as "plungers".

The word "buzzer" comes from the rasping noise that buzzers made when they were electromechanical devices, operated from stepped-down AC line voltage at 50 or 60 cycles. Other sounds commonly used to indicate that a button has been pressed are a ring or a beep.

## LCD (Liquid Crystal Display)

### Introduction:

A liquid crystal display (LCD) is a thin, flat display device made up of any number of color or monochrome pixels arrayed in front of a light source or reflector. Each pixel consists of a column of liquid crystal molecules suspended between two transparent electrodes, and two polarizing filters, the axes of polarity of which are perpendicular to each other. Without the liquid crystals between them, light passing through one would be blocked by the other. The liquid crystal twists the polarization of light entering one filter to allow it to pass through the other.

A program must interact with the outside world using input and output devices that communicate directly with a human being. One of the most common devices attached to an controller is an LCD display. Some of the most common LCDs connected to the contollers are 16X1, 16x2 and 20x2 displays. This means 16 characters per line by 1 line 16 characters per line by 2 lines and 20 characters per line by 2 lines, respectively.

Many microcontroller devices use 'smart LCD' displays to output visual information. LCD displays designed around LCD NT-C1611 module, are inexpensive, easy to use, and it is even possible to produce a readout using the 5X7 dots plus cursor of the display. They have a standard ASCII set of characters and mathematical symbols. For an 8-bit data bus, the display requires a +5V supply plus 10 I/O lines (RS RW D7 D6 D5 D4 D3 D2 D1 D0). For a 4-bit data bus it only requires the supply lines plus 6 extra lines(RS RW D7 D6 D5 D4). When the LCD display is not enabled, data lines are tri-state and they do not interfere with the operation of the microcontroller.

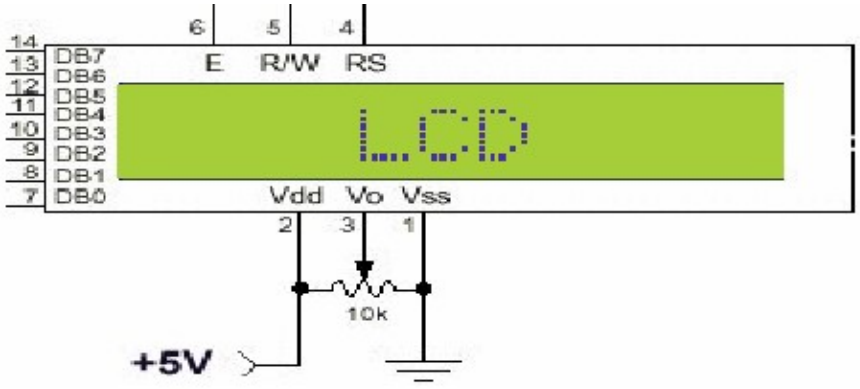
### Features:

* Operating Voltage is 4.7V to 5.3V
* Current consumption is 1mA without backlight
* Alphanumeric LCD display module, meaning can display alphabets and numbers
* Consists of two rows and each row can print 16 characters.

* Each character is build by a 5 by 8 pixel box
* Can work on both 8-bit and 4-bit mode
* It can also display any custom generated characters
* Available in Green and Blue Backlight

**PIN DESCRIPTION:**

Most LCDs with 1 controller has 14 Pins and LCDs with 2 controller has 16 Pins (two pins are extra in both for back-light LED connections).




| PIN | SYMBOL | FUNCTION |
|---|---|---|
| 1 | Vss | Power Supply(GND) |
| 2 | Vdd | Power Supply(+5V) |
| 3 | Vo | Contrast Adjust |
| 4 | RS | Instruction/Data Register Select |
| 5 | R/W | Data Bus Line |
| 6 | E | Enable Signal |
| 7-14 | DB0-DB7 | Data Bus Line |
| 15 | A | Power Supply for LED B/L(+) |
| 16 | K | Power Supply for LED B/L(-) |

**CONTROL LINES:**

*EN:*

Line is called "Enable." This control line is used to tell the LCD that you are sending it data. To send data to the LCD, your program should make sure this line is low (0) and then set the other two control lines and/or put data on the data bus. When the other lines are completely ready, bring EN high (1) and wait for the minimum amount of time required by the LCD datasheet (this varies from LCD to LCD), and end by bringing it low (0) again.

*RS:*

Line is the "Register Select" line. When RS is low (0), the data is to be treated as a command or special instruction (such as clear screen, position cursor, etc.). When RS is high (1), the data being sent is text data which sould be displayed on the screen. For example, to display the letter "T" on the screen you would set RS high.

*RW:*

Line is the "Read/Write" control line. When RW is low (0), the information on the data bus is being written to the LCD. When RW is high (1), the program is effectively querying (or reading) the LCD. Only one instruction ("Get LCD status") is a read command. All others are write commands, so RW will almost always be low.Finally, the data bus consists of 4 or 8 lines (depending on the mode of operation selected by the user). In the case of an 8-bit data bus, the lines are referred to as DB0, DB1, DB2, DB3, DB4, DB5, DB6, and DB7.

*Logic status on control lines:*

* E - 0 Access to LCD disabled - 1 Access to LCD enabled
* R/W - 0 Writing data to LCD - 1 Reading data from LCD
* RS - 0 Instructions - 1 Character

*Writing data to the LCD:*

1) Set R/W bit to low
2) Set RS bit to logic 0 or 1 (instruction or character)
3) Set data to data lines (if it is writing)
4) Set E line to high
5) Set E line to low

*Read data from data lines (if it is reading)on LCD:*

1) Set R/W bit to high
2) Set RS bit to logic 0 or 1 (instruction or character)
3) Set data to data lines (if it is writing)
4) Set E line to high
5) Set E line to low

*Entering Text:*

First, a little tip: it is manually a lot easier to enter characters and commands in hexadecimal rather than binary (although, of course, you will need to translate commands from binary couple of sub-miniature hexadecimal rotary switches is a simple matter, although a little bit into hex so that you know which bits you are setting). Replacing the d.i.l. switch pack with a of re-wiring is necessary.

The switches must be the type where On = 0, so that when they are turned to the zero position, all four outputs are shorted to the common pin, and in position "F", all four outputs are open circuit.

All the available characters that are built into the module are shown in Table 3. Studying the table, you will see that codes associated with the characters are quoted in binary and hexadecimal, most significant bits ("left-hand" four bits) across the top, and least significant bits ("right-hand" four bits) down the left.

Most of the characters conform to the ASCII standard, although the Japanese and Greek characters (and a few other things) are obvious exceptions. Since these intelligent modules were designed in the "Land of the Rising Sun," it seems only fair that their Katakana phonetic symbols should also be incorporated. The more

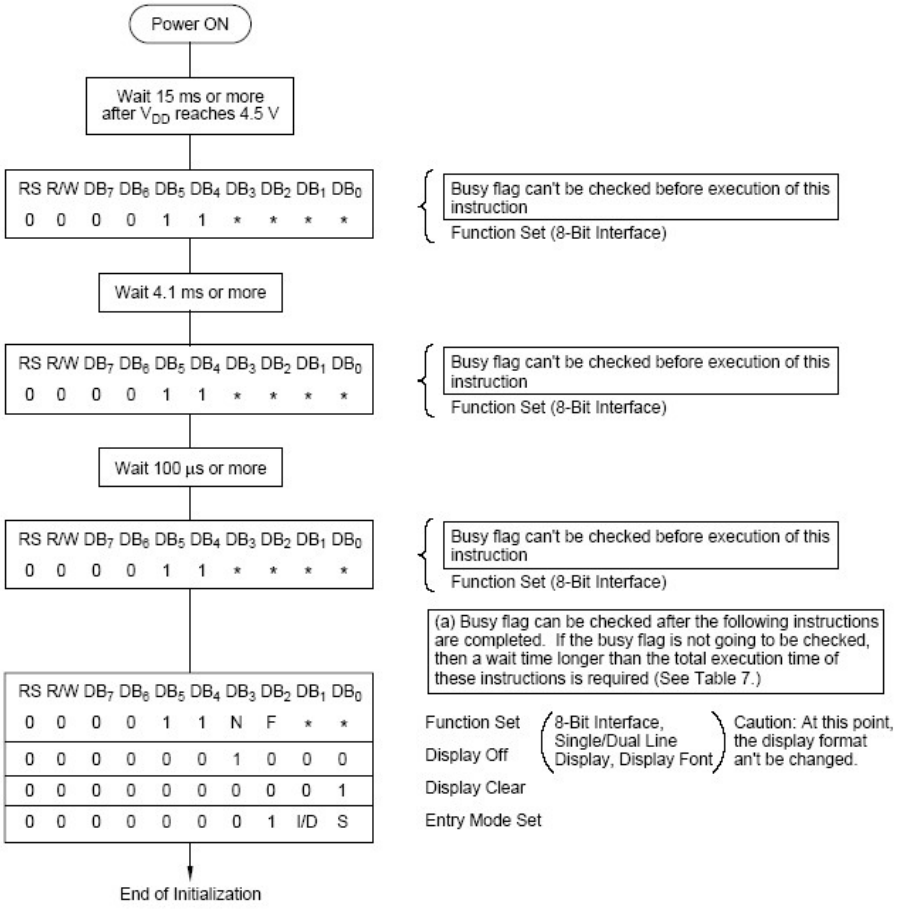
extensive Kanji character set, which the Japanese share with the Chinese, consisting of several thousand different characters, is not included!

Using the switches, of whatever type, and referring to Table 3, enter a few characters onto the display, both letters and numbers. The RS switch (S10) must be "up" (logic 1) when sending the characters, and switch E (S9) must be pressed for each of them. Thus the operational order is: set RS high, enter character, trigger E, leave RS high, enter another character, trigger E, and so on.

The first 16 codes in Table 3, 00000000 to 00001111, (00*to*0F) refer to the CGRAM. This is the Character Generator RAM (random access memory), which can be used to hold user-defined graphics characters. This is where these modules really start to show their potential, offering such capabilities as bar graphs, flashing symbols, even animated characters. Before the user-defined characters are set up, these codes will just bring up strange looking symbols.

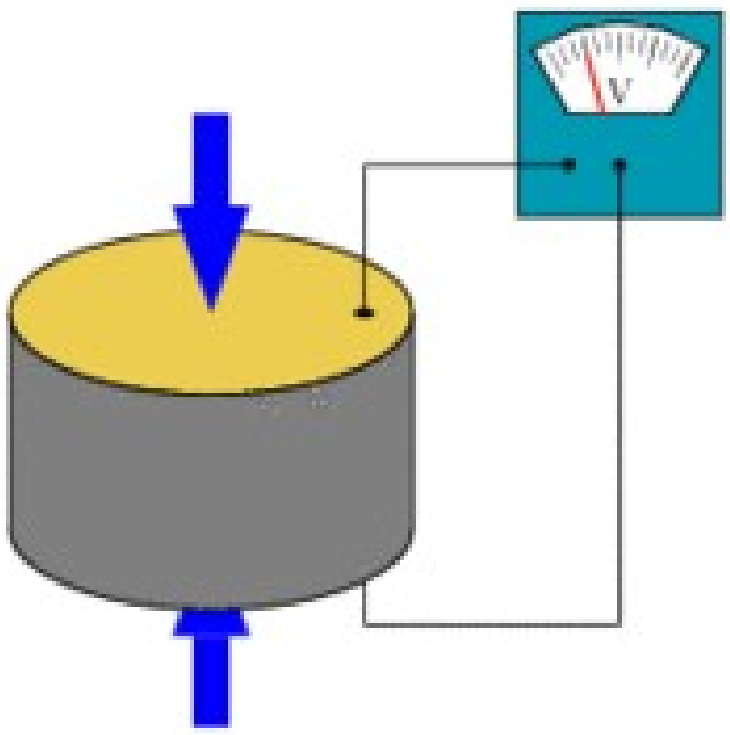
Codes 00010000 to 00011111 (10*to*1F) are not used and just display blank characters. ASCII codes "proper" start at 00100000 (20)*andendwith*01111111(7F). Codes 10000000 to 10011111 (80*to*9F) are not used, and 10100000 to 11011111 (*A*0*to*DF) are the Japanese characters.

*Initialization by Instructions:*



## Accident Sensor

A sensor that utilizes the piezoelectric effect, to measure changes in acceleration, strain, pressure, and force by converting them into electrical charge is called as a piezoelectric sensor. Piezo is a Greek word which means 'press' or 'squeeze'. Piezoelectric effect causes the occurrence of electric dipole moments in solids due to the pressure applied to certain solid materials such as piezoelectric crystals, ceramics, bone, DNA, and some proteins that generates electric charge. This generated piezoelectricity is proportional to the pressure applied to the solid piezoelectric crystal materials. In this article, we will discuss about one of the most frequently used piezoelectric sensor applications, that is, piezo sensor switch.

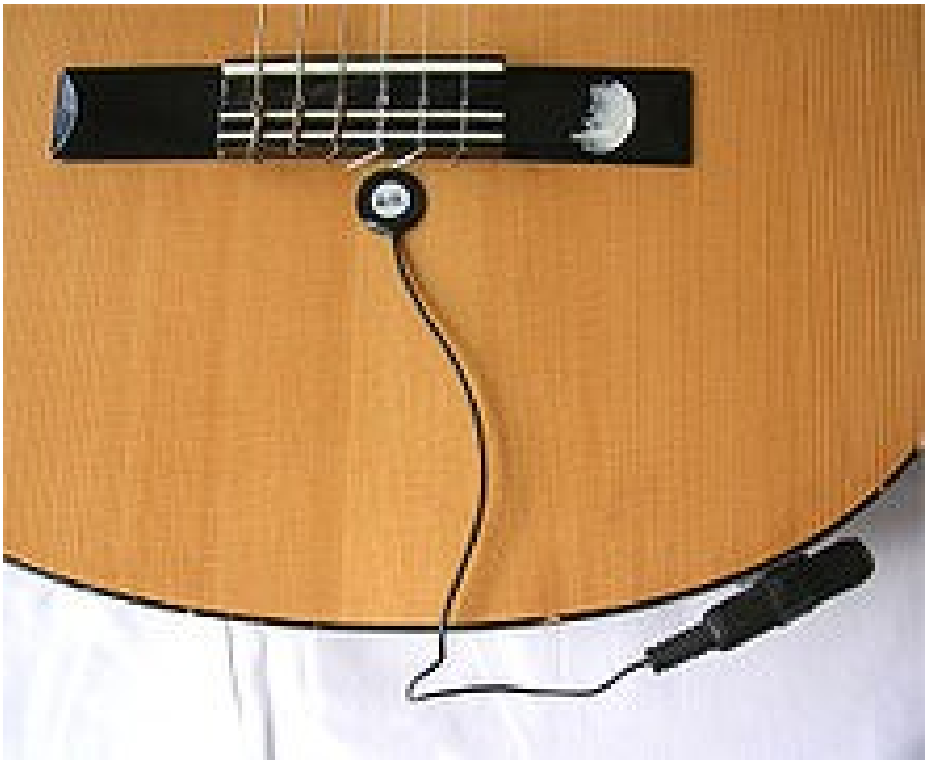



A piezoelectric disk generates a voltage when deformed (change in shape is greatly exaggerated)

A piezoelectric sensor is a device that uses the piezoelectric effect, to measure changes in pressure, acceleration,temperature, strain orforce by converting them to an electrical charge. The prefix piezo- is Greek for 'press' or 'squeeze'.

**Applications:**

Piezoelectric sensors have proven to be versatile tools for the measurement of various processes. They are used for quality assurance,process control and for research and development in many industries. Although the piezoelectric effect was discovered by Pierre Curie in 1880, it was only in the 1950s that the piezoelectric effect started to be used for industrial sensing applications. Since then, this measuring principle has been increasingly used and can be regarded as a mature technology with an outstanding inherent reliability. It has been successfully used in various applications, such as in medical, aerospace, nuclear instrumentation, and as a tilt sensor in consumer electronics or a pressure sensor in the touch pads of mobile phones. In the automotive industry, piezoelectric elements are used to monitor combustion when developing internal combustion engines. The sensors are either directly mounted into additional holes into the cylinder head or the spark/glow plug is equipped with a built-in miniature piezoelectric sensor.



The rise of piezoelectric technology is directly related to a set of inherent advantages. The high modulus of elasticity of many piezoelectric materials is comparable to that of many metals and goes up to 106 Newton per squaremeter. Even though piezoelectric sensors are electromechanical systems that react to compression, the sensing elements show almost zero deflection. This gives piezoelectric sensors ruggedness, an extremely high natural frequency and an excellent linearity over a wide amplitude range. Additionally, piezoelectric technology is insensitive to electromagnetic fields and radiation, enabling measurements under harsh conditions. Some materials used (especially gallium phosphate ortourmaline) are extremely stable at high temperatures, enabling sensors to have a working range of up to 1000 degree C. Tourmaline shows pyroelectricity in addition to the piezoelectric effect; this is the ability to generate an electrical signal when the temperature of the crystal changes. This effect is also common to piezoceramic materials. Gautschi in Piezoelectric Sensorics (2002) offers this comparison table of characteristics of piezo sensor materials vs other types:

One disadvantage of piezoelectric sensors is that they cannot be used for truly static measurements. A static force will result in a fixed amount of charges on the piezoelectric material. While working with conventional readout electronics, imperfect insulating materials, and reduction in internal sensor resistance will result in a constant loss of electrons, and yield a decreasing signal. Elevated temperatures cause an additional drop in internal resistance and sensitivity. The main effect on the piezoelectric effect is that with increasing pressure loads and temperature, the sensitivity is reduced due to twin-formation. While quartz sensors need to be cooled during measurements at temperatures above 300 degree C, special types of crystals like GaPO4 gallium phosphate do not show any twin formation up to the melting point of the material itself.

However, it is not true that piezoelectric sensors can only be used for very fast processes or at ambient conditions. In fact, there are numerous applications that show quasi-static measurements, while there are other applications with temperatures higher than 500 degree C.

Piezoelectric sensors can also be used to determine aromas in the air by simultaneously measuring resonance and capacitance. Computer controlled electronics vastly increase the range of potential applications for piezoelectric sensors.

Piezoelectric sensors are also seen in nature. The collagen in bone is piezoelectric, and is thought by some to act as a biological force sensor.

**Working:**

We know that piezoelectric sensors generate an electric charge proportional to the pressure applied to certain materials. But, in case of piezoelectric sensor switches, typically the disc-shaped piezo element tend to bend very slightly like a drumhead due to the force or compressive pressure applied to certain materials. The voltage generated due to a single on pulse, produced by the pressure applied to the piezo switch can be varied by varying the amount of pressure. If the pressure applied to the piezoelectric sensor switch is increased, then higher voltages can be generated, which take a long time for dissipation.

We can also increase the pulse width by lengthening the time constant of the gate circuit using a capacitor that stores charge. If we use a flip-flop, then by toggling flip-flop, we can change the output state from steady off to steady on. Compared to conventional mechanical switches the piezoelectric sensor switches don't have moving parts, but the front plate and piezo element get little deformed typically by a few micrometers. As there are no moving parts, the lifetime of the piezoelectric sensor switch is more and these switches can be used for tens of millions of operations.

These piezoelectric sensor switches are weatherproof as they are completely sealed from the environment. As, stainless steel is used for construction of piezo sensor switches, they can withstand the damage and are resistant to heavy use.

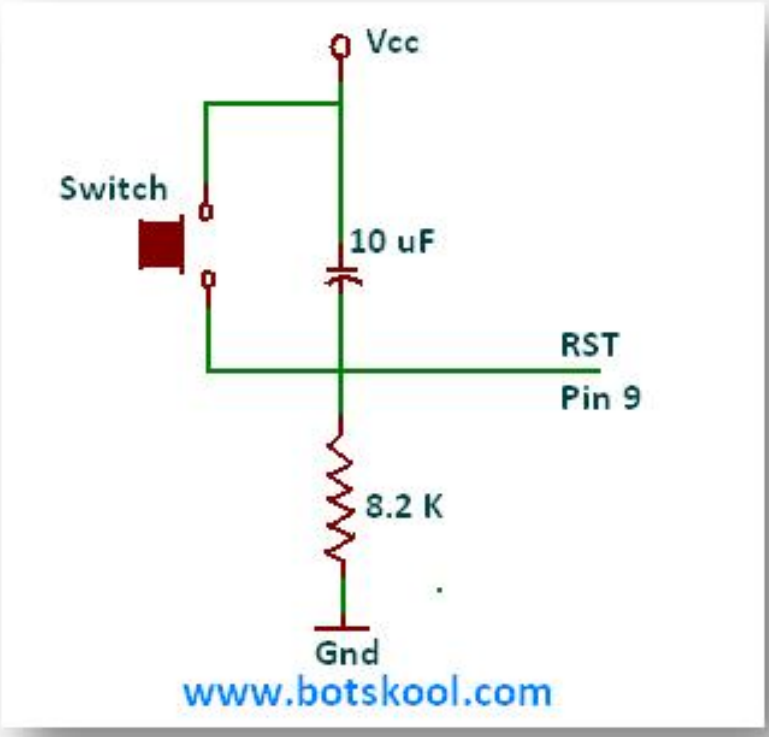
The piezoelectric sensor switch is an alternative for impact or vibration detection and momentary switch applications. Strain is induced on the laminated piezo film sensor element due to the direct contact of the force applied to the stainless steel cantilever beam. Piezoelectric sensor element will generate an output that activates a normally opened, built-in circuit. If a circuit is activated, then it resembles a contact switch closure and due to corrosion, bouncing and pitting the contact points exhibits.

Thus, a single digital pulse is provided for triggering digital circuits. Because of the features like improved reliability and elasticity of the piezoelectric sensor element, it is suitable for applications demanding reliability and consistency in performance for tens of millions of cycles of operations.

Pressure is applied to the surface of the piezoelectric sensor switch that deflects about 2microns and this applied pressure is converted into an electrical signal by the piezoelectric crystal. This electrical signal generated by the piezoelectric sensor material is given to the electronics embedded in the piezoelectric sensor switch housing for amplification.

## RESET

A reset condition causes the microcontroller to immediately stop operation and clear its regis ters. A reset signal may be generated externally at any moment (the MCLR pin is driven low). It can also be generated by from within the microcontroller if needed. A power-on condition always causes a reset to occur. Since there are many accompanying occurrences taking place when the power supply is turned on (switch contact flashing and sparkling, slow voltage rise, gradual clock frequency stabilization etc.), it is necessary to provide a certain time delay for the microcontroller before it starts to operate. Two independent timers PWRT and OST are in charge of that. The first one can be enabled or disabled during the process programming. Let's see what really happens here:




When the power supply voltage reaches 1.2 - 1.7V, a circuit called Power-up timer resets the microcontroller within approximately 72mS. As soon as this time

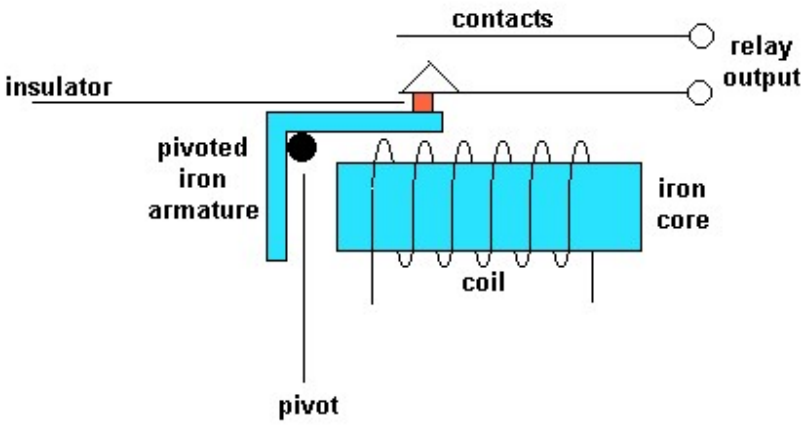
expires, another timer called Oscillator startup timer generates another reset signal within 1024 quartz oscillator periods. When this time delay expires (marked as T reset in figure on the right) and the MCLR pin is driven high, the microcontroller can start to execute the first program instruction.

Reset control circuit is used to reset the microcontroller at any stage of work. This section also comprises of auto power on reset. If the reset switch is pressed, the microcontroller restarts and the function will start from the beginning. This circuit is connected to 9th pin of microcontroller.

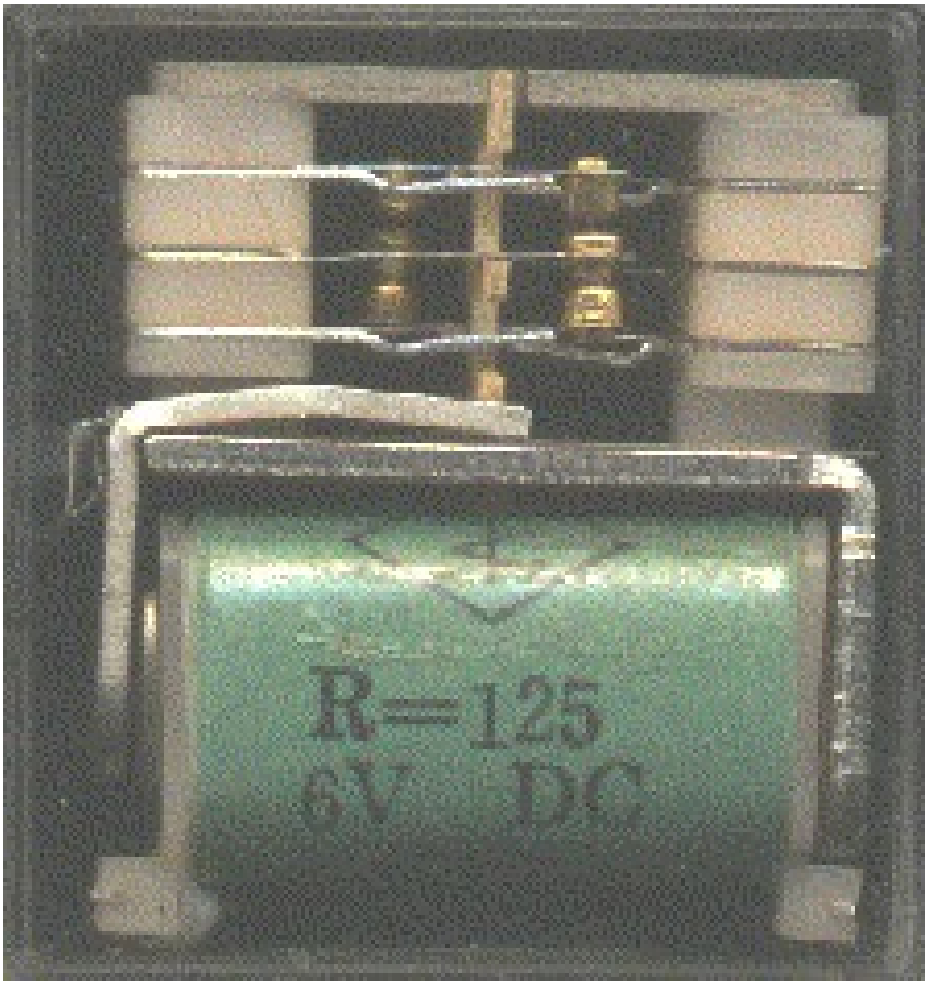
## Relays

### Introduction:

A relay is an electrical switch that opens and closes under the control of another electrical circuit. In the original form, the switch is operated by an electromagnet to open or close one or many sets of contacts. A relay is able to control an output circuit of higher power than the input circuit, it can be considered to be, in a broad sense, a form of an electrical amplifier.

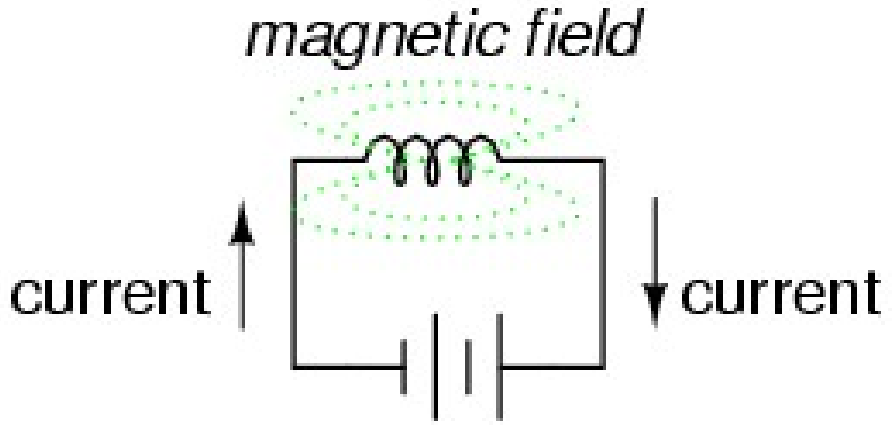


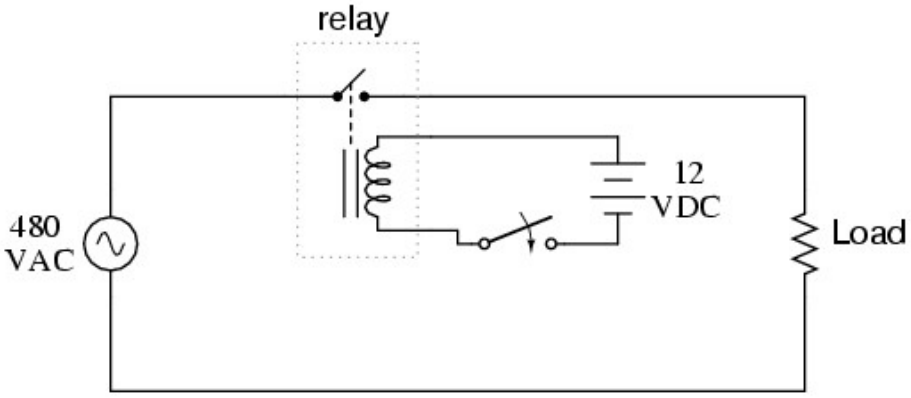

Relays are usuallly SPDT (single pole double through switch)or DPDT (double pole double through switch) but they can have many more sets of switch contacts, for example relays with 4 sets of changeover contacts are readily available.




**Basic operation of a relay:**

An electric current through a conductor will produce a magnetic field at right angles to the direction of electron flow. If that conductor is wrapped into a coil shape, the magnetic field produced will be oriented along the length of the coil. The greater the current, the greater the strength of the magnetic field, all other factors being equal.




Inductors react against changes in current because of the energy stored in this magnetic field. When we construct a transformer from two inductor coils around a common iron core, we use this field to transfer energy from one coil to the other. However, there are simpler and more direct uses for electromagnetic fields than the applications we've seen with inductors and transformers. The magnetic field produced by a coil of current-carrying wire can be used to exert a mechanical force on any magnetic object, just as we can use a permanent magnet to attract magnetic objects, except that this magnet (formed by the coil) can be turned on or off by switching the current on or off through the coil.

If we place a magnetic object near such a coil for the purpose of making that object move when we energize the coil with electric current, we have what is called a solenoid. The movable magnetic object is called an armature, and most armatures can be moved with either direct current (DC) or alternating current (AC) energizing

the coil. The polarity of the magnetic field is irrelevant for the purpose of attracting an iron armature. Solenoids can be used to electrically open door latches, open or shut valves, move robotic limbs, and even actuate electric switch mechanisms and is used to actuate a set of switch contacts.

**Relays can be categorized according to the magnetic system and operation:**

*Neutral Relays:*

This is the most elementary type of relay. The neutral relays have a magnetic coil, which operates the relay at a specified current, regardless of the polarity of the voltage applied.

*Biased Relays:*

Biased relays have a permanent magnet above the armature. The relay operates if the current through the coil winding establishes a magneto-motive force that opposes the flux by the permanent magnet. If the fluxes are in the same direction, the relay will not operate, even for a greater current through the coil.

*Polarized Relays:*

Like the biased relays, the polarized relays operate only when the current through the coil in one direction. But there the principle is different. The relay coil has a diode connected in series with it. This blocks the current in the reverse direction.

The major difference between biased relays and polarized relays is that the former allows the current to pass through in the reverse direction, but does the not operate the relay and the later blocks the current in reverse direction. You can imagine how critical these properties when relays are connected in series to form logic circuits.

*Magnetic Stick Relays or Perm polarized Relays:*

These relays have a magnetic circuit with high permanence. Two coils, one to operate (pick up) and one to release (drop) are present. The relay is activated by a current in the operate coil. On the interruption of the current the armature remains in picked up position by the residual magnetism. The relay is released by a current through the release coil.

*Slow Release Relays:*

These relays have a capacitor connected in parallel to their coil. When the operating current is interrupted the release of relay is delayed by the stored charge in the capacitor. The relay releases as the capacitor discharges through the coil.

*Relays for AC:*

These are neutral relays and picked up for a.c. current through their coil. These are very fast in action and used on power circuits of the point motors, where high current flows through the contacts. A normal relay would be slow and make sparks which in turn may weld the contacts together.

All relays have two operating values (voltages), one pick-up and the other other drop away. The pick-up value is higher than the drop away value.

**Applications for AC:**

* To control a high-voltage circuit with a low-voltage signal, as in some types of modems or audio amplifiers,
* To control a high-current circuit with a low-current signal, as in the starter solenoid of an automobile,
* To detect and isolate faults on transmission and distribution lines by opening and closing circuit breakers (protection relays),
* To isolate the controlling circuit from the controlled circuit when the two are at

different potentials, for example when controlling a mains-powered device from a low-voltage switch. The latter is often applied to control office lighting as the low voltage wires are easily installed in partitions, which may be often moved as needs change. They may also be controlled by room occupancy detectors in an effort to conserve energy,

* To perform logic functions. For example, the boolean AND function is realised by connecting NO relay contacts in series, the OR function by connecting NO contacts in parallel. The change-over or Form C contacts perform the XOR (exclusive or) function. Similar functions for NAND and NOR are accomplished using NC contacts. The Ladder programming language is often used for designing relay logic networks.

o Early computing. Before vacuum tubes and transistors, relays were used as logical elements in digital computers. See ARRA (computer), Harvard Mark II, Zuse Z2, and Zuse Z3.

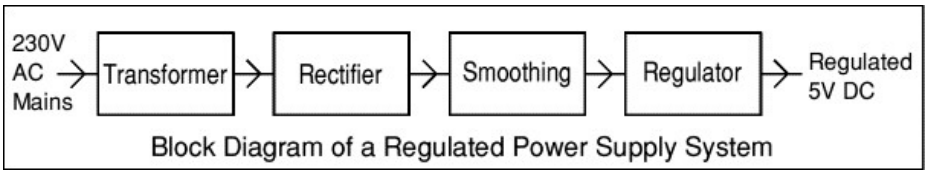
o Safety-critical logic. Because relays are much more resistant than semiconductors to nuclear radiation, they are widely used in safety-critical logic, such as the control panels of radioactive waste-handling machinery.

* To perform time delay functions. Relays can be modified to delay opening or delay closing a set of contacts. A very short (a fraction of a second) delay would use a copper disk between the armature and moving blade assembly. Current flowing in the disk maintains magnetic field for a short time, lengthening release time. For a slightly longer (up to a minute) delay, a dashpot is used. A dashpot is a piston filled with fluid that is allowed to escape slowly. The time period can be varied by increasing or decreasing the flow rate. For longer time periods, a mechanical clockwork timer is installed.

## Power Supply

### Types of Power Supply:

There are many types of power supply. Most are designed to convert high voltage AC mains electricity to a suitable low voltage supply for electronics circuits and other devices. A power supply can by broken down into a series of blocks, each of which performs a particular function. For example a 5V regulated supply:



Block Diagram of a Regulated Power Supply System

Each of the blocks is described in more detail below:

• Transformer - steps down high voltage AC mains to low voltage AC.

• Rectifier - converts AC to DC, but the DC output is varying.

• Smoothing - smooths the DC from varying greatly to a small ripple.

• Regulator - eliminates ripple by setting DC output to a fixed voltage. Power supplies made from these blocks are described below with a circuit diagram and a graph of their output:

• Transformer only

• Transformer + Rectifier

• Transformer + Rectifier + Smoothing

• Transformer + Rectifier + Smoothing + Regulator

### Dual Supplies:

Some electronic circuits require a power supply with positive and negative outputs as well as zero volts (0V). This is called a 'dual supply' because it is like two ordinary supplies connected together as shown in the diagram. Dual supplies have three outputs, for example a positive and negative 9V supply has +9V, 0V and -9V outputs.

*Transformer only:*

The low voltage AC output is suitable for lamps, heaters and special AC motors. It is not suitable for electronic circuits unless they include a rectifier and a smoothing capacitor.

*Transformer + Rectifier:*

The varying DC output is suitable for lamps, heaters and standard motors. It is not suitable for electronic circuits unless they include a smoothing capacitor.

*Transformer + Rectifier + Smoothing:*

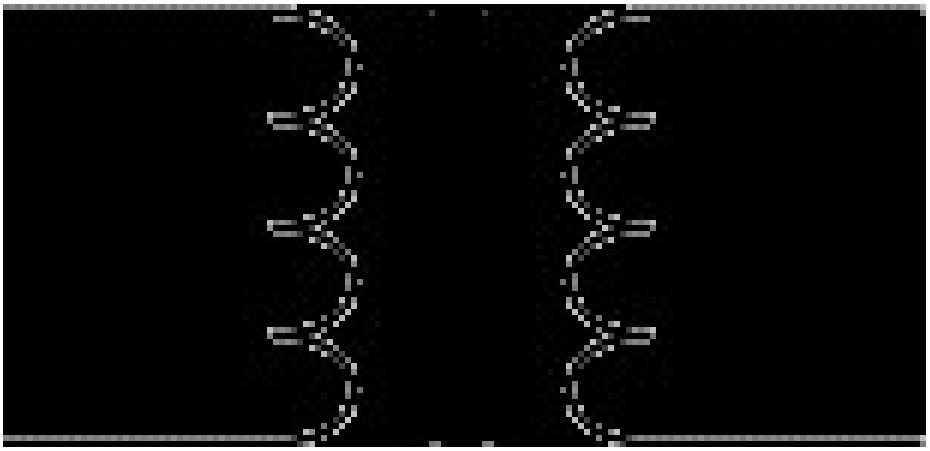
The smooth DC output has a small ripple. It is suitable for most electronic circuits.

*Transformer + Rectifier + Smoothing + Regulator:*

The regulated DC output is very smooth with no ripple. It is suitable for all electronic circuits.

**Transformer:**

Transformers convert AC electricity from one voltage to another with little loss of power. Transformers work only with AC and this is one of the reasons why mains electricity is AC.



Step-up transformers increase voltage, step-down transformers reduce voltage. Most power supplies use a step-down transformer to reduce the dangerously high mains voltage (230V in UK) to a safer low voltage.


The input coil is called the primary and the output coil is called the secondary. There is no electrical connection between the two coils, instead they are linked by an alternating magnetic field created in the soft-iron core of the transformer. The two lines in the middle of the circuit symbol represent the core.

Transformers waste very little power so the power out is (almost) equal to the power in. Note that as voltage is stepped down current is stepped up.

The ratio of the number of turns on each coil, called the turns ratio, determines the ratio of the voltages. A step-down transformer has a large number of turns on its primary (input) coil which is connected to the high voltage mains supply, and a small number of turns on its secondary (output) coil to give a low output voltage.

**Rectifier:**

There are several ways of connecting diodes to make a rectifier to convert AC to DC. The bridge rectifier is the most important and it produces full-wave

varying DC. A full-wave rectifier can also be made from just two diodes if a centre-tap transformer is used, but this method is rarely used now that diodes are cheaper. A single diode can be used as a rectifier but it only uses the positive (+) parts of the AC wave to produce half-wave varying DC.

*Bridge Rectifier:*

A bridge rectifier can be made using four individual diodes, but it is also available in special packages containing the four diodes required. It is called a full-wave rectifier because it uses all the AC wave (both positive and negative sections). 1.4V is used up in the bridge rectifier because each diode uses 0.7V when conducting and there are always two diodes conducting, as shown in the diagram below. Bridge rectifiers are rated by the maximum current they can pass and the maximum reverse voltage they can withstand (this must be at least three times the supply RMS voltage so the rectifier can withstand the peak voltages). Please see the Diodes page for more details, including pictures of bridge rectifiers.

*Single Diode Rectifier:*

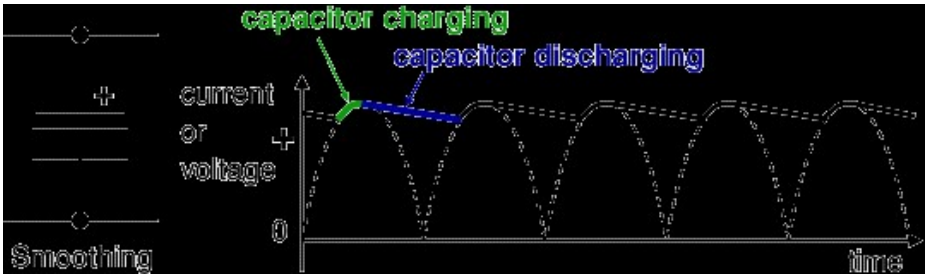
A single diode can be used as a rectifier but this produces half-wave varying DC which has gaps when the AC is negative. It is hard to smooth this sufficiently well to supply electronic circuits unless they require a very small current so the smoothing capacitor does not significantly discharge during the gaps. Please see the Diodes page for some examples of rectifier diodes.

**Smoothing:**

Smoothing is performed by a large value electrolytic capacitor connected across the DC supply to act as a reservoir, supplying current to the output when the varying DC voltage from the rectifier is falling. The diagram shows the un-smoothed varying DC (dotted line) and the smoothed DC (solid line). The capacitor charges quickly near the peak of the varying DC, and then discharges as it supplies current to the output.

Smoothing is not perfect due to the capacitor voltage falling a little as it discharges, giving a small ripple voltage. For many circuits a ripple which is 10% of the supply voltage is satisfactory and the equation below gives the required value for

the smoothing capacitor. A larger capacitor will give less ripple. The capacitor value must be doubled when smoothing half-wave DC.

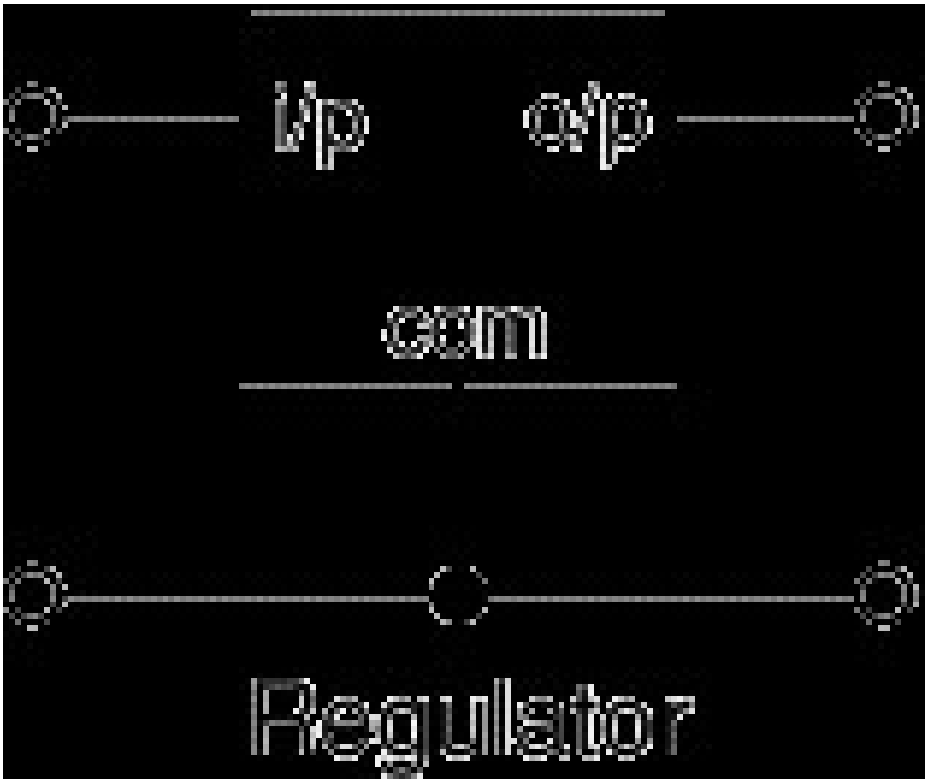



**Regulator:**

Voltage regulator ICs are available with fixed (typically 5, 12 and 15V) or variable output voltages. They are also rated by the maximum current they can pass. Negative voltage regulators are available, mainly for use in dual supplies. Most regulators include some automatic protection from excessive current ('overload protection') and overheating ('thermal protection').

Many of the fixed voltage regulator ICs have 3 leads and look like power transistors, such as the 7805 +5V 1A regulator shown on the right. They include a hole for attaching a heatsink if necessary.

Please see the Electronics in Meccano website for more information about voltage regulator ICs.


Vp
Vp
Regulator

## 5. **Keil Software Implementation**

Installing the Keil software on a Windows PC

• Insert the CD-ROM in your computer's CD drive

• On most computers, the CD will "auto run", and you will see the Keil installation menu. If the menu does not appear, manually double click on the Setup icon, in the root directory: you will then see the Keil menu.

• On the Keil menu, please select "Install Evaluation Software". (You will not require a license number to install this software).

• Follow the installation instructions as they appear.

Loading the Projects The example projects for this book are NOT loaded automatically when you install the Keil compiler. Rather than using the projects on the CD (where changes cannot be saved), please copy the files from CD onto an appropriate directory on your hard disk.

**Keil Cross Compiler**

Keil is a German based Software development company. It provides several development tools like

• IDE (Integrated Development environment

• Project Manager

• Simulator

• Debugger

• C Cross Compiler , Cross Assembler, Locator/Linker

Keil Software provides you with software development tools for the 8051 family of microcontrollers. With these tools, you can generate embedded applications for the multitude of 8051 derivatives. Keil provides following tools for 8051 development

1. C51 Optimizing C Cross Compiler,
2. A51 Macro Assembler,
3. 8051 Utilities (linker, object file converter, library manager),
4. Source-Level Debugger/Simulator,
5. Vision for Windows Integrated Development Environment.

The keil 8051 tool kit includes three main tools, assembler, compiler and linker.

An assembler is used to assemble your 8051 assembly program

A compiler is used to compile your C source code into an object file
A linker is used to create an absolute object module suitable for your in-circuit emulator.
8051 project development cycle: - these are the steps to develop 8051 project using keil
1.Create source files in C or assembly.
2.Compile or assemble source files.
3.Correct errors in source files.
4.Link object files from compiler and assembler.
5.Test linked application.
now let us start how to work with keil.

Keil is a cross compiler. So first we have to understand the concept of compilers and cross compilers. After then we shall learn how to work with keil.

**Working with keil:**

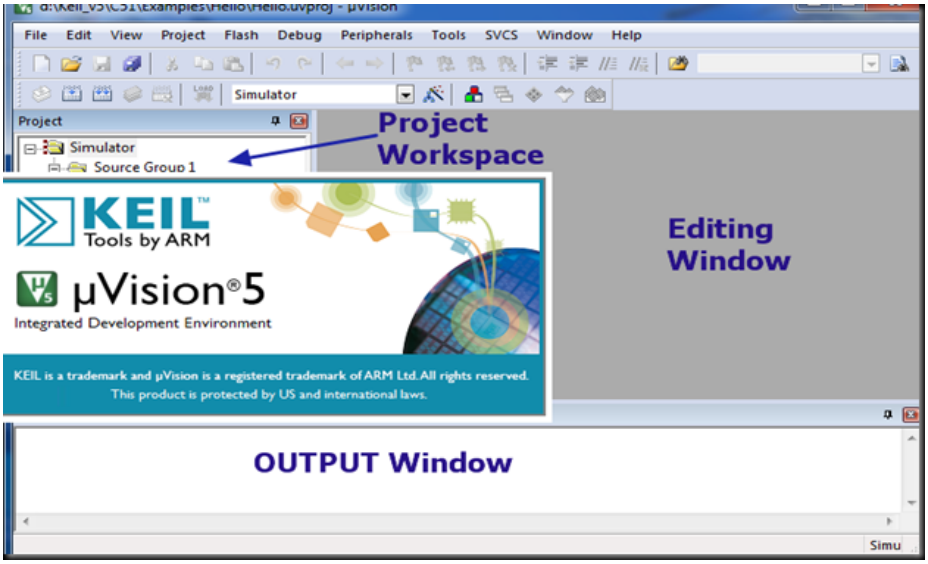
The main & first part of your embedded project is creation of .HEX file from the C or Assembly code.For 8051 devices KEIL MICROVISION is a well known IDE .

The free version of KEIL has a limitation of 2k code size. Programs that generate more than 2 Kbytes of object code will not compile, assemble, or link in the free version.

This software is an integrated development environment (IDE), which integrates a text editor to write programs & a compiler which converts your source code to hex file.This HEX file is then fused on to the target chip.

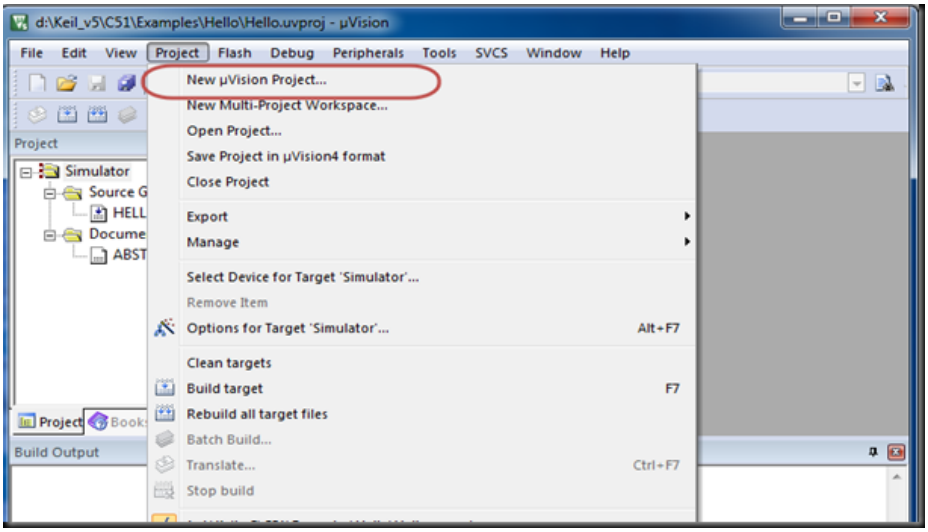
The free version can be downloaded from : https://www.keil.com/demo/eval/c51.htm

Install the downloaded KEIL software & open it.The IDE is simple with 3 windows : Project Workspace , Editing Window & the Output window

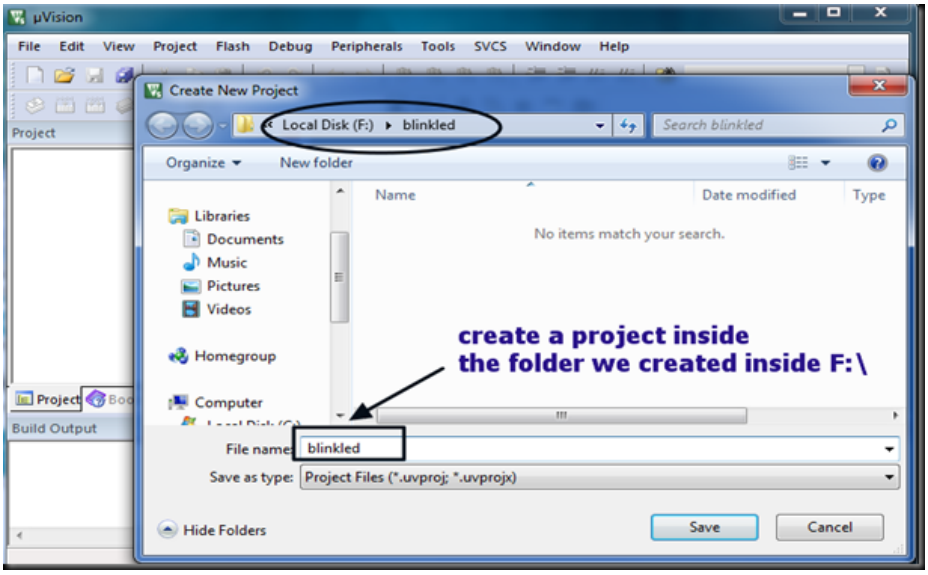



Before starting with your new project , create a folder for your project. For this e.g we create a folder F:

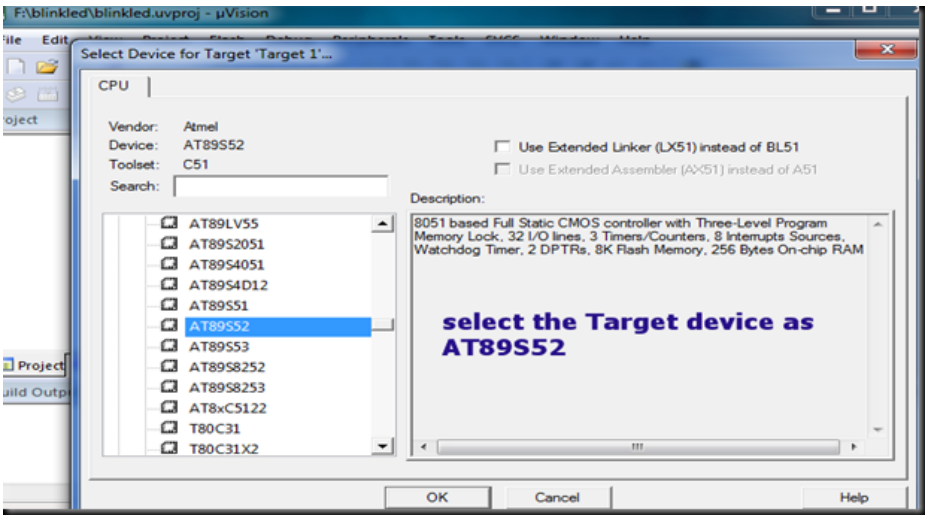
blinkled Click on Project – ¿ New uvision project & browse to the location of the folder we created in F:



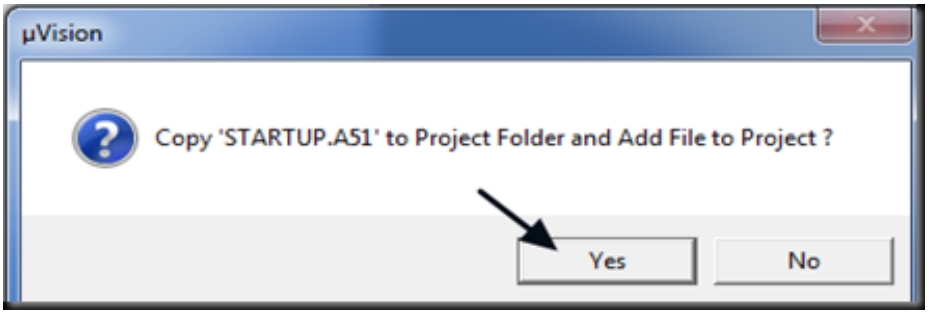
Provide a filename as “blinkled” & click on Save.



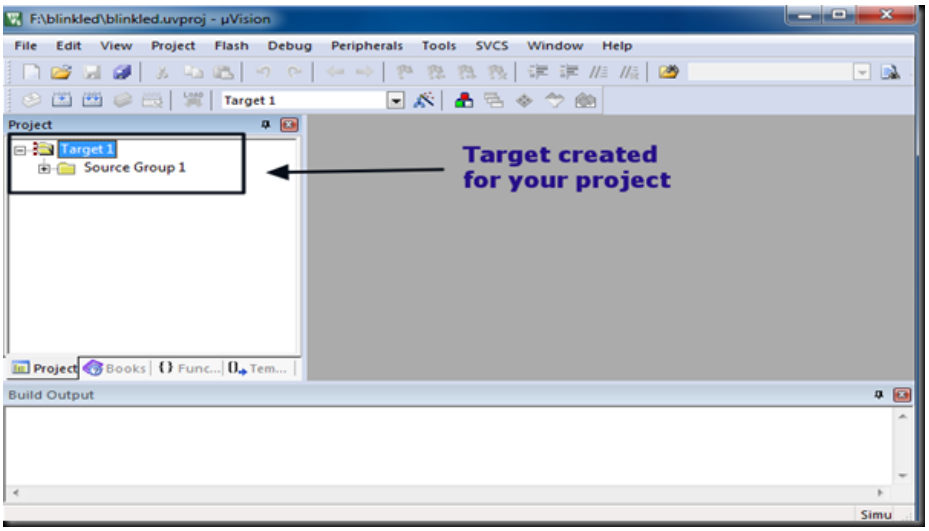

Device selection window opens automatically. Select the target device as AT89S52 & click OK.



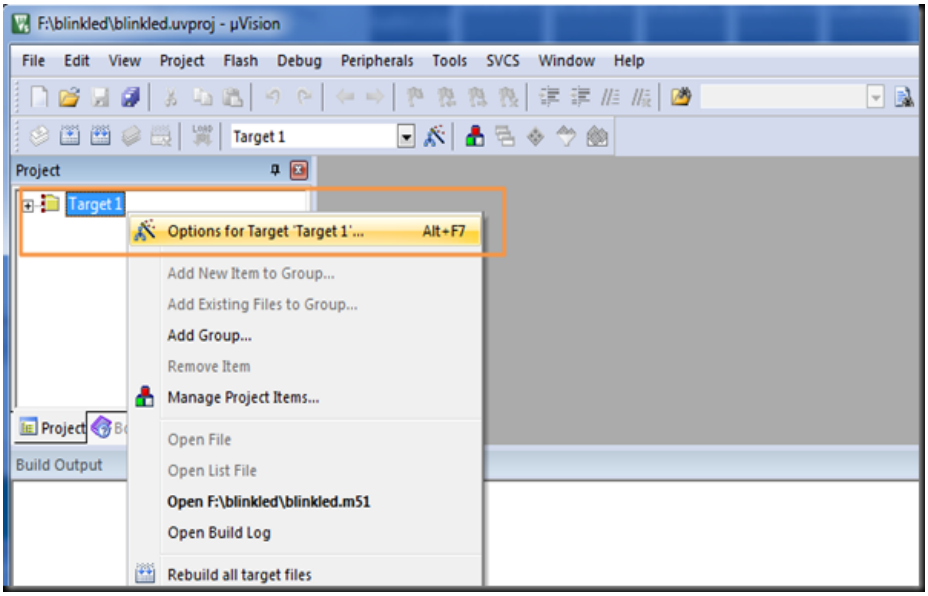
Confirm with YES button on the next screen.



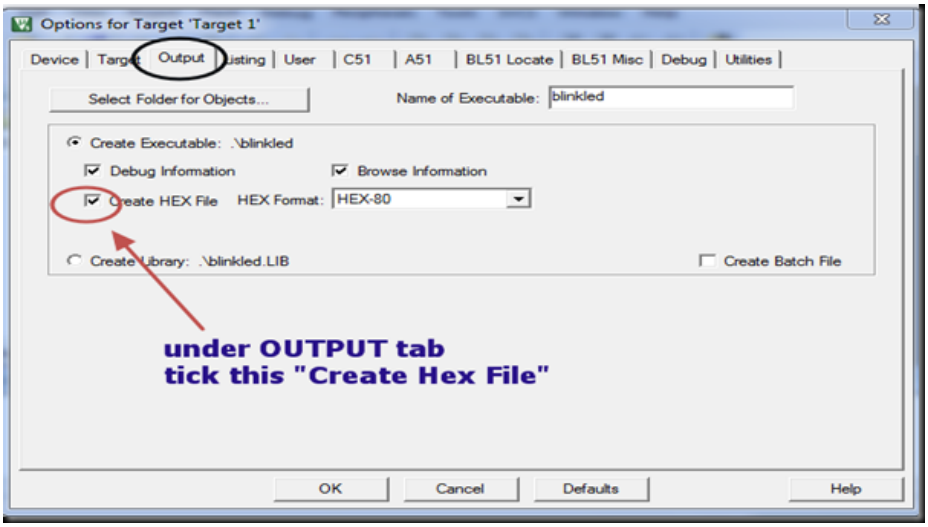

You can see the TARGET1 created under the Project space.



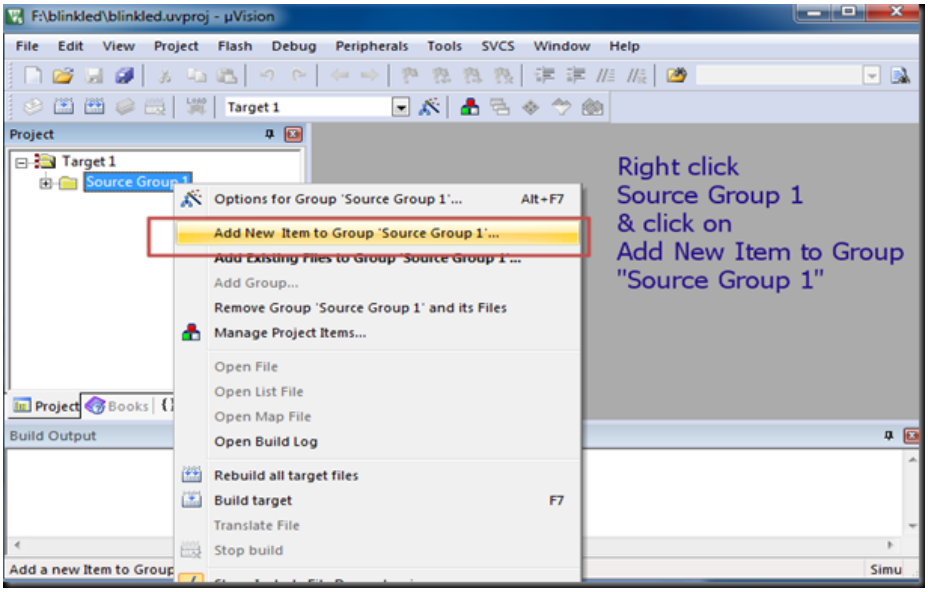
Right Click on that Target1 & select Options for Target



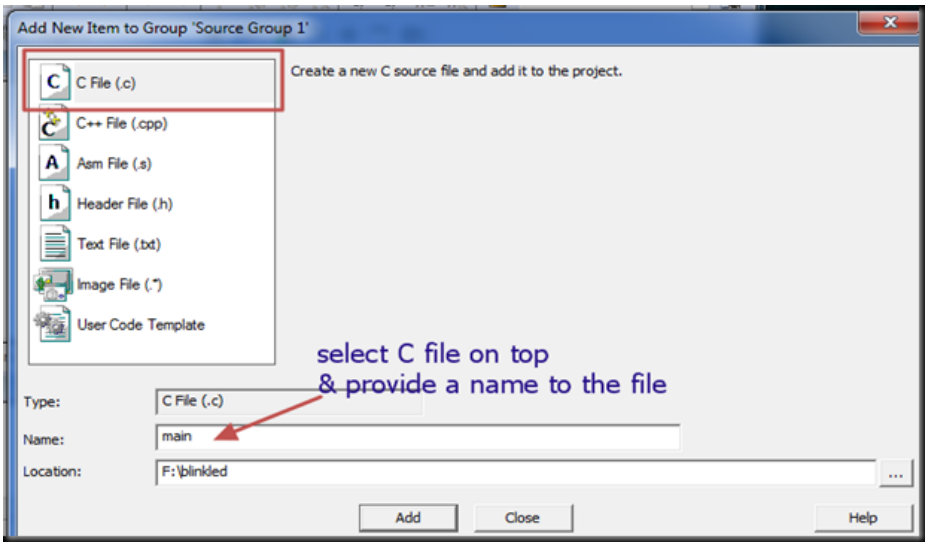

A new Options window opens.Click on the OUTPUT tab .Tick mark against "Create Hex File ". If you forget to check this option , you will not find the HEX file in the project folder after a Build.



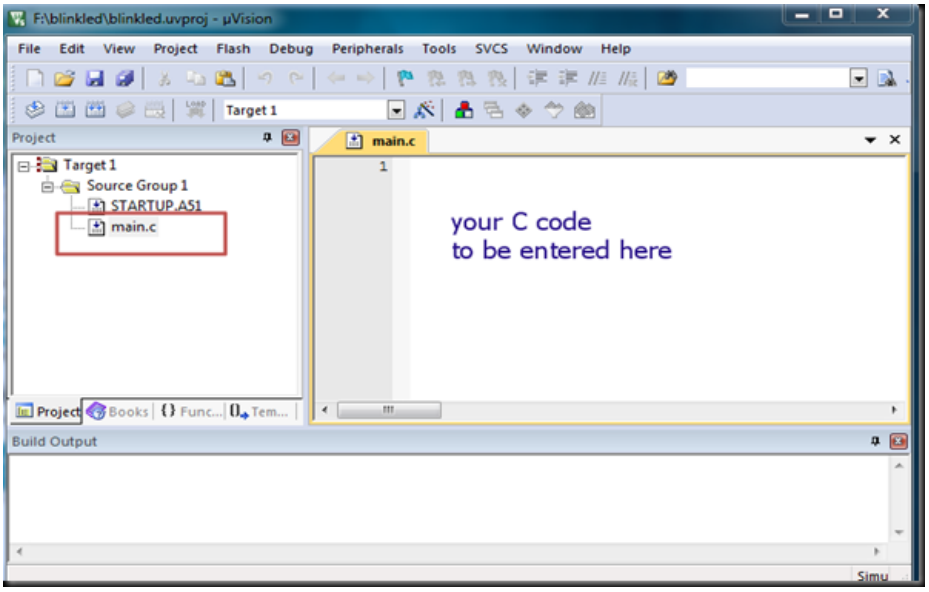
Click OK to close the Options window. To add the .C file Right click on Source Group1 under Target1 & click on " Add New item to Group"




On the next screen select the first option C File ,provide a name & click on ADD.

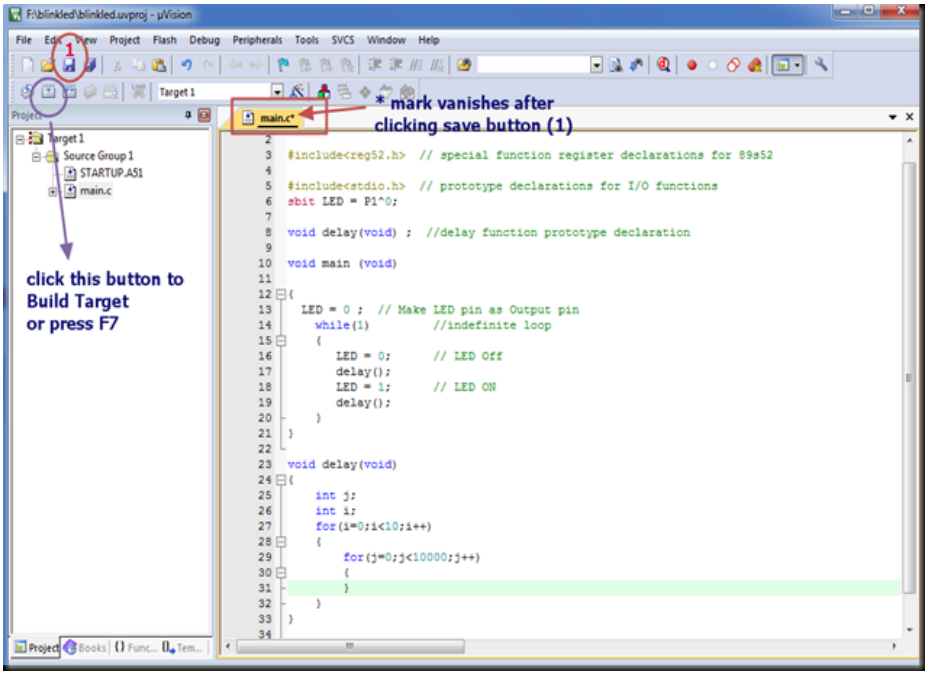


Now your .c file is added to the Source Group.

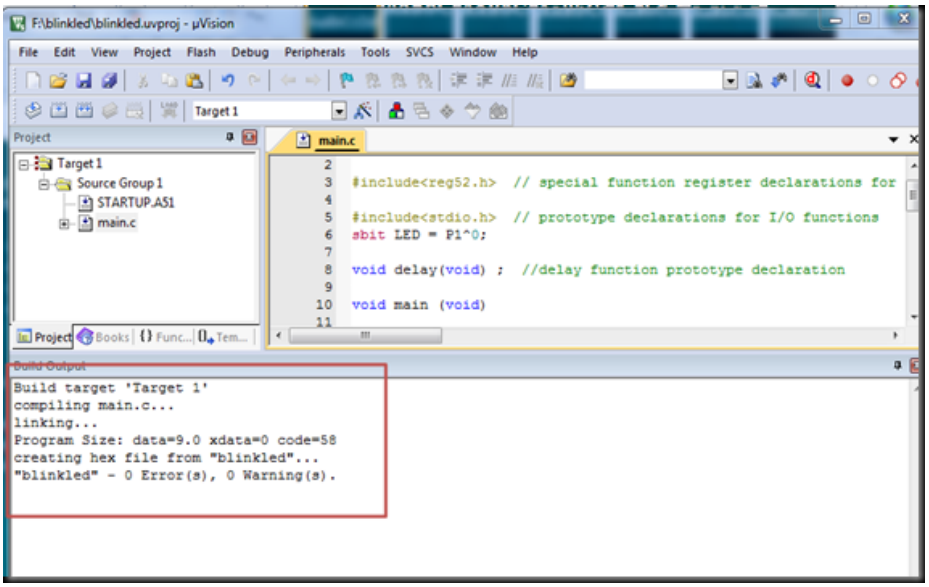



Enter the code in to the Editor window. This sample code makes the LED connected to port pin P1.0 BLINK.

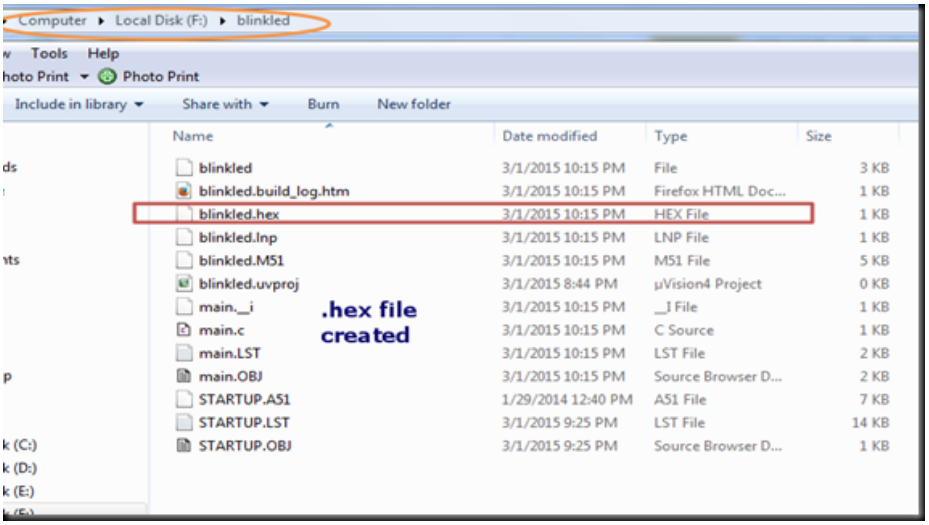
After entering the code click on the SAVE icon .Now the * mark will vanish on the main.c file.



Press F7 or click on the BUILD button to start compiling the code.

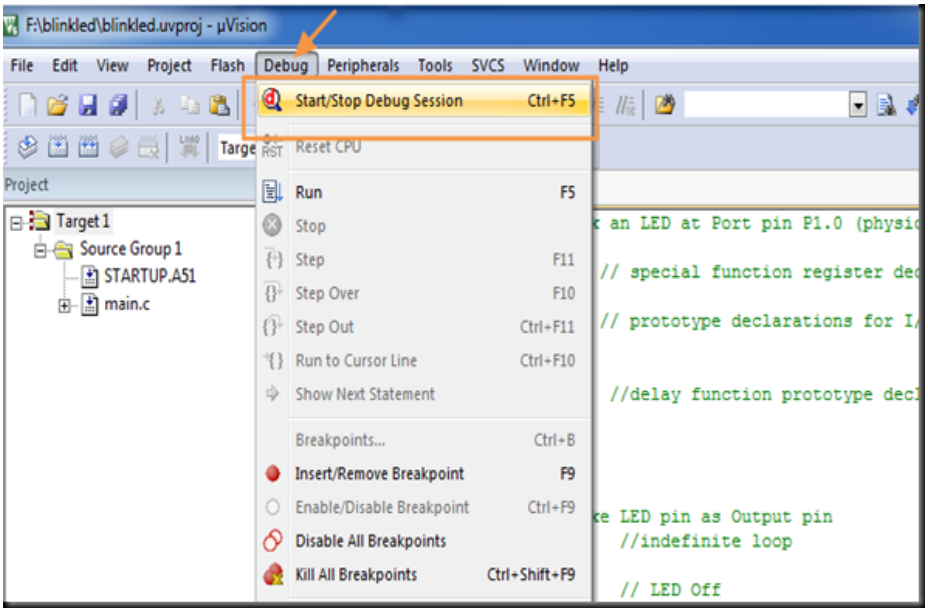



If there is no syntax error , a HEX file is created inside your project folder.




This .HEX file has to be fused on to the Target chip using the ISP programmer & PROGISP software. This Fusing procedure is explained in the next post.

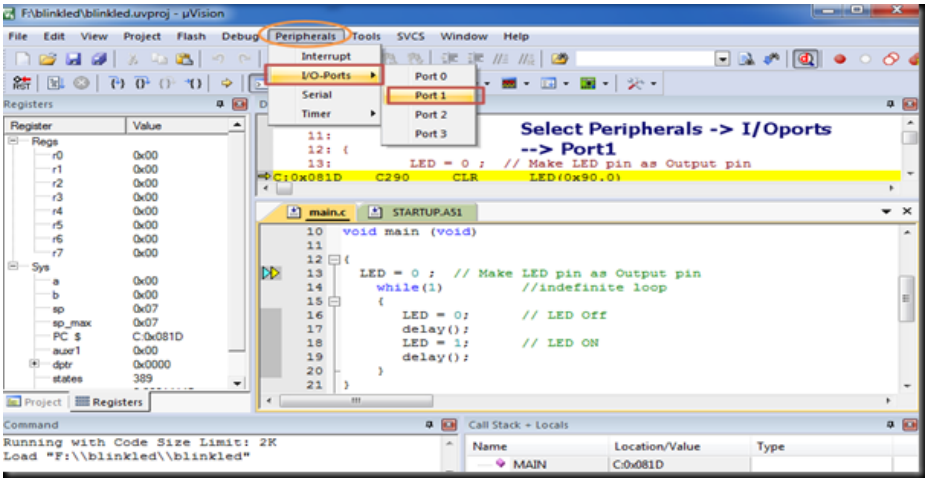
SIMULATION : KEIL's inbuilt Debug can be used for Simulation of the code , without any physical Hardware. Click on Debug – ¿ Start/stop Debug session.



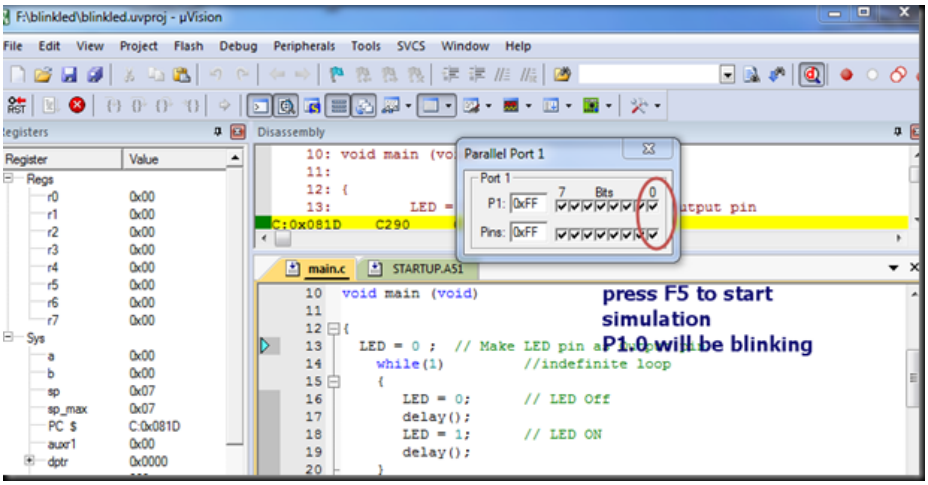

Now your project workspace window shows most of the SFRs as well as GPRs r0-r7. Also one more window “Watches “ is now open. In this window you can see different variable values.

To add variable in watch window goto ”watch#1” tab. Type F2 to edit and enter the name of your variable . To see the output on ports ,under Peripherals—¿ select I/O ports – Port 1.

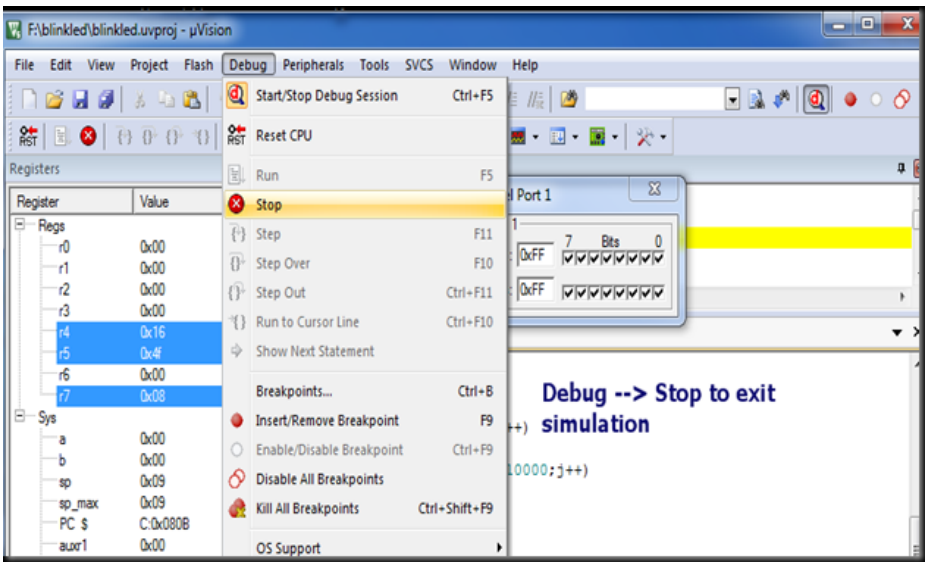
You can give input to port pins by checking or unchecking the check box. here the check mark means digit 1 and no check mark means 0. The output on the pin will be shown in same manner To run the program you can use any of the option provided ”go”, ”step by step”, ”step forward”, ”step ove” etc.



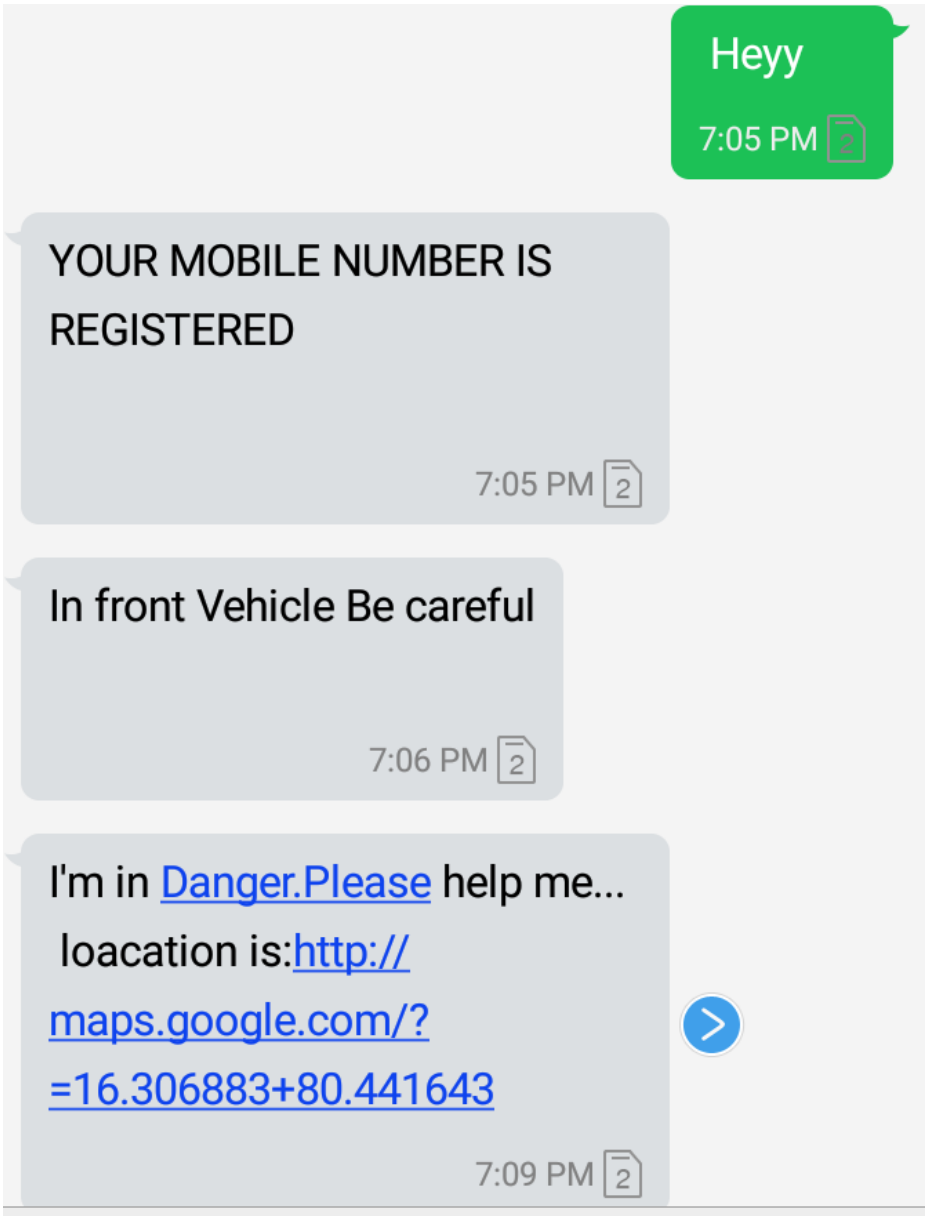

Press F5 to start simulation .The port pin 1.0 starts blinking to show the result.



Click on Debug – ¿ Stop to Exit simulation.



## 6. Result of the work



## 7. Conclusion and Future Work

This project presents vehicle accident detection and alert system with SMS to the user defined mobile numbers. The GPS tracking and GSM alert based algorithm is designed and implemented with LPC2148 MCU in embedded system domain. The proposed Vehicle accident detection system can track geographical information automatically and sends an alert SMS regarding accident. Experimental work has been carried out carefully. The result shows that higher sensitivity and accuracy is indeed achieved using this project. EEPROM is interfaced to store the mobile numbers permanently. This made the project more user-friendly and reliable. The proposed method is verified to be highly beneficial for the automotive industry.

The proposed system uses the IoT for vehicle accident detection and alarming the authorities regarding accidents, vehicle tracking using GPS Modem. In this project we have designed IoT based vehicle accident detection and tracking system using GPS Modem. Hence IoT can revolutionize the way the system interact and respond for the variety of applications especially in case of traffic control

This approach presents several advantages such as:

* It is inexpensive to be developed.
* It does not require a private network for sensor data exchange because it can use the 4G network;
* Installing mobile traffic sensors on private and/or public transportation vehicles, it is possible to cover a wide area of the city, even the peripheral zones characterized by little traffic;
* The system is flexible because traffic sensors can be installed on other volunteer vehicles.

### Future Scope:

This system can be interfaced with vehicle airbag system that prevents vehicle occupants from striking interior objects such as the steering wheel or window. This can also be developed by interconnecting a camera to the controller module that takes the photograph of the accident spot that makes the tracking easier.

## 8. **References**


[1] https://www.elprocus.com/basics-and-structure-of-embedded-c-program-with-examples-for-beginners/

[2] Sadhana B Shabrin, Bhagyashree Jagadish Nikharge, Maithri M Poojary and T Pooja, "Smart helmet -intelligent safety for motorcyclist using raspberry pi and open CV", proc.IEEE,vol.03, no.03 pp.2395-0056 2016

[3] Jagdish A. Patel, Aringale Shubhangi, Shweta Joshi, Aarti Pawar and Namrata Bari discussed on "Raspberry Pi based smart home", Proc. IEEE, vol.6, no.3, pp.2321-3361 2016

[4] Dr. pankaj Tomar and preeti Mehta focused on " An Efficient Management System based on Face Recognition using Matlab and Raspberry Pi 2", Proc-IEEE, vol.3, no.5, pp.239 2016

[5] T. Anitha and T. Uppalaigh focused on "Android based home automation using Raspberry pi", Proc-IEEE, vol.04, no.01, pp-2351-8665 2016

[6] Shailesh Bhavthankar and Prof. H.G.Sayyed discussedon" Wireless System for Vehicle Accident Detection and Reporting using Accelerometer and GPS",Proc .IEEE vol.6, no.8, pp-2229-5518 2015

[7] Md.Shaad Mahmud, Honggang Wang, A.M.Esfar-E-Alam and Hua Fang has focused on "A Wireless Health Monitoring System Using Mobile Phone Accessories", Proc-IEEE,vol.1, no.99, pp-2327-4662 2016

[8] Sarika R. Gujar and Prof. A. R. Itkikar has focused on "Advanced Embedded System of Vehicle Accident Detection and Tracking System" , Proc-IEEE, vol.5, no.2, pp- 2277 128X 2015

[9] Zaobo He, Zhipeng Cai, Jiguo Yu, Xiaoming Wang, Yunchuan Sun, and Yingshu Li, has discussed on "Cost-Efficient Strategies for Restraining Rumor Spreading in Mobile Social Networks",Proc-IEEE,vol.66,no.3 2017

[10] Hyung-Sin Kim, Hongchan Kim, jeongyeuo Paek and Saewoong Bahk has discussed on "Load Balancing Under Heavy Traffic in RPL Routing Protocol for Low Power and Lossy Networks",Proc-IEEE,vol.16, no.4, pp. 1536-1233 2017

[11] GPS: Theory and Practice, B. Hofmann-Wellenhof et al., Springer Verlag, 1992, ISBN 3-211-82364-6 and 0-387-82364-6.

[12] Understanding GPS: Principles and Applications (Artech House Telecommunications Library), Elliott D. Kaplan (Editor) / Hardcover / (1996), (USD 99).
[13] GSM Networks: Protocols, Terminology and Implementation by Gunnar Heine.
[14] GSM Switching, Services, and Protocols by Joerg Eberspaecher.
[15] GSM System Engineering (Artech House Mobile Communications Series) by Asha K. Mehrotra.
[16] Working with GSM Network By Cruis Leonardo.
[17] https://alselectro.wordpress.com/tag/how-to-write-c-code-in-keil/ figures for keil
[18] https://www.engineersgarage.com/tutorials/introduction-micro-vision-keil
[19] https://www.electronicwings.com/8051/8051-uart
[20] https://components101.com/ultrasonic-sensor-working-pinout-datasheet