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SMART GLOVE FOR WOMEN SECURITY

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ABSTRACT

India which sees itself as a promising super power and an economic hub, is still trapped in the clutches of various patriarchal evils like molestations, dowry, crime against women, worst among all is rape. In today's world, women safety has become a major issue as they can't step out of their house at any given time due to fear of physical/sexual abuse and violence. So, in an attempt to curb this menace, the atrocities against the women can be now brought to an end with the help of a Women Safety Device. Safety of women in present scenario is very important. Therefore, a compatible safety device is designed. This compatible safety device is named as smart glove which is easy to carry and easy to use.

This smart glove will give the shock to the attacker without killing him.

CHAPTER-1

1 INTRODUCTION

This women safety device is a microcontroller-based system. An ATmega8 microcontroller is one of the series AVR microcontrollers, one of the oldest yet commonly used microcontrollers. It has the less complex features than other microcontrollers and it is also easily available and cheap in comparison of other microcontrollers. The implementation of women safety system was done on AVR microcontroller via GSM modem and the interfacing is done through MAX-RS 232. Communication of alarming situation & prevention of incident has achieved by GPS, GSM technology, and defensive system respectively. This is the aim of our system. As a result, the design is separated into two parts.

A) Message of the offense throughout wireless

B) Prevention of the crime.

1) The women wearing a watch or band when finds that someone is going to harass, she presses a switch that is located on the watch or band, which is accompanied by a condition check by temperature and heartbeat sensor. The signal gets transmitted to GSM module which then decodes the received information (either some code or name) and then activates the AVR microcontroller in which contacts of 4 people and message "HELP" is stored in memory is sent to the destination through GSM.

2) This safety device works for self-defense and prevention of crime as well. As soon as the emergency situation is detected, a bright flash light as well as a loud siren are turned on which alert the people nearby about the woman in danger. In panic, if a woman is not able to shout out, this device can easily indicate about her dangerous situation to people surrounding by. Also, for self-defense, this device includes a shock generator which a woman can use against an attacker in case of emergency. This shock is intense enough to scare the attacker away

1.1 VIEWS ON WOMEN SAFETY

As we all know that India is a most famous country all over the world for its great tradition and culture where women are given most respected place in the society from the ancient time. It is the country where women are considered as safer and most respected. Women are given the place of Goddess Lakshmi in the Indian society. Indian women are found working in all fields like aeronautics, space, politics, banks, schools, sports, businesses, army, police, and many more. We cannot say that this country has no any women concern however we cannot ignore positive points for women in India. If we remember our history, we found that there was PanchaaliPratha in which a single woman (Draupadi) was allowed to get married to five men (Pandavas). It was all that what we see from our open eyes however if we see behind the curtain, we will found all the crimes against women at home, offices, streets, etc. By seeing last few crimes against women in India such as rape cases, acid attacks, etc., the safety of women has been in doubt. Safety of women matters a lot whether at home, outside the home or working place. Last few crimes against women especially rape cases were very dread and fearful. Because of such crimes, women safety in India has become a doubtful topic. According to the statistics of National Crime Records Bureau, highest rate of crime against women was recorded in the Chennai in 2000 (around 4,037 incidences). Chennai is the capital of southern state of Tamil Nadu however has been marked as city with high rate of crimes against women. However, it was seen some decrease in the crime rate against women in the subsequent years (around 838 by 2013). It has been recorded as the largest fall in the crime rate than other cities in India. It was just opposite in the capital of India, Delhi. Crime rate against women in Delhi was 17.6/100,000 females in 2000 (2,122 incidents) and 151.13/100,000 females in 2013 (11,449 incidents). Some of the most common crimes against women are rape, dowry deaths, sexual harassment at home or work place, kidnapping and abduction, cruelty by husband, relatives, assault on a woman and sex trafficking. Our primary goal of this project is to ensure every woman in our society to feel safe and secured.

According to the survey in India 53% of working women are not feeling safe - Women is working in night shift (Bangalore56%, Chennai-28%, Hyderabad-35%, Mumbai-26%). Overall, 86% of working women in India, women facing hurdles are high in Delhi, Mumbai, Hyderabad, Kolkata and Pune comparatively to other places. Women Safety Device can play a major role by providing women a safe environment in all situations for example (detecting hidden camera, physically threatened, harassed, robbery, stalked). Implementing real time application and a device, we can solve the problems to an extent. With further research and innovation, this project can be used as a small wearable device like watch, pendent etc.

1.2 LITERATURE REVIEW

In "ASHLESHA WANKHEDE, ASHWINI VELANKAR, PRIYANKA SHINDE," PORTABLE DEVICE FOR WOMEN SECURITY" INTERNATIONAL JOURNAL OF RESEARCH IN ENGINEERING AND TECHNOLOGY, VOLUME: 04 ISSUE: 03, MARCH 2015" Today's world is full of rush and most of the women work independently to support their family. They have to work till late night. For such women, safety is the most important requirement. The security issue for such women comes forward because cases of harassment and rapes on those women are3increasing. Best suitable system for those women will be a portable system which the women will be able to carry will her and easy to use. Portable system will generate a shock which will make to attacking person to get back. After generation of shock the message will be sent with the help of Global System for Mobile Communication (GSM) on the particular number stored and the location of those women is traced with the help of Global Positioning System (GPS). If the message is not checked by the particular number mentioned, the system will continuously give the call until the message is checked by the particular number mentioned Our life has become too fast now-a-days. To remain part of this fast life women also works a lot to survive and supports their family. They work at different places like IT firms, BPO's, call centers and so many places like it. The call Centre and BPO jobs are scheduled for late night. After completion of their duty, they have to go home late night so anything may happen at such timings as well as there is a chance of harassment at lonely places. For this purpose, portable system is designed which can be easily carried with the women.

IN "ANNU KUMARI, SHIKHA TRIPATHI, SANDEEPTI SINGH, "EVE TEASING AVOIDANCE GADGET ALONG WITH HEALTHCARE", INTERNATIONAL JOURNAL OF ENGINEERING RESEARCH& MANAGEMENT TECHNOLOGY, ELECTRONICS AND COMMUNICATION ENGINEERING, SRM UNIVERSITY NCR CAMPUS MODINAGAR INDIA, MARCH 2014." Today in the current global scenario, the prime question in every girl's mind, taking into account the everrising increase of issues on women harassment in recent past, is only about her safety and security. This paper suggests a new perspective to use technology to protect women. The system resembles a normal belt which when activated, tracks the location of the victim using GPS and sends emergency messages using GSM, to three emergency contacts and the police control room. The system also incorporates a screaming alarm that uses real-time clock, to call out for help and also generates an electric shock to injure the attacker for self-defense. The main advantage of this system is that the user does not require a Smartphone unlike other applications that have been developed earlier. The belt provides with all the features which will leave no stone unturned to help the victim in any kind of emergency situations. Kids, aged people & ladies mostly not able to fight to criminal for self-security. Sometime government security may not give on time support. For developing smart system two factors has been considered i.e., prevention of incident & cure of incident The research and engineering challenges along the way to this vision encompass many technical fields including physics, chemistry, biology, mathematics, computing science, systems, mechanical, electronics and civil engineering. Each must be identified or, if already existing, tailored for the appropriate application. Associated with this would be the interface to the computerized "monitoring" capability for each given function. Smart City will take advantage of communication and sensor capabilities sewn into the cities' infrastructures to optimize electrical, transport, and other logistical operations supporting daily life, thereby improving the quality of life for everyone. It would be overly simplistic, and probably a big mistake, to believe that traditional networking technologies can simply be added into a city's critical infrastructure to make it "smarter". In addition, since the assumptions and requirements for smart critical infrastructures are very different, implying that networks for smart cities should be engineered quite differently, this also raises an integration problem. Communication of alarming situation & prevention of incident has achieved by GPS, GSM technology, and defensive system respectively. This is the aim of our system. As a result the design is separated into two parts. 1) message of the offense throughout wireless 2) Prevention of the crime. Liquid spray pump system, shocking system with automation & alarm has been used for defense. Pulse rate sensor, pressure switches, & manual switches contribution has been considered for alarming, defensive situation, as well as communication. The text message will be send to the added data based people at destination for instant help to the user. User will have freedom to add choice people's data base number. Family member, doctor & police will have immediate indication to help user in disaster situation. Fear situation of user will be studied by different bio sensors. Biosensors are capable of measuring significant physiological Parameters like heart rate, blood pressure, body and skin Temperature, oxygen, saturation, respiration rate, electrocardiogram. The vision of "Smart person security" is the urban center of the future, made safe, secure, environmentally, green, and efficient because all structures, whether for power, water, transportation, etc. are designed, constructed, and maintained making use of advanced, integrated materials, sensors, electronics, and networks which are interfaced with computerized systems comprised of databases, tracking, and decision-making algorithms.

1.3 BLOCK DIAGRAM

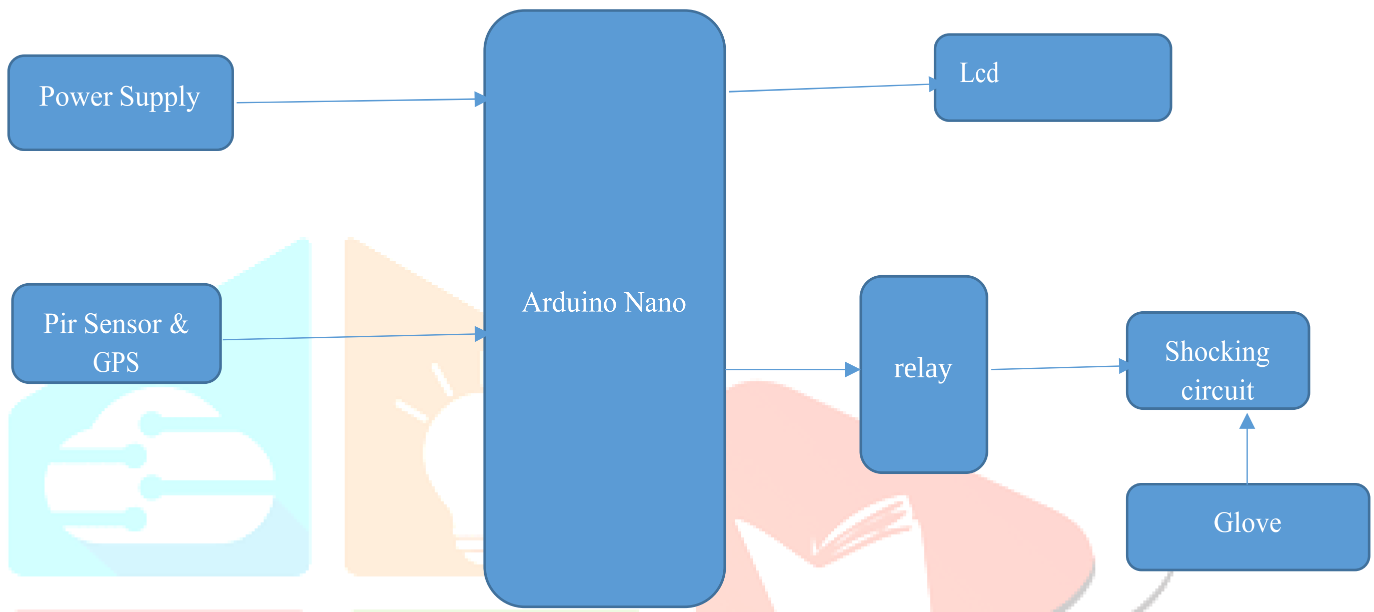

Fig 1.3 Block Diagram

CHAPTER-2 2 EMBEDDED SYSTEMS

Many embedded systems have substantially different design constraints than desktop computing applications. No single characterization applies to the diverse spectrum of embedded systems. However, some combination of cost pressure, long life-cycle, real-time requirements, reliability requirements, and design culture dysfunction can make it difficult to be successful applying traditional computer design methodologies and tools to embedded applications. Embedded systems in many cases must be optimized for life-cycle and businessdriven factors rather than for maximum computing throughput. There is currently little tool support for expanding embedded computer design to the scope of holistic embedded system design. However, knowing the strengths and weaknesses of current approaches can set expectations appropriately, identify risk areas to tool adopters, and suggest ways in which tool builders can meet industrial needs. If we look around us, today we see numerous appliances which we use daily, be it our refrigerator, the microwave oven, cars, PDAs etc. Most appliances today are powered by something beneath the sheath that makes them do what they do. These are tiny microprocessors, which respond to various keystrokes or inputs. These tiny microprocessors, working on basic assembly languages, are the heart of the appliances. We call them embedded systems. Of all the semiconductor industries, the embedded systems market place is the most conservative, and engineering decisions here usually lean towards established, low risk solutions. Welcome to the world of embedded systems, of computers that will not look like computers and won't function like anything we are familiar with.

2.1 CLASSIFICATION

Embedded systems are divided into autonomous, real-time, networked & mobile categories.

2.1.1 Autonomous systems

They function in standalone mode. Many embedded systems used for process control in manufacturing units& automobiles fall under this category.

2.1.2 Real-time embedded systems

These are required to carry out specific tasks in a specified amount of time. These systems are extensively used to carry out time critical tasks in process control.

2.1.3 Networked embedded systems

They monitor plant parameters such as temperature, pressure and humidity and send the data over the network to a centralized system for on line monitoring.

2.1.4 Mobile gadgets

Mobile gadgets need to store databases locally in their memory. These gadgets imbibe powerful computing & communication capabilities to perform realtime as well as nonrealtime tasks and handle multimedia applications. The embedded system is a combination of computer hardware, software, firmware and perhaps additional mechanical parts, designed to perform a specific function. A good example is an automatic washing machine or a microwave oven. Such a system is in direct contrast to a personal computer, which is not designed to do only a specific task. But an embedded system is designed to do a specific task with in a given timeframe, repeatedly, endlessly, with or without human interaction.

2.1.5 Hardware

Good software design in embedded systems stems from a good understanding of the hardware behind it. All embedded systems need a microprocessor, and the kinds of microprocessors used in them are quite varied. A list of some of the common microprocessors families are: ARM family, The Zilog Z8 family, Intel 8051/X86 family, Motorola 68K family and the power PC family. For processing of information and execution of programs, embedded system incorporates microprocessor or micro-controller. In an embedded system the microprocessor is a part of final product and is not available for reprogramming to the end user. An embedded system also needs memory for two purposes, to store its program and to store its data. Unlike normal desktops in which data and programs are stored at the same place, embedded systems store data and programs in different memories. This is simply because the embedded system does not have a hard drive and the program must be stored in memory even when the power is turned off. This type of memory is called ROM. Embedded applications commonly employ a special type of ROM that can be programmed or reprogrammed with the help of special devices.

2.2 OTHER COMMON PARTS FOUND ON MANY EMBEDDED SYSTEMS

- UART& RS232
- PLD
- ASIC's& FPGA's
- Watch dog timer etc.

2.3 DESIGN PROCESS

Embedded system design is a quantitative job. The pillars of the system design methodology are the separation between function and architecture, is an essential step from conception to implementation. In recent past, the search and industrial community has paid significant attention to the topic of hardwaresoftware (HW/SW) codesign and has tackled the problem of coordinating the design of the parts to be implemented as software and the parts to be implemented as hardware avoiding the HW/SW integration problem marred the electronics system industry so long. In any large-scale embedded systems design methodology, concurrency must be considered as a first-class citizen at all levels of abstraction and in both hardware and software. Formal models & transformations in system design are used so that verification and synthesis can be applied to advantage in the design methodology. Simulation tools are used for exploring the design space for validating the functional and timing behaviors of embedded systems. Hardware can be simulated at different levels such as electrical circuits, logic gates, RTL etc. using VHDL description. In some environments software development tools can be coupled with hardware simulators, while in others the software is executed on the simulated hardware. The later approach is feasible only for small parts of embedded systems. Design of an embedded system using Intel's 80C188EB chip is shown in the figure. In order to reduce complexity, the design process is divided in four major steps: specification, system synthesis, implementation synthesis and performance evaluation of the prototype.

2.3.1 SPECIFICATION

During this part of the design process, the informal requirements of the analysis are transformed to formal specification using SDL.

2.3.2 SYSTEM-SYNTHESIS

For performing an automatic HW/SW partitioning, the system synthesis step translates the SDL specification to an internal system model switch contains problem graph& architecture graph. After system synthesis, the resulting system model is translated back to SDL.

2.3.3 IMPLEMENTATION-SYNTHESIS

SDL specification is then translated into conventional implementation languages such as VHDL for hardware modules and C for software parts of the system.

2.3.4 PROTOTYPING

On a prototyping platform, the implementation of the system under development is executed with the software parts running on multiprocessor unit and the hardware part running on a FPGA board known as phoenix, prototype hardware for Embedded Network Interconnect Accelerators.

2.3.5 APPLICATIONS

Embedded systems are finding their way into robotic toys and electronic pets, intelligent cars and remote controllable home appliances. All the major toy makers across the world have been coming out with advanced interactive toys that can become our friends for life. 'Fur by' and 'AIBO' are good examples at this kind. Furbies have a distinct life cycle just like human beings, starting from being a baby and growing to an adult one. In AIBO first two letters stand for Artificial Intelligence. Next two letters represent robot. The AIBO is robotic dog. Embedded systems in cars also known as Telematic Systems are used to provide navigational security communication & entertainment services using GPS, satellite. Home appliances are going the embedded way. LG electronics digital DIOS refrigerator can be used for surfing the net, checking e-mail, making video phone calls and watching TV.IBM is developing an air conditioner that we can control over the net. Embedded systems cover such a broad range of products that generalization is difficult. Here are some broad categories.

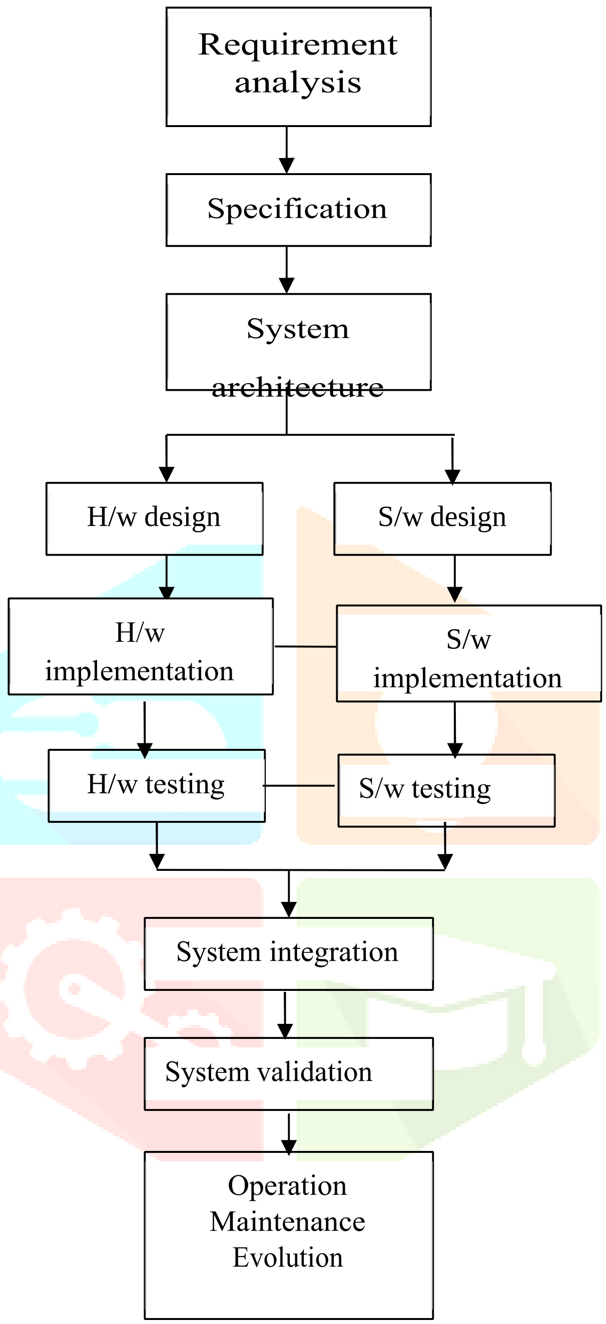

Fig 2.1: Embedded Development Life Cycle

- Aerospace and defense electronics: Fire control, radar, robotics/sensors, sonar.
- Automotive: Autobody electronics, auto power train, auto safety, car information systems.
- Broadcast & entertainment: Analog and digital sound products, camaras, DVDs, Set top boxes, virtual reality systems, graphic products.
- Consumer/internet appliances: Business handheld computers, business network computers/terminals, electronic books, internet smart handheld devices, PDAs.

- Data communications: Analog modems, ATM switches, cable modems, XDSL modems, Ethernet switches, concentrators.
- Digital imaging: Copiers, digital still cameras, Fax machines, printers, scanners.
- Industrial measurement and control: Hydro electric utility research & management traffic management systems, train marine vessel management systems.
- Medical electronics: Diagnostic devices, real time medical imaging systems, surgical devices, critical care systems.
- Server I/O: Embedded servers, enterprise PC servers, PCI LAN/NIC controllers, RAID devices, SCSI devices.
- Telecommunications: ATM communication products, base stations, networking switches, SONET/SDH cross connect, multiplexer.
- Mobile data infrastructures: Mobile data terminals, pagers, VSATs, Wireless LANs, Wireless phones.

CHAPTER-3

ARDUINO NANO (Micro controller)

3.1 Introduction to the Arduino NANO Board

The Arduino Nano, as the name suggests is a compact, complete and bread-board friendly microcontroller board. The Nano board weighs around 7 grams with dimensions of 4.5 cms to 1.8 cms (L to B). This article discusses about the technical specs most importantly the pinout and functions of each and every pin in the Arduino Nano board.

Arduino Nano has similar functionalities as Arduino Duemilanove but with a different package. The Nano is inbuilt with the ATmega328P microcontroller, same as the Arduino UNO. The main difference between them is that the UNO board is presented in PDIP (Plastic Dual-In-line Package) form with 30 pins and Nano is available in TQFP (plastic quad flat pack) with 32 pins. The extra 2 pins of

Arduino Nano serve for the ADC functionalities, while UNO has 6 ADC ports but Nano has 8 ADC ports. The Nano board doesn't have a DC power jack as other Arduino boards, but instead has a mini-USB port. This port is used for both programming and serial monitoring. The fascinating feature in Nano is that it will choose the strongest power source with its potential difference, and the power source selecting jumper is invalid.

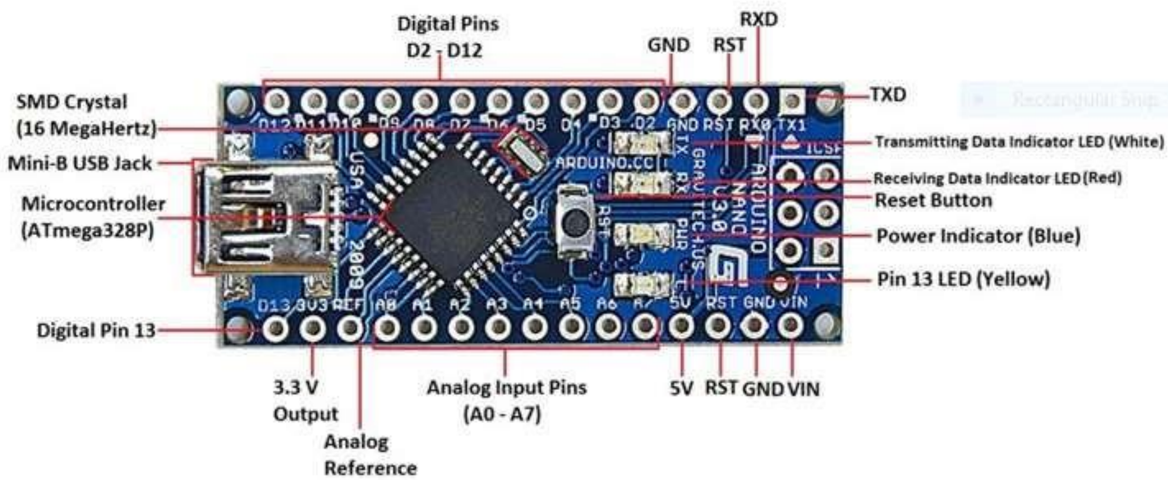

Figure 3.1.1 Arduino nano Board

Arduino Nano – Specification

Arduino Nano	Specifications
Analog I/O Pins	8
Architecture	AVR
Clock Speed	16 MHz
DC Current per I/O Pins	40 milliamps
Digital I/O Pins	22
EEPROM	1 KB
Flash Memory	32 KB of which 2 KB used by Bootloader
Input Voltage	(7-12) Volts

Microcontroller	ATmega328P
Operating Voltage	5 Volts
Arduino Nano	Specifications
PCB Size	18 x 45 mm
Power Consumption	19 milliamps
PWM Output	6
SRAM	2KB
Weight	7 gms

3.2 Pin diagram

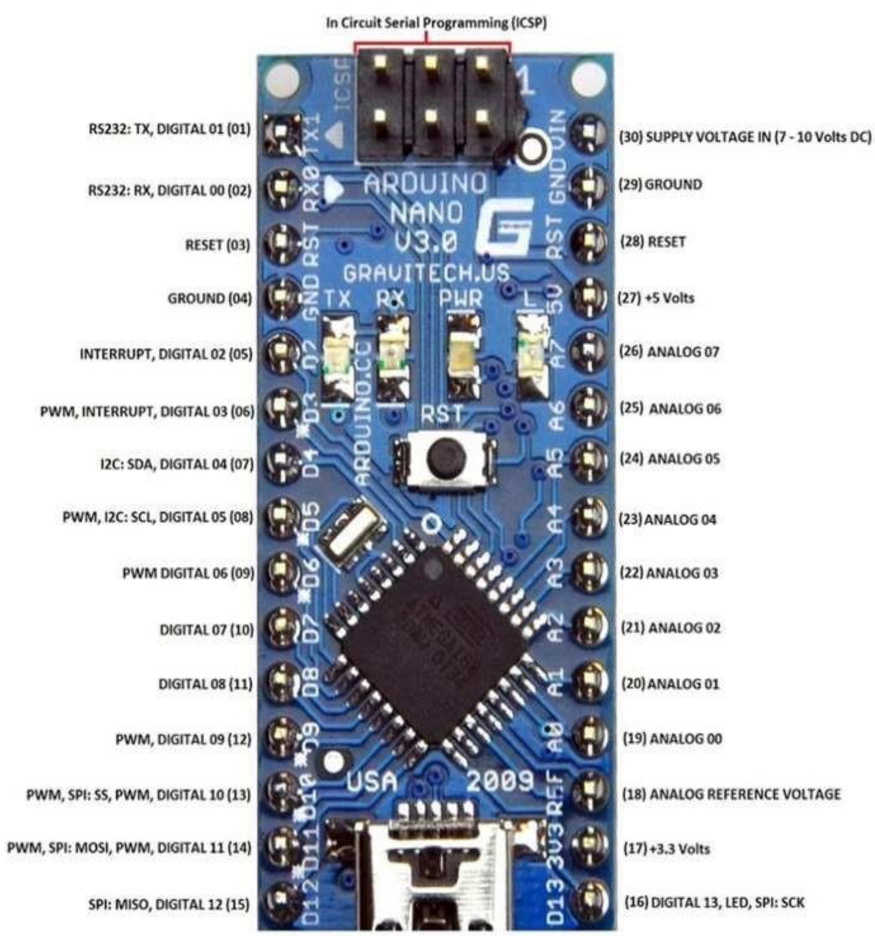

Figure 3.2.3 Pin Configuration of Atmega328

3.3 Pin Description

Arduino Nan0 – Pin Description

Pins 1 to 30

Arduino Nano Pin Pin	Name	Type	Function
1	D1/TX	I/O	Digital I/O Pin Serial TX Pin
2	D0/RX	I/O	Digital I/O Pin Serial RX Pin
3	RESET	Input	Reset (Active Low)
4	GND	Power	Supply Ground
5	D2	I/O	Digital I/O Pin
6	D3	I/O	Digital I/O Pin
7	D4	I/O	Digital I/O Pin
8	D5	I/O	Digital I/O Pin

Arduino Nano Pin Pin	Name	Type	Function
9	D6	I/O	Digital I/O Pin

10	D7	I/O	Digital I/O Pin
11	D8	I/O	Digital I/O Pin
12	D9	I/O	Digital I/O Pin
13	D10	I/O	Digital I/O Pin
14	D11	I/O	Digital I/O Pin
15	D12	I/O	Digital I/O Pin
16	D13	I/O	Digital I/O Pin
17	3V3	Output	+3.3V Output (from FTDI)
18	AREF	Input	ADC reference
19	A0	Input	Analog Input Channel 0
20	A1	Input	Analog Input Channel 1
Arduino Nano Pin Pin	Name	Type	Function
21	A2	Input	Analog Input Channel 2
22	A3	Input	Analog Input Channel 3
23	A4	Input	Analog Input Channel 4

24	A5	Input	Analog Input Channel 5
25	A6	Input	Analog Input Channel 6
26	A7	Input	Analog Input Channel 7
27	+5V	Output or Input	+5V Output (From On-board Regulator) or +5V (Input from External Power Supply
28	RESET	Input	Reset (Active Low)
29	GND	Power	Supply Ground
30	VIN	Power	Supply voltage

ICSP Pins

Arduino Nano ICSP Pin Name	Type	Function
MISO	Input or Output	Master In Slave Out
Vcc	Output	Supply Voltage
SCK	Output	Clock from Master to Slave
MOSI	Output or Input	Master Out Slave In

RST	Input	Reset (Active Low)
GND	Power	Supply Ground

3.4 Arduino Nano Digital Pins

Pins - 1, 2, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, and 16

As mentioned earlier, Arduino Nano has 14 digital I/O pins that can be used either as digital input or output. The pins work with 5V voltage as maximum, i.e., digital high is 5V and digital low is 0V. Each pin can provide or receive a current of 20mA, and has a pull-up resistance of about 20-50k ohms. Each of the 14 digital pins on the Nano pinout can be used as an input or output, using pin Mode (), digitalWrite (), and digital Read () functions.

Other than the digital input and output functions, the digital pins have some additional functionality as well.

3.5 Serial Communication Pins

Pins - 1, 2

1 - RX and 2 - TX

These two pins RX- receive and TX- transmit are used for TTL serial data communication. The pins RX and TX are connected to the corresponding pins of the USB-to-TTL Serial chip.

3.6 PWM Pins

Pins - 6, 8, 9, 12, 13, and 14

Each of these digital pins provide a Pulse Width Modulation signal of 8-bit resolution. The PWM signal can be generated using analog Write () function.

3.6.1 External Interrupts

```
Pins - 5, 6
```

When we need to provide an external interrupt to other processor or controller, we can make use of these pins. These pins can be used to enable interrupts INT0 and INT1 respectively by using the attach Interrupt () function. These pins can be used to trigger three types of interrupts such as interrupt on a low value, a rising or falling edge interrupt and a change in value interrupt.

3.7 SPI Pins

```
Pins - 13, 14, 15, and 16
```

When you don't want the data to be transmitted asynchronously you can use these Serial Peripheral Interface pins. These pins support synchronous communication with SCK as the synchronizing clock. Even though the hardware has this feature, the Arduino software doesn't have this by default. So you have to include a library called SPI Library for using this feature.

3.8 LED

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Pin - 16
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If you remember your first Arduino code, blinking LED, then you'll definitely came across this Pin16. The pin 16 is being connected to the blinking LED on the board.

3.9 Arduino Nano Analog Pins

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Pins - 18, 19, 20, 21, 22, 23, 24, 25, and 26
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As mentioned earlier UNO got 6 analog input pins but Arduino Nano has 8 analog inputs (19 to 26), marked A0 through A7. This means you can connect *8 channel analog sensor inputs for processing. Each of these analog pins has a inbuilt ADC of resolution of 1024 bits (so it will give 1024 values). By default, the pins are measured from ground to 5V. If you want the reference voltage to be 0V to 3.3V, we can give 3.3V to AREF pin (18th Pin) by using the analogReference () function.

Similar to digital pins in Nano, analog pins also got some other functions as well.

3.9.1 I2C

Since Pins 23, 24 as A4 and A5

SPI communication also has its disadvantages such as 4 essential pins and limited within a device. For long distance communication we use the I2C protocol. I2C supports multi master and multi slave with only two wires. One for clock (SCL) and another for data (SDA). For using this I2C feature we need to import a library called Wire library.

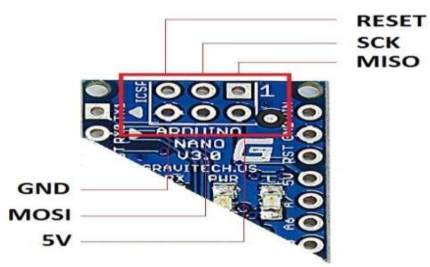
3.9.2 AREF

Pin 18

As mentioned already the AREF- Analog Reference pin is used as a reference voltage for analog input for the ADC conversion.

Reset

ICSP



Arduino Nano ISCP

ICSP stands for In Circuit Serial Programming, which represents one of the several methods available for programming Arduino boards. Ordinarily, an Arduino bootloader program is used to program an Arduino board, but if the bootloader is missing or damaged, ICSP can be used instead. ICSP can be used to restore a missing or damaged bootloader.

Each ICSP pin usually is cross-connected to another Arduino pin with the same name or function. For example, MISO on Nano's ICSP header is connected to MISO / digital pin 12 (Pin 15); MOSI on the ISCP header is connected to MOSI / digital pin 11 (Pin 16); and so forth. Note, MISO, MOSI, and SCK pins taken together make up most of an SPI interface.

We can use one Arduino to program another Arduino using this ICSP.

Arduino as ISP	ATMega328
Vcc/5V	Vcc
GND	GND
MOSI/D11	D11
MISO/D12	D12
SCK/D13	D13
D10	Reset

RESET

Pins 3, 28 and 5 in ICSP

Power

Pins 4, 17, 27, 28, 30 and 2 & 6 in ICSP

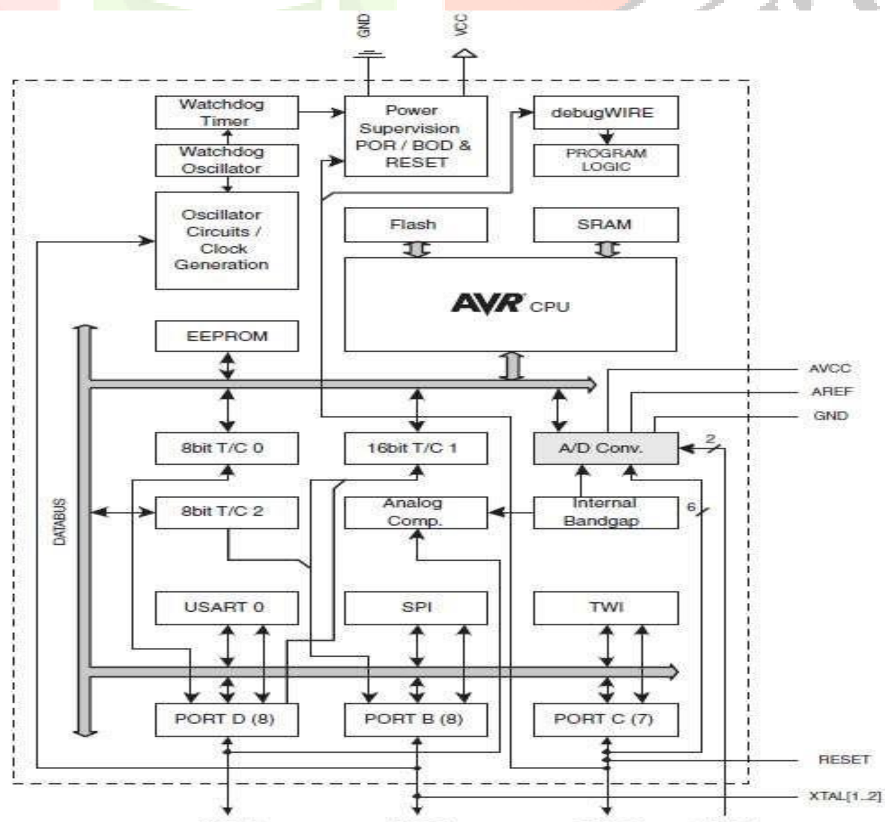
Features

- 1.8-5.5V operating range
- Up to 20MHz
- Part: ATMEGA328P-AU
- 32kB Flash program memory
- 1kB EEPROM

- 2kB Internal SRAM
- 2 8-bit Timer/Counters
- 16-bit Timer/Counter
- RTC with separate oscillator
- Master/Slave SPI interface
- 2-wire (I2C) interface
- Watchdog timer
- 23 IO lines
- Data retention: 20 years at 85C/ 100 years at 25C □ Digital I/O Pins are 14 (out of which 6 provide PWM output)
- Analog Input Pins are 6.
- DC Current per I/O is 40 mA
- DC Current for 3.3V Pin is 50mA

AVR CPU Core

The AVR core combines a rich instruction set with 32 general purpose working registers. All the 32 registers are directly connected to the Arithmetic Logic Unit (ALU), allowing two independent registers to be accessed in one single instruction executed in one clock cycle. The resulting architecture is more code efficient while achieving throughputs up to ten times faster than conventional.



CISC

Figure 3.9.3 AVR Block Diagram

Overview

This section discusses the AVR core architecture in general. The main function of the CPU core is to ensure correct program execution. The CPU must therefore be able to access memories, perform calculations, control peripherals, and handle interrupts

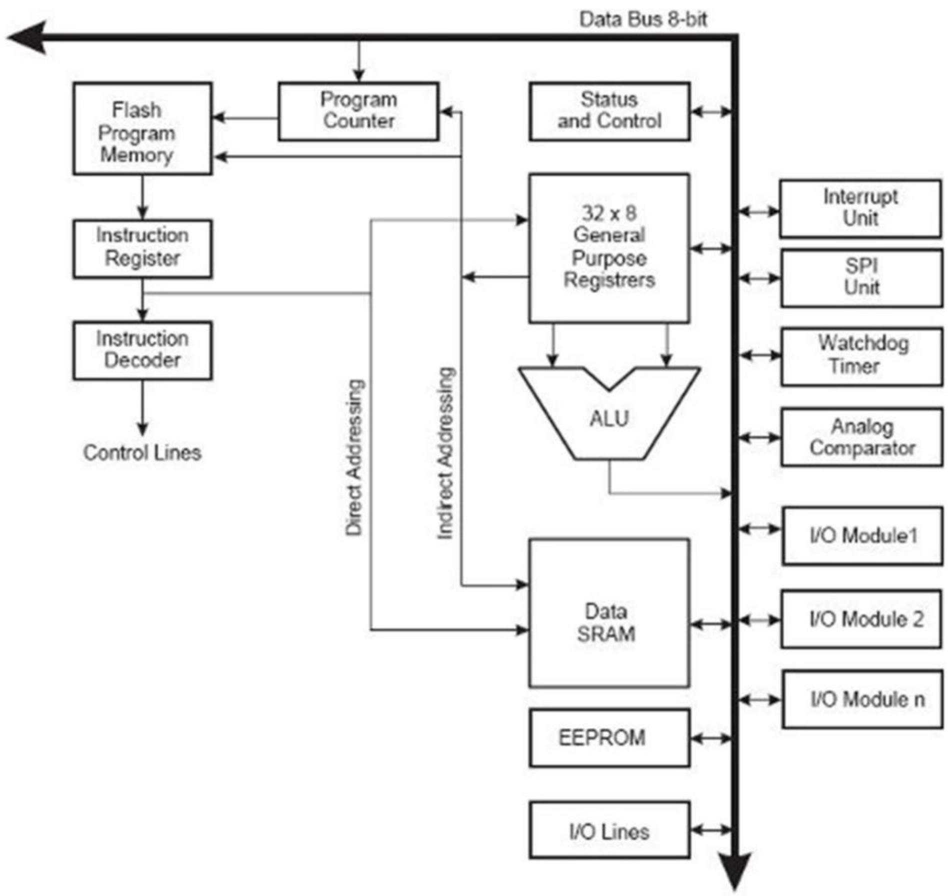


Figure 3.9.4 AVR core architecture

In order to maximize performance and parallelism, the AVR uses a Harvard architecture – with separate memories and buses for program and data. Instructions in the program memory are executed with a single level pipelining. While one instruction is being executed, the next instruction is pre-fetched from the program memory. This concept enables instructions to be executed in every clock cycle. The program memory is In-System Reprogrammable Flash memory. The fast-access Register File contains 32 x 8-bit general purpose working registers with a single clock cycle access time. This allows single-cycle Arithmetic Logic Unit (ALU) operation. In a typical ALU operation, two operands are output from the Register File, the operation is executed, and the result is stored back in the Register File– in one clock cycle.

Six of the 32 registers can be used as three 16-bit indirect address register pointers for Data Space addressing – enabling efficient address calculations. One of these address pointers can also be used as an address pointer for look up tables in Flash program memory. These added function registers are the

16-bit X-, Y-, and Z-register, described later in this section. The ALU supports arithmetic and logic operations between registers or between a constant and a register. Single register operations can also be executed in the ALU. After an arithmetic operation, the Status Register is updated to reflect information about the result of the operation. Program flow is provided by conditional and unconditional jump and call instructions, able to directly address the whole address space. Most AVR instructions have a single 16-bit word format. Every program memory address contains a 16- or 32-bit instruction.

Arduino with ATmega328

The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started.

The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to versionR2) programmed as a USB-to-serial converter.

- Pin out: Added SDA and SCL pins that are near to the AREF pin and two other new pins placed near to the RESET pin, the IOREF that allow the shields to adapt to the voltage provided from the board. In future, shields will be compatible with both the board that uses the AVR, which operates with 5V and with the Arduino. Due that operates with 3.3V. The second one is a not connected pin that is reserved for future purposes.
- Stronger RESET circuit.
- At mega 16U2 replace the 8U2.

"Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno and version 1.0 will be the reference versions of Arduino, moving forward. The Uno is the latest in a series of USB Arduino boards, and the reference model for the Arduino platform; for a comparison with previous versions, see the index of Arduino boards.

Arduino Characteristics

Power

The Arduino Uno can be powered via the USB connection or with an external power supply. The power source is selected automatically. External (non-USB) power can come either from an AC-to-DC adapter (wall-wart) or battery. The adapter can be connected by plugging a 2.1mm center-positive plug into the board's power jack. Leads from a battery can be inserted in the Gnd and Vin pin headers of the POWER connector. The board can operate on an external supply of 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may be unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts.

The power pins are as follows:

- VIN: The input voltage to the Arduino board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.
- 5V: This pin outputs a regulated 5V from the regulator on the board. The board can be supplied with power either from the DC power jack (7 - 12V), the USB connector (5V), or the VIN pin of the board (7-12V). Supplying voltage via the 5V or 3.3V pins bypasses the regulator, and can damage your board. We don't advise it.
- 3V3. A 3.3-volt supply generated by the on-board regulator. Maximum current draw is 50 mA.
- GND. Ground pins.
- IOREF. This pin on the Arduino board provides the voltage reference with which the microcontroller operates. A properly configured shield can read the IOREF pin voltage and select the appropriate power source or enable voltage translators on the outputs for working with the 5V or 3.3V.

Memory:

The ATmega328 has 32 KB (with 0.5 KB used for the boot loader). It also has 2 KB of SRAM and 1 KB of EEPROM (which can be read and written with the EEPROM library).

Serial Communication:

The Arduino Uno has a number of facilities for communicating with a computer, another Arduino, or other microcontrollers. The ATmega328 provides UART TTL (5V) serial communication, which is available on digital pins 0 (RX) and 1 (TX). An ATmega16U2 on the board channels this serial communication over USB and appears as a virtual com port to software on the computer. The '16U2 firmware uses the standard USB COM drivers, and no external driver is needed. However, on Windows, a .inf file is required. The Arduino software includes a serial monitor which allows simple textual data to be sent to and from the Arduino board. The RX and TX LEDs on the board will flash when data is being transmitted via the USB-to-serial chip and USB connection to the computer (but not for serial communication on pins 0 and 1).

A Software Serial library allows for serial communication on any of the Uno's digital pins. The ATmega328 also supports I2C (TWI) and SPI communication. The Arduino software includes a Wire library to simplify use of the I2C bus. For SPI communication, use the SPI library.

CHAPTER-4 HARDWARE COMPONENTS

LCD (Liquid Cristal Display)

4.1 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 a controller is an LCD display. Some of the most common LCDs connected to the controllers 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.

4.1.1 Features:

(1) Interface with either 4-bit or 8-bit microprocessor.

(2) Display data RAM

(3) 80x□8 bits (80 characters).

(4) Character generator ROM

(5). 160 different 5 □□7 dot-matrix character patterns.

(6). Character generator RAM

(7) □8 different user programmed 5 □□7 dot-matrix patterns.

(8). Display data RAM and character generator RAM may be

Accessed by the microprocessor.

(9) Numerous instructions

10). Clear Display, Cursor Home, Display ON/OFF, Cursor ON/OFF,

Blink Character, Cursor Shift, Display Shift.

(11). Built-in reset circuit is triggered at power ON.

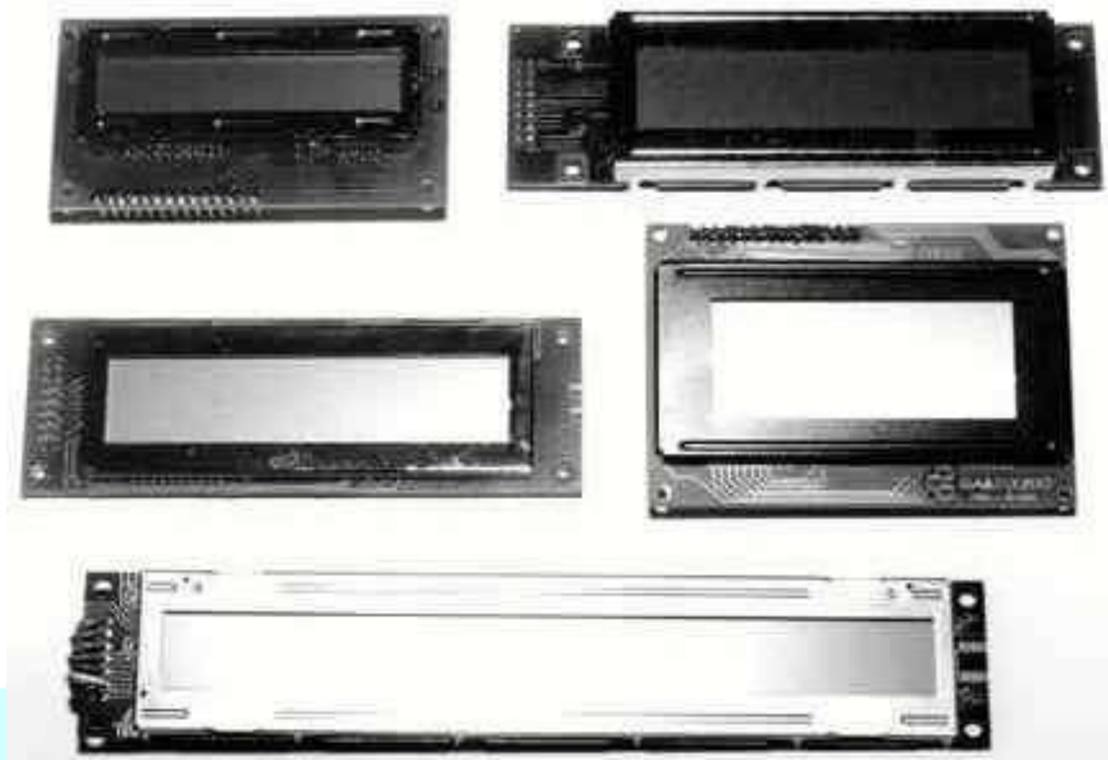
(12). Built-in oscillator.

Data can be placed at any location on the LCD. For 16×1 LCD, the address locations are:

POSITION		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
ADDRESS	LINE1	00	01	02	03	04	05	06	07	40	41	42	43	44	45	46	47

Fig: Address locations for a 1x16 line LCD

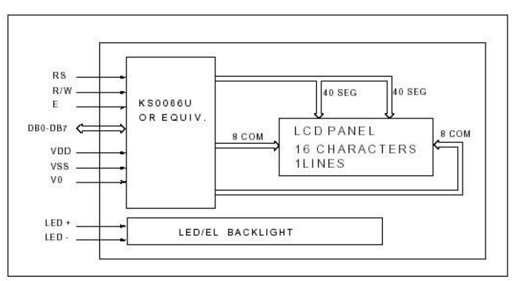
4.1.2 Shapes and sizes:



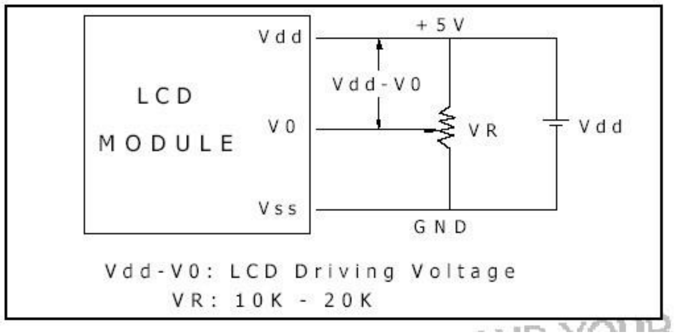
Even limited to character-based modules, there is still a wide variety of shapes and sizes available. Line lengths of 8,16,20,24,32 and 40 characters are all standard, in one-, two- and four-line versions.

Several different LC technologies exists. “supertwist” types, for example, offer Improved contrast and viewing angle over the older “twisted nematic” types. Some modules are available with back lighting, so so that they can be viewed in dimly-lit conditions. The back lighting may be either “electro-luminescent”, requiring a high voltage inverter circuit, or simple LED illumination.

4. 1.3Electrical block diagram:



4.1.4 Power supply for lcd driving:



4.2 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).

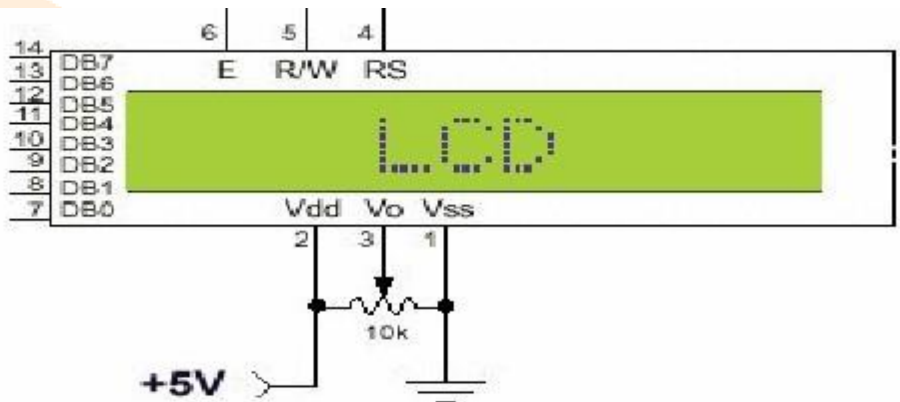


Fig4.2.1: pin diagram of 1x16 lines lcd

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(-)

Fig4.2.1: Tabular Description

4.3 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 written 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.

4.3.1 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

4.3.2 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

4.3.3 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

4.4 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 0n = 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

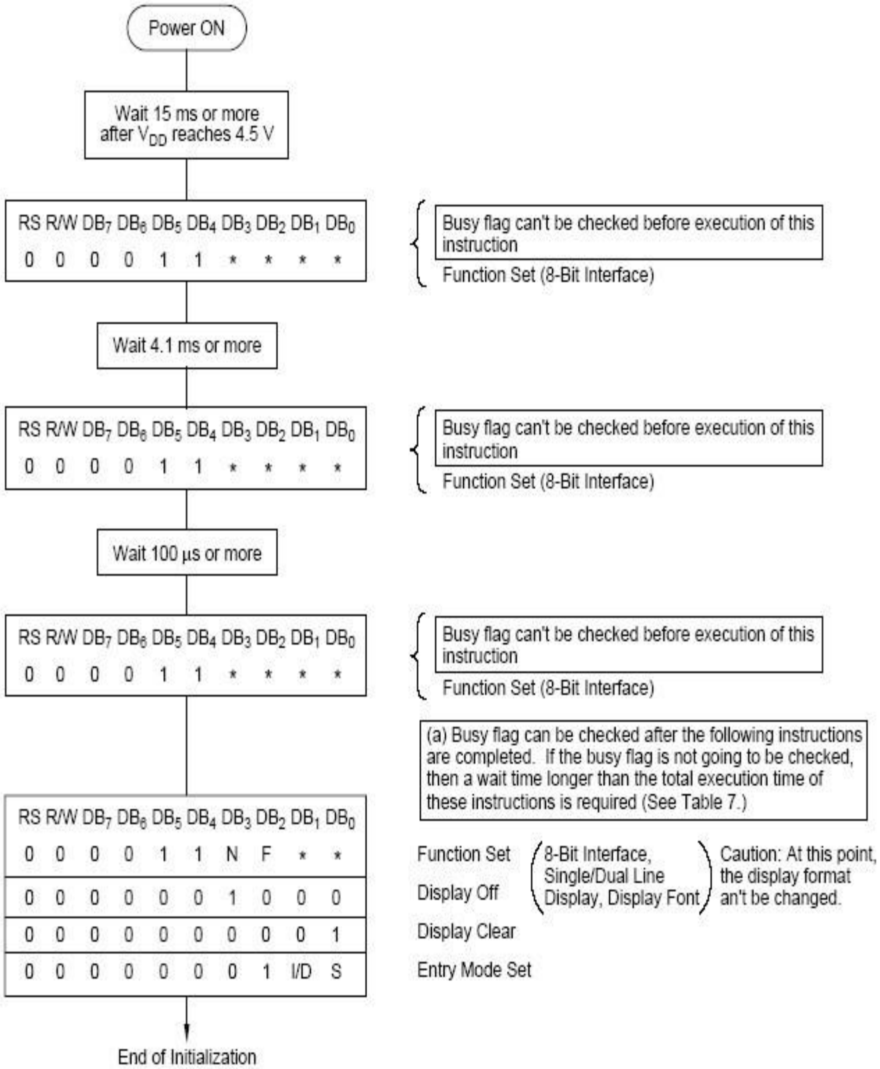
incorporated. The more extensive Kanji character set, which the Japanese share with the Chinese, consisting of several thousand different characters, is not included!

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) and end with 01111111 ($7F). Codes 10000000 to 10011111 ($80 to $9F) are not used, and 10100000 to 11011111 ($A0 to $DF) are the Japanese characters.

4.5 Initialization by Instructions:



If the power conditions for the normal operation of the internal reset circuit are not satisfied, then executing a series of instructions must initialize LCD unit. The procedure for this initialization process is as above show.

CHAPTER-5 REGULATED POWER SUPPLY:

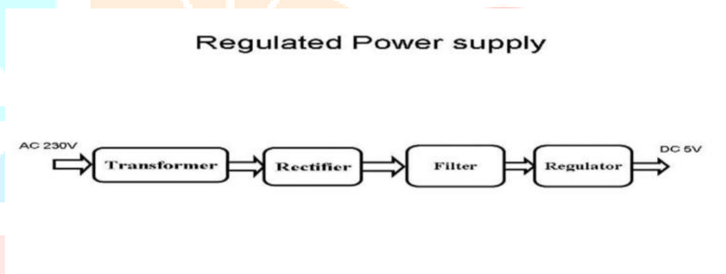
5.1 INTRODUCTION:

Power supply is a supply of electrical power. A device or system that supplies electrical or other types of energy to an output load or group of loads is called a power supply unit or PSU. The term is most commonly applied to electrical energy supplies, less often to mechanical ones, and rarely to others.

A power supply may include a power distribution system as well as primary or secondary sources of energy such as

- Conversion of one form of electrical power to another desired form and voltage, typically involving converting AC line voltage to a well-regulated lower-voltage DC for electronic devices. Low voltage, low power DC power supply units are commonly integrated with the devices they supply, such as computers and household electronics.
- Batteries.
- Chemical fuel cells and other forms of energy storage systems.
- Solar power.
- Generators or alternators.

5.2 Block Diagram:



The basic circuit diagram of a regulated power supply (DC O/P) with led connected as load is shown in fig:

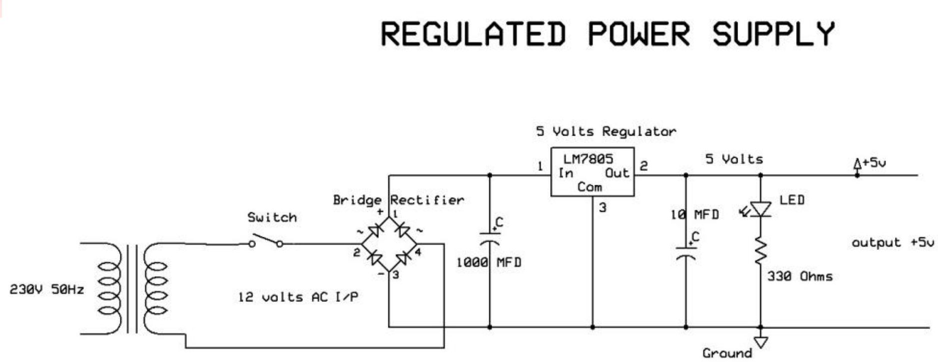


Fig 5.2.1 Circuit diagram of Regulated Power Supply with Led connection

The components mainly used in above figure are

- 230V AC MAINS TRANSFORMER

- BRIDGE RECTIFIER(DIODES)
- CAPACITOR
- VOLTAGE REGULATOR (IC 7805)
- RESISTOR
- LED (LIGHT EMITTING DIODE)

The detailed explanation of each and every component mentioned above is as follows:

5.3 Step 1: Transformation: The process of transforming energy from one device to another is called transformation. For transforming energy we use transformers.

5.3 Transformers:

A transformer is a device that transfers electrical energy from one circuit to another through inductively coupled conductors without changing its frequency. A varying current in the first or primary winding creates a varying magnetic flux in the transformer's core, and thus a varying magnetic field through the secondary winding. This varying magnetic field induces a varying electromotive force (EMF) or "voltage" in the secondary winding. This effect is called mutual induction.

If a load is connected to the secondary, an electric current will flow in the secondary winding and electrical energy will be transferred from the primary circuit through the transformer to the load. This field is made up from lines of force and has the same shape as a bar magnet.

If the current is increased, the lines of force move outwards from the coil. If the current is reduced, the lines of force move inwards.

If another coil is placed adjacent to the first coil then, as the field moves out or in, the moving lines of force will "cut" the turns of the second coil. As it does this, a voltage is induced in the second coil. With the 50 Hz AC mains supply, this will happen 50 times a second. This is called MUTUAL INDUCTION and forms the basis of the transformer.

The input coil is called the PRIMARY WINDING; the output coil is the SECONDARY WINDING. Fig: 3.3.4 shows step-down transformer.

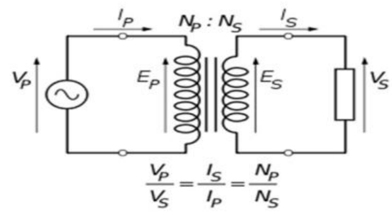


Fig 5.3: Step-Down Transformer

The voltage induced in the secondary is determined by the TURNS RATIO.

$$\frac{\text{primary voltage}}{\text{secondary voltage}} = \frac{\text{number of primary turns}}{\text{number of secondary turns}}$$

For example, if the secondary has half the primary turns; the secondary will have half the primary voltage.

Another example is if the primary has 5000 turns and the secondary has 500 turns, then the turn's ratio is 10:1.

If the primary voltage is 240 volts, then the secondary voltage will be x 10 smaller = 24 volts. Assuming a perfect transformer, the power provided by the primary must equal the power taken by a load on the secondary. If a 24watt lamp is connected across a 24-volt secondary, then the primary must supply 24 watts.

To aid magnetic coupling between primary and secondary, the coils are wound on a metal CORE. Since the primary would induce power, called EDDY CURRENTS, into this core, the core is LAMINATED. This means that it is made up from metal sheets insulated from each other. Transformers to work at higher frequencies have an iron dust core or no core at all.

Note that the transformer only works on AC, which has a constantly changing current and moving field. DC has a steady current and therefore a steady field and there would be no induction.

Some transformers have an electrostatic screen between primary and secondary. This is to prevent some types of interference being fed from the equipment down into the mains supply, or in the other direction. Transformers are sometimes used for IMPEDANCE MATCHING.

We can use the transformers as step up or step down.

5.3.1 Step Up transformer:

In case of step-up transformer, primary windings are every less compared to secondary winding.

Because of having more turns secondary winding accepts more energy, and it releases more voltage at the output side.

5.3.2 Step down transformer:

In case of step-down transformer, Primary winding induces more flux than the secondary winding, and secondary winding is having less number of turns because of that it accepts less number of flux, and releases less amount of voltage.

5.3.3 Battery power supply:

A battery is a type of linear power supply that offers benefits that traditional line-operated power supplies lack: mobility, portability and reliability. A battery consists of multiple electrochemical cells connected to provide the voltage desired. Fig: 3.3.4 shows Hi-Watt 9V battery

Fig5.3.3: Hi-Watt 9V Battery

The most commonly used dry-cell battery is the carbon-zinc dry cell battery. Dry-cell batteries are made by stacking a carbon plate, a layer of electrolyte paste, and a zinc plate alternately until the desired total voltage is achieved. The most common dry-cell batteries have one of the following voltages: 1.5, 3, 6, 9, 22.5, 45, and 90. During the discharge of a carbon-zinc battery, the zinc metal is converted to a zinc salt in the electrolyte, and magnesium dioxide is reduced at the carbon electrode. These actions establish a voltage of approximately 1.5 V.

The lead-acid storage battery may be used. This battery is rechargeable; it consists of lead and lead/dioxide electrodes which are immersed in sulfuric acid. When fully charged, this type of battery has a 2.06-2.14 V potential (A 12 volt car battery uses 6 cells in series). During discharge, the lead is converted to lead sulfate and the sulfuric acid is converted to water. When the battery is charging, the lead sulfate is converted back to lead and lead dioxide A nickel-cadmium battery has become more popular in recent years. This battery cell is completely sealed and rechargeable. The electrolyte is not involved in the electrode reaction, making the voltage constant over the span of the batteries long service life. During the charging process, nickel oxide is oxidized to its higher oxidation state and cadmium oxide is reduced. The nickel-cadmium batteries have many benefits. They can be stored both charged and uncharged. They have a long service life, high current availabilities, constant voltage, and the ability to be recharged. Fig: 3.3.5 shows pencil battery of 1.5V.

Fig5.3.2: Pencil Battery of 1.5V

5.4 Step 2: Rectification

The process of converting an alternating current to a pulsating direct current is called as rectification. For rectification purpose we use rectifiers.

5.4 Rectifiers:

A rectifier is an electrical device that converts alternating current (AC) to direct current (DC), a process known as rectification. Rectifiers have many uses including as components of power supplies and as detectors of radio signals. Rectifiers may be made of solid-state diodes, vacuum tube diodes, mercury arc valves, and other components.

A device that it can perform the opposite function (converting DC to AC) is known as an inverter.

When only one diode is used to rectify AC (by blocking the negative or positive portion of the waveform), the difference between the term diode and the term rectifier is merely one of usage, i.e., the term rectifier describes a diode that is being used to convert AC to DC. Almost all rectifiers comprise a number of diodes in a specific arrangement for more efficiently converting AC to DC than is possible with only one diode. Before the development of silicon semiconductor rectifiers, vacuum tube diodes and copper (I) oxide or selenium rectifier stacks were used.

5.4.1Bridge full wave rectifier:

The Bridge rectifier circuit is shown in figure, which converts an ac voltage to dc voltage using both half cycles of the input ac voltage. The Bridge rectifier circuit is shown in the figure. The circuit has four diodes connected to form a bridge. The ac input voltage is applied to the diagonally opposite ends of the bridge. The load resistance is connected between the other two ends of the bridge.

For the positive half cycle of the input ac voltage, diodes D1 and D3 conduct, whereas diodes D2 and D4 remain in the OFF state. The conducting diodes will be in series with the load resistance R_L and hence the load current flows through R_L.

For the negative half cycle of the input ac voltage, diodes D2 and D4 conduct whereas, D1 and D3 remain OFF. The conducting diodes D2 and D4 will be in series with the load resistance R_L and hence the current flows through R_L in the same direction as in the previous half cycle. Thus a bi-directional wave is converted into a unidirectional wave.

Input Output

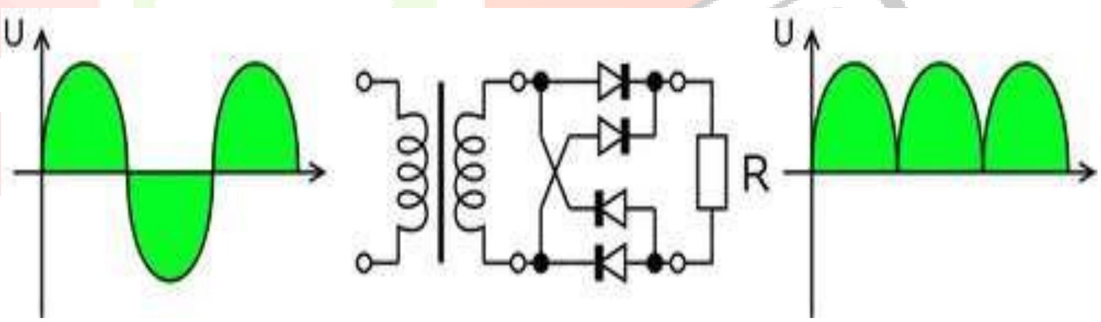


Fig 5.4.1: Bridge rectifier: a full-wave rectifier using 4 diodes

5.4.2 DB107:

Now -a -days Bridge rectifier is available in IC with a number of DB107. In our project we are using an IC in place of bridge rectifier.

Features:

- Good for automation insertion
- Surge overload rating - 30 amperes peak
- Ideal for printed circuit board
- Reliable low cost construction utilizing molded
- Glass passivated device
- Polarity symbols molded on body
- Mounting position: Any
- Weight: 1.0 gram

Fig 5.4.2: DB107

5.5 Step 3: Filtration

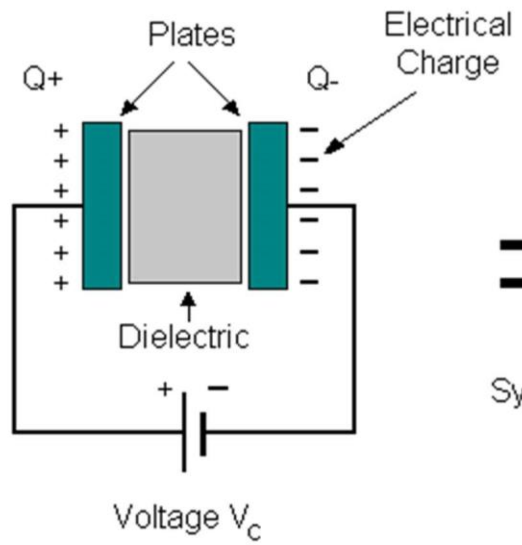
The process of converting a pulsating direct current to a pure direct current using filters is called as filtration.

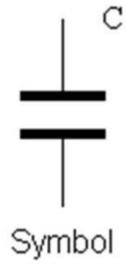
5.5 Filters:

Electronic filters are electronic circuits, which perform signalprocessing functions, specifically to remove unwanted frequency components from the signal, to enhance wanted ones.

5.6 Introduction to Capacitors:

The Capacitor or sometimes referred to as a Condenser is a passive device, and one which stores energy in the form of an electrostatic field which produces a potential (static voltage) across its plates. In its basic form a capacitor consists of two parallel conductive plates that are not connected but are electrically separated either by air or by an insulating material called the Dielectric. When a voltage is applied to these plates, a current flows charging up the plates with electrons giving one plate a positive charge and the other plate an equal and opposite negative charge. This flow of electrons to the plates is known as the Charging Current and continues to flow until the voltage across the plates (and hence the capacitor) is equal to the applied voltage Vcc. At this point the capacitor is said to be fully charged and this is illustrated below.





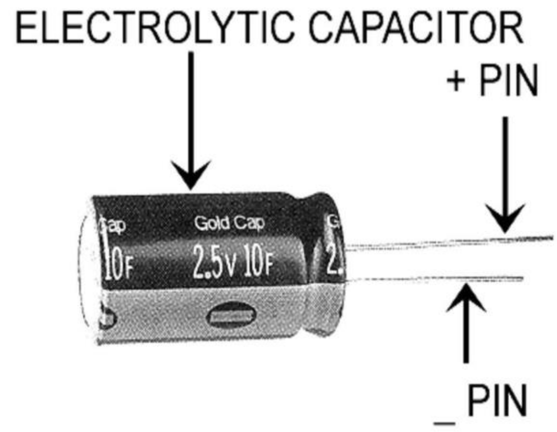


Fig 5.6.1:Construction Of a Capacitor Fig 5.6.1 :Electrolytic Capacitor Units of Capacitance:

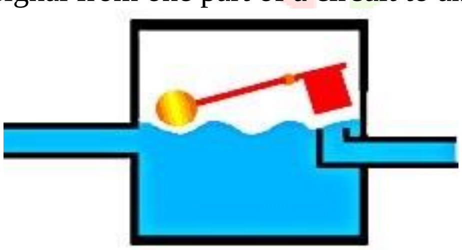
Microfarad (μF) 1μF = 1/1,000,000 = 0.000001 = 10^{-6} F

Nano-farad (nF) 1nF = 1/1,000,000,000 = 0.000000001 = 10^{-9} F Pico farad (pF) 1pF = 1/1,000,000,000,000 = 0.000000000001 = 10^{-12} F

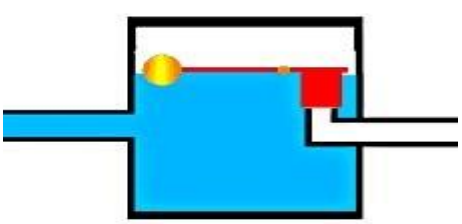
5.6.2 Operation of Capacitor:

Think of water flowing through a pipe. If we imagine a capacitor as being a storage tank with an inlet and an outlet pipe, it is possible to show approximately how an electronic capacitor works.

First, let's consider the case of a "coupling capacitor" where the capacitor is used to connect a signal from one part of a circuit to another but without allowing any direct current to flow.



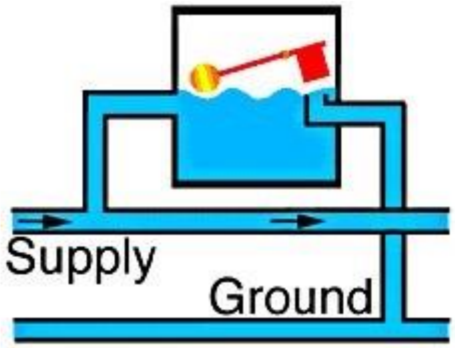
If the current flow is alternating between zero and a maximum, our "storage tank" capacitor will allow the current waves to pass through.



However, if there is a steady current, only the initial short burst will flow until the "floating ball valve" closes and stops further flow.

So a coupling capacitor allows "alternating current" to pass through because the ball valve doesn't get a chance to close as the waves go up and down. However, a steady current quickly fills the tank so that all flow stops.

A capacitor will pass alternating current but (apart from an initial surge) it will not pass d.c.



Where a capacitor is used to decouple a circuit, the effect is to "smooth out ripples". Any ripples, waves or pulses of current are passed to ground while d.c. Flows smoothly.

5.7 Step 4: Regulation

The process of converting a varying voltage to a constant regulated voltage is called as regulation. For the process of regulation we use voltage regulators.

5.7 Voltage Regulator:

A voltage regulator (also called a ‘regulator’) with only three terminals appears to be a simple device, but it is in fact a very complex integrated circuit. It converts a varying input voltage into a constant ‘regulated’ output voltage. Voltage Regulators are available in a variety of outputs like 5V, 6V, 9V, 12V and 15V. The LM78XX series of voltage regulators are designed for positive input. For applications requiring negative input, the LM79XX series is used. Using a pair of ‘voltage-divider’ resistors can increase the output voltage of a regulator circuit.

It is not possible to obtain a voltage lower than the stated rating. You cannot use a 12V regulator to make a 5V power supply. Voltage regulators are very robust. These can withstand over-current draw due to short circuits and also over-heating. In both cases, the regulator will cut off before any damage occurs. The only way to destroy a regulator is to apply reverse voltage to its input. Reverse polarity destroys the regulator almost instantly. Fig: 3.3.10 shows voltage regulator.

Fig 5.7.1: Voltage Regulator

5.8 Resistors:

A resistor is a two-terminal electronic component that produces a voltage across its terminals that is proportional to the electric current passing through it in accordance with Ohm's law:

$$V = IR$$

Resistors are elements of electrical networks and electronic circuits and are ubiquitous in most electronic equipment. Practical resistors can be made of various compounds and films, as well as resistance wire (wire made of a highresistivity alloy, such as nickel/chrome).

The primary characteristics of a resistor are the resistance, the tolerance, maximum working voltage and the power rating. Other characteristics include temperature coefficient, noise, and inductance. Less well-known is critical resistance, the value below which power dissipation limits the maximum permitted current flow, and above which the limit is applied voltage. Critical resistance is determined by the design, materials and dimensions of the resistor.

Resistors can be made to control the flow of current, to work as Voltage dividers, to dissipate power and it can shape electrical waves when used in combination of other components. Basic unit is ohms.

Theory of operation:

Ohm's law:

The behavior of an ideal resistor is dictated by the relationship specified in Ohm's law:

$$V = IR$$

Ohm's law states that the voltage (V) across a resistor is proportional to the current (I) through it where the constant of proportionality is the resistance (R).

Power dissipation:

The power dissipated by a resistor (or the equivalent resistance of a resistor network) is calculated using the following:

$$P = I^2 R = IV = \frac{V^2}{R}$$

Formula

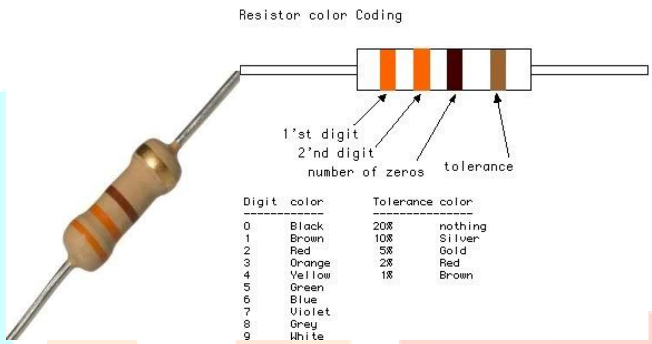
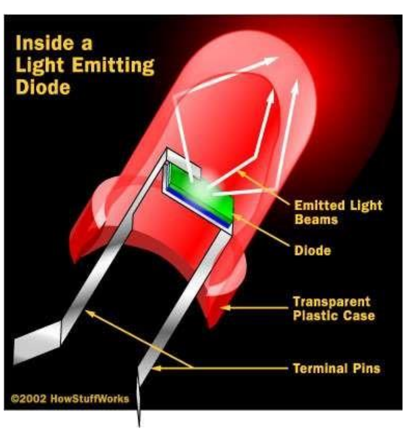


Fig 5.8: Resistor and Colours in Resistors

5.8.1 LED:

A light-emitting diode (LED) is a semiconductor light source. LEDs are used as indicator lamps in many devices, and are increasingly used for lighting. Introduced as a practical electronic component in 1962, early LEDs emitted low-intensity red light, but modern versions are available across the visible, ultraviolet and infrared wavelengths, with very high brightness. The internal structure and parts of a led are shown below.



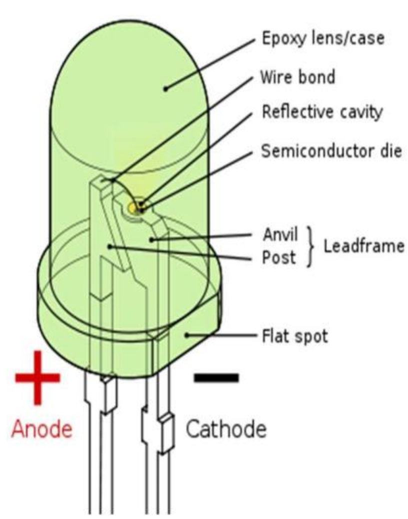


Fig5.8.1: Inside a LED Fig 5.8.1 : Parts of a LED

5.8.2 WORKING:

The structure of the LED light is completely different than that of the light bulb. Amazingly, the LED has a simple and strong structure. The lightemitting semiconductor material is what determines the LED's color. The LED is based on the semiconductor diode.

When a diode is forward biased (switched on), electrons are able to recombine with holes within the device, releasing energy in the form of photons. This effect is called electroluminescence and the color of the light (corresponding to the energy of the photon) is determined by the energy gap of the semiconductor. An LED is usually small in area (less than 1 mm^2), and integrated optical components are used to shape its radiation pattern and assist in reflection. LEDs present many advantages over incandescent light sources including lower energy consumption, longer lifetime, improved robustness, smaller size, faster switching, and greater durability and reliability. However, they are relatively expensive and require more precise current and heat management than traditional light sources. Current LED products for general lighting are more expensive to buy than fluorescent lamp sources of comparable output. They also enjoy use in applications as diverse as replacements for traditional light sources in automotive lighting (particularly indicators) and in traffic signals. The compact size of LEDs has allowed new text and video displays and sensors to be developed, while their high switching rates are useful in advanced communications technology. The electrical symbol and polarities of led are shown in fig:

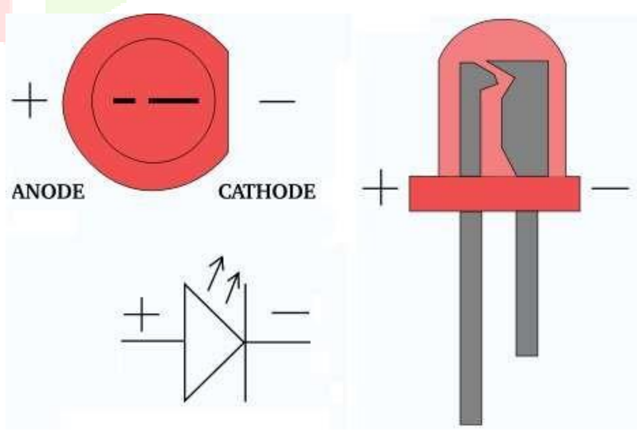


Fig 5.8.2: Electrical Symbol & Polarities of LED

LED lights have a variety of advantages over other light sources:

- High-levels of brightness and intensity
- High-efficiency
- Low-voltage and current requirements
- Low radiated heat
- High reliability (resistant to shock and vibration)
- No UV Rays
- Long source life
- Can be easily controlled and programmed

Applications of LED fall into three major categories:

- Visual signal application where the light goes more or less directly from the LED to the human eye, to convey a message or meaning.
- Illumination where LED light is reflected from object to give visual response of these objects.
- Generate light for measuring and interacting with processes that do not involve the human visual system.

5.9 PIR SENSOR

PIR Sensor is short for passive infrared sensor, which applies for projects that need to detect human or particle movement in a certain range, and it can also be referred as PIR(motion) sensor, or IR sensor. Since its powerful function and low-cost advantages, it has been adopted in tons of projects and widely accepted by the open-source hardware community for projects related to Arduino and raspberry pi. All this can help the beginners learn about PIR sensor more easily.

Fig 5.9: PIR Motion Sensor – Large Lens version

A passive infrared sensor is an electronic sensor that measures infrared light radiating from objects in its field of view. They are most often used in PIR-based motion detectors. PIR sensors are commonly used in security alarms and automatic lighting applications.

Technically, PIR is made of a pyroelectric sensor, which is able to detect different levels of infrared radiation. For example, Everything emits varied level radiation and the level of radiation will increase with the increase of the object’s temperature. Actually, the motion detector is separated by two parts since motion change is what we want, rather than IR level. The output will swing high or low if one half see different IR radiation than the other.

As we all know that PIR sensors can be also refer to PID, which is short for passive infrared detectors. As you have learned about the technical term in the first part, PIR sensor can detect infrared radiation which is emitted by particles.

Generally, PIR can detect animal/human movement in a requirement range, which is determined by the spec of the specific sensor. The detector itself does not emit any energy but passively receives it, detects infrared radiation from the environment. Once there is infrared radiation from the human body/ particle with temperature, focusing on the optical system causes the pyroelectric device to generate a sudden electrical signal and an alarm is issued.

The passive infrared alarm does not radiate energy to space but relies on receiving infrared radiation from the human body to make an alarm. Any object with temperature is constantly radiating infrared rays to the outside world. The surface temperature of the human body is 36-27 ° C, and most of its radiant energy is concentrated in the wavelength range of 8-12 um.

Passive infrared alarms can be classified into infrared detectors (infrared probes) and alarm control sections. The most widely used infrared detector is a pyroelectric detector, which is used as a sensor for converting human infrared radiation into electricity. If the human infrared radiation is directly irradiated on the detector, it will, of course, cause a temperature change to output a signal, but in doing so, the detection distance will not be far. In order to lengthen the detection distance of the detector, an optical system must be added to collect the infrared radiation, usually using a plastic optical reflection system or a Fresnel lens made of plastic as a focusing system for infrared radiation.

Detect motion, so we will say PIR sensor is a subset of motion sensor. Because of PIR sensor are small in size, cheap in price, low-power and very easy to understand, which makes in quite popular. A lot of merchants will add “motion” between PIR sensor for the convenience of beginners.

If you can understand the above introduction, I think you will know the answer to this question. Of course, yes, they work fine in daylight.

5.9.1 RELAY:

A relay is an electrically operated switch. Many relays use an electromagnet to operate a switching mechanism, but other operating principles are also used. Relays find applications where it is necessary to control a circuit by a low-power signal, or where several circuits must be controlled by one signal. The first relays were used in long distance telegraph circuits, repeating the signal coming in from one circuit and re-transmitting it to another. Relays found extensive use in telephone exchanges and early computers to perform logical operations. A type of relay that can handle the high power required to directly drive an electric motor is called a contactor. Solid-state relays control power circuits with no moving parts, instead using a semiconductor device triggered by light to perform switching. Relays with calibrated operating characteristics and sometimes multiple operating coils are used to protect electrical circuits from overload or faults; in modern electric power systems these functions are performed by digital instruments still called "protection relays".

Basic design and operation:

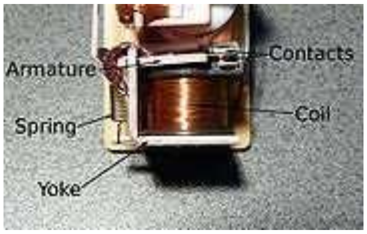


Fig 5.9.1: Simple electromechanical relay

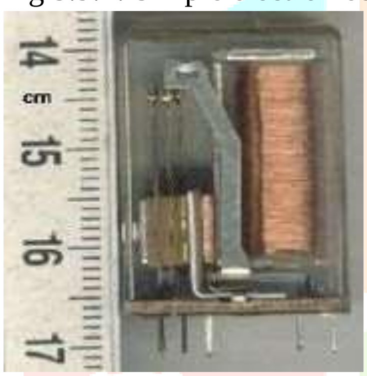


Fig 5.9.1: Small relay as used in electronics

A simple electromagnetic relay, such as the one taken from a car in the first picture, is an adaptation of an electromagnet. It consists of a coil of wire surrounding a soft iron core, an iron yoke, which provides a low reluctance path for magnetic flux, a movable iron armature, and a set, or sets, of contacts; two in the relay pictured. The armature is hinged to the yoke and mechanically linked to a moving contact or contacts. It is held in place by a spring so that when the relay is de-energized there is an air gap in the magnetic circuit. In this condition, one of the two sets of contacts in the relay pictured is closed, and the other set is open. Other relays may have more or fewer sets of contacts depending on their function. The relay in the picture also has a wire connecting the armature to the yoke. This ensures continuity of the circuit between the moving contacts on the armature, and the circuit track on the printed circuit board (PCB) via the yoke, which is soldered to the PCB.

When an electric current is passed through the coil, the resulting magnetic field attracts the armature and the consequent movement of the movable contact or contacts either makes or breaks a connection with a fixed contact. If the set of contacts was closed when the relay was De-energized, then the movement opens the contacts and breaks the connection, and vice versa if the contacts were open. When the current to the coil is switched off, the armature is returned by a force, approximately half as strong as the magnetic force, to its relaxed position.

Usually this force is provided by a spring, but gravity is also used commonly in industrial motor starters. Most relays are manufactured to operate quickly. In a low voltage application, this is to reduce noise. In a high voltage or high current application, this is to reduce arcing.

If the coil is energized with DC, a diode is frequently installed across the coil, to dissipate the energy from the collapsing magnetic field at deactivation, which would otherwise generate a voltage spike dangerous to circuit components. Some automotive relays already include a diode inside the relay case. Alternatively a contact protection network, consisting of a capacitor and resistor in series, may absorb the surge. If the coil is designed to be energized with AC, a small copper ring can be crimped to the end of the solenoid. This "shading ring" creates a small out-of-phase current, which increases the minimum pull on the armature during the AC cycle.

By analogy with the functions of the original electromagnetic device, a solid-state relay is made with a thyristor or other solid-state switching device. To achieve electrical isolation an opt coupler can be used which is a light-emitting diode (LED) coupled with a photo transistor.

Types

Fig 5.9.2: Latching relay

Latching relay, dust cover removed, showing pawl and ratchet mechanism. The ratchet operates a cam, which raises and lowers the moving contact arm, seen edge-on just below it. The moving and fixed contacts are visible at the left side of the image.

A latching relay has two relaxed states (bistable). These are also called "impulse", "keep", or "stay" relays. When the current is switched off, the relay remains in its last state. This is achieved with a solenoid operating a ratchet and cam mechanism, or by having two opposing coils with an over-center spring or permanent magnet to hold the armature and contacts in position while the coil is relaxed, or with a remanent core. In the ratchet and cam example, the first pulse to the coil turns the relay on and the second pulse turns it off. In the two coil example, a pulse to one coil turns the relay on and a pulse to the opposite coil turns the relay off. This type of relay has the advantage that it consumes power only for an instant, while it is being switched, and it retains its last setting across a power outage. A remanent core latching relay requires a current pulse of opposite polarity to make it change state.

5.9.3 Reed relay

A reed relay has a set of contacts inside a vacuum or inert gas filled glass tube, which protects the contacts against atmospheric corrosion. The contacts are closed by a magnetic field generated when current passes through a coil around the glass tube. Reed relays are capable of faster switching speeds than larger types of relays, but have low switch current and voltage ratings.

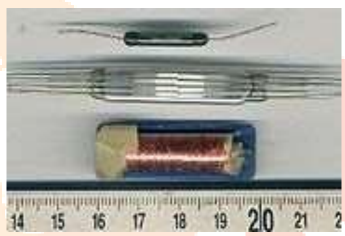


Fig 5.9.3: Reed Relay

5.9.4 Mercury-wetted relay

A mercury-wetted reed relay is a form of reed relay in which the contacts are wetted with mercury. Such relays are used to switch low-voltage signals (one volt or less) because of their low contact resistance, or for high-speed counting and timing applications where the mercury eliminates contact bounce. Mercury wetted relays are position-sensitive and must be mounted vertically to work properly. Because of the toxicity and expense of liquid mercury, these relays are rarely specified for new equipment. See also mercury switch.

5.9.5 Polarized relay

A polarized relay placed the armature between the poles of a permanent magnet to increase sensitivity. Polarized relays were used in middle 20th Century telephone exchanges to detect faint pulses and correct telegraphic distortion. The poles were on screws, so a technician could first adjust them for maximum sensitivity and then apply a bias spring to set the critical current that would operate the relay.

5.9.6 Machine tool relay

A machine tool relay is a type standardized for industrial control of machine tools, transfer machines, and other sequential control. They are characterized by a large number of contacts (sometimes extendable in the field) which are easily converted from normally-open to normally-closed status, easily replaceable coils, and a form factor that allows compactly installing many relays in a control panel. Although such relays once were the backbone of automation in such industries as automobile assembly, the programmable logic controller (PLC) mostly displaced the machine tool relay from sequential control applications.

5.9.7 Contactor relay

Solid-state relay

Solid state relay, which has no moving parts

25 A or 40 A solid state contactors

A solid-state relay (SSR) is a solid-state electronic component that provides a similar function to an electromechanical relay but does not have any moving components, increasing long-term reliability. With early SSR's, the tradeoff came from the fact that every transistor has a small voltage drop across it. This voltage drop limited the amount of current a given SSR could handle. As transistors improved, higher current SSR's, able to handle 100 to 1,200 Amperes, have become commercially available. Compared to electromagnetic relays, they may be falsely triggered by transients.

5.9.8 Solid state contactor relay

A solid-state contactor is a very heavy-duty solid-state relay, including the necessary heat sink, used for switching electric heaters, small electric motors and lighting loads; where frequent on/off cycles are required. There are no moving parts to wear out and there is no contact bounce due to vibration. They are activated by AC control signals or DC control signals from Programmable logic controller (PLCs), PCs, Transistor-transistor logic (TTL) sources, or other microprocessor and microcontroller controls.

5.9.9 Buchholz relay

A Buchholz relay is a safety device sensing the accumulation of gas in large oilfilled transformers, which will alarm on slow accumulation of gas or shut down the transformer if gas is produced rapidly in the transformer oil.

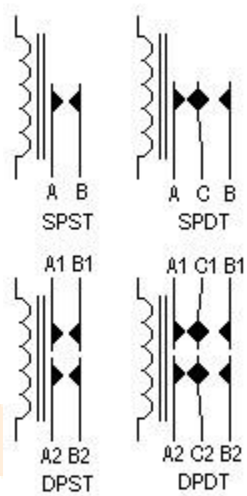
5.9.10 Forced-guided contact’s relay

A forced-guided contacts relay has relay contacts that are mechanically linked together, so that when the relay coil is energized or de-energized, all of the linked contacts move together. If one set of contacts in the relay becomes immobilized, no other contact of the same relay will be able to move. The function of forcedguided contacts is to enable the safety circuit to check the status of the relay. Forced-guided contacts are also known as "positive-guided contacts", "captive contacts", "locked contacts", or "safety relays".

5.9.11 Overload protection relay

Electric motors need over current protection to prevent damage from overloading the motor, or to protect against short circuits in connecting cables or internal faults in the motor windings. One type of electric motor overload protection relay is operated by a heating element in series with the electric motor. The heat generated by the motor current heats a bimetallic strip or melts solder, releasing a spring to operate contacts. Where the overload relay is exposed to the same environment as the motor, a useful though crude compensation for motor ambient temperature is provided.

Pole and throw:



Circuit symbols of relays. "C" denotes the common terminal in SPDT and DPDT types.

The diagram on the package of a DPDT AC coil relay

Since relays are switches, the terminology applied to switches is also applied to relays. A relay will switch one or more poles, each of whose contacts can be thrown by energizing the coil in one of three ways:

- Normally-open (NO) contacts connect the circuit when the relay is activated; the circuit is disconnected when the relay is inactive. It is also called a Form A contact or "make" contact.
- Normally-closed (NC) contacts disconnect the circuit when the relay is activated; the circuit is connected when the relay is inactive. It is also called a Form B contact or "break" contact.
- Change-over (CO), or double-throw (DT), contacts control two circuits: one normally-open contact and one normally-closed contact with a common terminal. It is also called a Form C contact or "transfer" contact ("break before make"). If this type of contact utilizes"make before break" functionality, then it is called a Form D contact.

The following designations are commonly encountered:

- SPST – Single Pole Single Throw. These have two terminals which can be connected or disconnected. Including two for the coil, such a relay has four terminals in total. It is ambiguous whether the pole is normally open or normally closed. The terminology "SPNO" and "SPNC" is sometimes used to resolve the ambiguity.
- SPDT – Single Pole Double Throw. A common terminal connects to either of two others. Including two for the coil, such a relay has five terminals in total.

- DPST – Double Pole Single Throw. These have two pairs of terminals. Equivalent to two SPST switches or relays actuated by a single coil. Including two for the coil, such a relay has six terminals in total. The poles may be Form A or Form B (or one of each).
- DPDT – Double Pole Double Throw. These have two rows of change-over terminals. Equivalent to two SPDT switches or relays actuated by a single coil. Such a relay has eight terminals, including the coil.

The "S" or "D" may be replaced with a number, indicating multiple switches connected to a single actuator. For example 4PDT indicates a four pole double throw relay (with 14 terminals).

APPLICATIONS:

Relays are used to and for:

- Control a high-voltage circuit with a low-voltage signal, as in some types of modems or audio amplifiers,
- Control a high-current circuit with a low-current signal, as in the starter solenoid of an automobile,
- Detect and isolate faults on transmission and distribution lines by opening and closing circuit breakers (protection relays),

A DPDT AC coil relay with "ice cube" packaging

- 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,
- Logic functions. For example, the Boolean AND function is realesed by connecting normally open relay contacts in series, the OR function by connecting normally open 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 normally closed 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 safetycritical logic, such as the control panels of radioactive wastehandling machinery.
- 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.

Advantages of relays:

- Relays can switch AC and DC, transistors can only switch DC.
- Relays can switch high voltages, transistors cannot.
- Relays are a better choice for switching large currents (> 5A).
- Relays can switch many contacts at once.

Disadvantages of relays:

- Relays are bulkier than transistors for switching small currents.
- Relays cannot switch rapidly (except reed relays), transistors can switch many times per second.
- Relays use more power due to the current flowing through their coil.
- Relays require more current than many ICs can provide, so a low power transistor may be needed to switch the current for the relay's coil.

CHAPTER-6

6.1 GPS (GLOBAL POSITIONING SYSTEM)

The Global Positioning System (GPS) is a U.S. space-based radio navigation system that provides reliable positioning, navigation, and timing services to civilian users on a continuous worldwide basis -- freely available to all. For anyone with a GPS receiver, the system will provide location and time. GPS provides accurate location and time information for an unlimited number of people in all weather, day and night, anywhere in the world.

The GPS is made up of three parts:

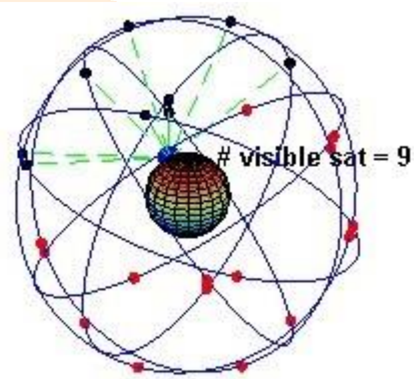
1. Satellites orbiting the Earth

2. Control and monitoring stations on Earth

3. The GPS receivers owned by users.

GPS satellites broadcast signals from space that are picked up and identified by GPS receivers. Each GPS receiver then provides three-dimensional location (latitude, longitude, and altitude) plus the time.

1. SPACE SEGMENT
    - 24+ satellites
    - 20,200 km altitude
    - 55 degrees inclination
    - 12 hour orbital period
    - 5 ground control stations
    - Each satellite passes over a ground monitoring station every 12 hours



6.2 The GPS satellite system:

The space segment is composed of the orbiting GPS satellites or Space Vehicles (SV) in GPS parlance. The GPS design originally called for 24 SVs, this was modified to six planes with four satellites each. The orbital planes are centered on the Earth, not rotating with respect to the distant stars. The six planes have approximately 55° inclination (tilt relative to Earth's equator) and are separated by 60° right ascension of the ascending node (angle along the equator from a reference point to the orbit's intersection). The orbits are arranged so that at least six satellites are always within line of sight from almost everywhere on Earth's surface.

The full constellation of 24 satellites that make up the GPS space segment are orbiting the earth about 20,200 km above us. They are constantly moving, making two complete orbits in less than 24 hours. These satellites are travelling at speeds of roughly 7,000 miles an hour.

GPS satellites are powered by solar energy. They have backup batteries onboard to keep them running in the event of a solar eclipse, when there's no solar power. Small rocket boosters on each satellite keep them flying in the correct path.

Here are some other interesting facts about the GPS satellites (also called NAVSTAR, the official U.S. Department of Defense name for GPS):

- The first GPS satellite was launched in 1978.
- A full constellation of 24 satellites was achieved in 1994.
- Each satellite is built to last about 10 years. Replacements are constantly being built and launched into orbit.
- A GPS satellite weighs approximately 2,000 pounds and is about 17 feet across with the solar panels extended.
- Transmitter power is only 50 watts or less.
- The orbits are arranged so that at anytime, anywhere on Earth, there are at least four satellites "visible" in the sky.
- All satellites broadcast at the same two frequencies, 1.57542 GHz (L1 signal) and 1.2276 GHz (L2 signal).
- The satellite network uses a CDMA spread-spectrum technique where the low-bitrate message data is encoded with a high-rate pseudo-random (PRN) sequence that is different for each satellite.

  The receiver must be aware of the PRN codes for each satellite to reconstruct the actual message data. The C/A code, for civilian use, transmits data at 1.023 million chips per second, whereas the P code, for U.S. military use, transmits at 10.23 million chips per second. The L1 carrier is modulated by both the C/A and P codes, while the L2 carrier is only modulated by the P code. The P code can be encrypted as a socalled P(Y) code which is only available to military equipment with a proper decryption key. Both the C/A and P(Y) codes impart the precise time-ofday to the user

6.3 Control and monitoring stations on Earth

Ground Stations (also known as the "Control Segment")

These stations monitor the GPS satellites, checking both their operational health and their exact position in space. The master ground station transmits corrections for the satellite's ephemeris constants and clock offsets back to the satellites themselves. The satellites can then incorporate these updates in the signals they send to GPS receivers.

There are five monitor stations: Hawaii, Ascension Island, Diego Garcia, Kwajalein, and Colorado Springs.

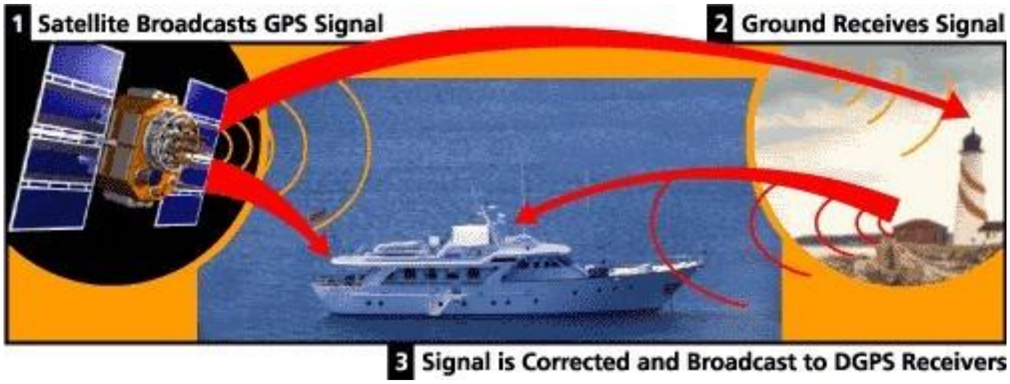
Each GPS satellite regularly with a navigational update using dedicated or shared ground antennas (GPS dedicated ground antennas are located at Kwajalein, Ascension Island, Diego Garcia, and Cape Canaveral). These updates synchronize the atomic clocks on board the satellites to within a few nanoseconds of each other, and adjust the ephemeris of each satellite's internal orbital model. The updates are created by a Kalman filter, which uses inputs from the ground monitoring stations, space weather information, and various other inputs. Satellite maneuvers are not precise by GPS standards. So to change the orbit of a satellite, the satellite must be marked unhealthy, so receivers will not use it in their calculation. Then the maneuver can be carried out, and the resulting orbit tracked from the ground. Then the new ephemeris is uploaded and the satellite marked healthy again.

6.3 THE GPS Receivers

- Receiver determines location, speed, direction, and time
- 3 satellite signals are necessary to locate the receiver in 3D space
- 4th satellite is used for time accuracy
- Position calculated within sub-centimeter scale

Individuals may purchase GPS handsets that are readily available through commercial retailers. Equipped with these GPS receivers, users can accurately locate where they are and easily navigate to where they want to go, whether walking, driving, flying, or boating.

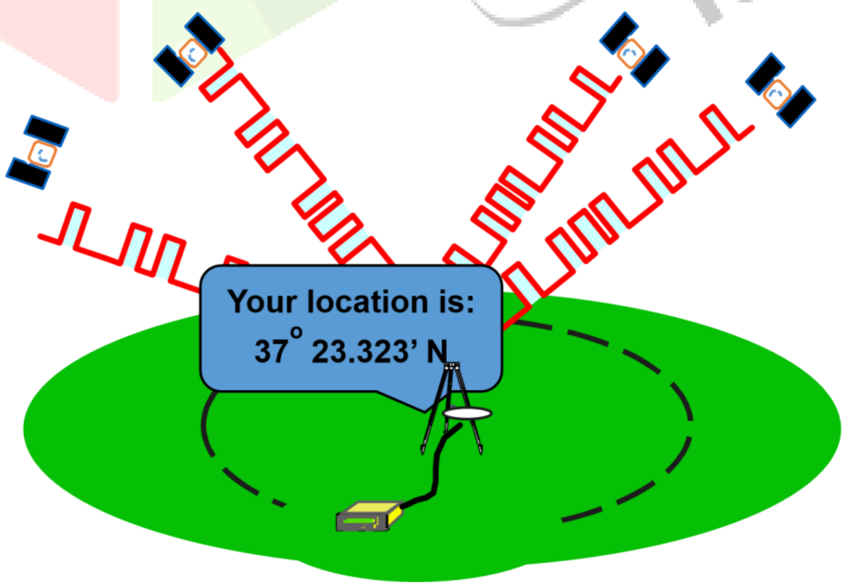
Today's GPS receivers are extremely accurate, thanks to their parallel multi-channel design. Garmin's 12 parallel channel receivers are quick to lock onto satellites when first turned on and they maintain strong locks, even in dense foliage or urban settings with tall buildings. Certain atmospheric factors and other sources of error can affect the accuracy of GPS receivers.
Garmin® GPS receivers are accurate to within 15 meters on average.



Newer Garmin GPS receivers with WAAS (Wide Area Augmentation System) capability can improve accuracy to less than three meters on average. No additional equipment or fees are required to take advantage of WAAS. Users can also get better accuracy with Differential GPS (DGPS), which corrects GPS signals to within an average of three to five meters. The U.S. Coast Guard operates the most common DGPS correction service. This system consists of a network of towers that receive GPS signals and transmit a corrected signal by beacon transmitters. In order to get the corrected signal, users must have a differential beacon receiver and beacon antenna in addition to their GPS.

Our ancestors had to go to pretty extreme measures to keep from getting lost. They erected monumental landmarks, laboriously drafted detailed maps and learned to read the stars in the night sky.

Things are much, much easier today. For less than $100, you can get a pocketsized gadget that will tell you exactly where you are on Earth at any moment. As long as you have a GPS receiver and a clear view of the sky, you'll never be lost again.



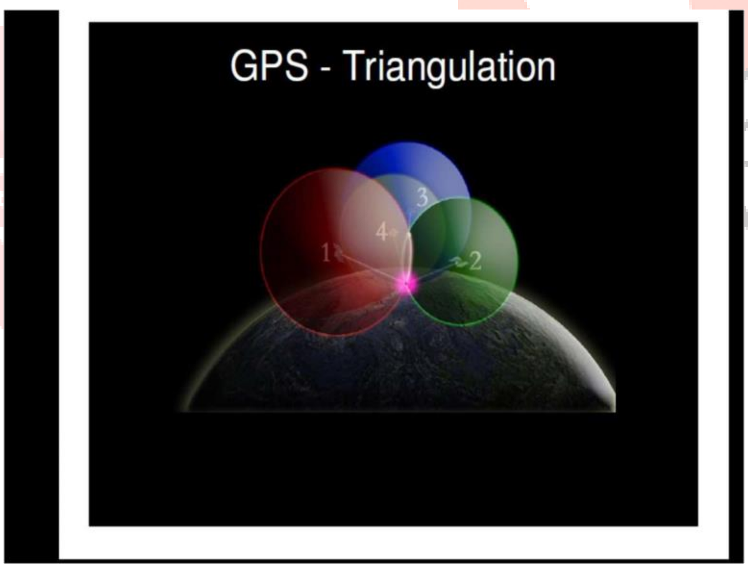
The user segment is composed of hundreds of thousands of U.S. and allied military users of the secure GPS Precise Positioning Service, and tens of millions of civil, commercial and scientific users of the

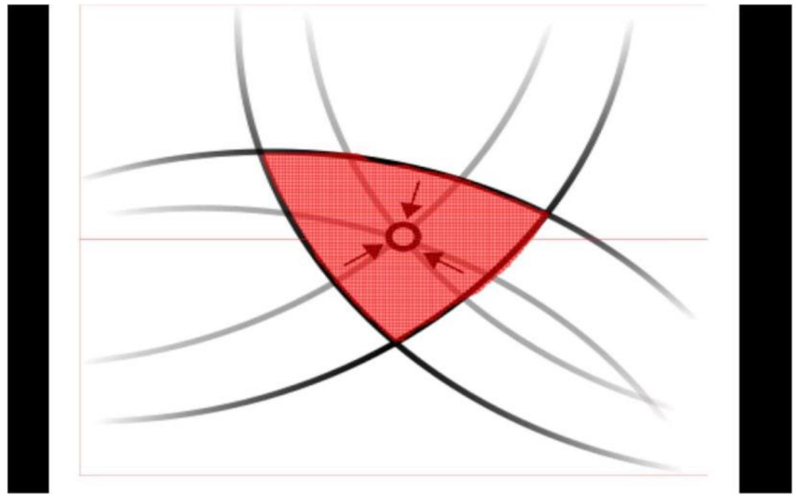
Standard Positioning Service. In general, GPS receivers are composed of an antenna, tuned to the frequencies transmitted by the satellites, receiver-processors, and a highly stable clock (often a crystal oscillator). They may also include a display for providing location and speed information to the user. A receiver is often described by its number of channels: this signifies how many satellites it can monitor simultaneously. Originally limited to four or five, this has progressively increased over the years so that, as of 2007, receivers typically have between 12 and 20 channels.

The Global Positioning System is vast, expensive and involves a lot of technical ingenuity, but the fundamental concepts at work are quite simple and intuitive.

When people talk about "a GPS," they usually mean a GPS receiver. The Global Positioning System (GPS) is actually a constellation of 24 Earth-orbiting satellites The U.S. military developed and implemented this satellite network as a military navigation system, but soon opened it up to everybody else.

Each of these 3,000- to 4,000-pound solar-powered satellites circles the globe making two complete rotations every day. The orbits are arranged so that at any time, anywhere on Earth, there are at least four satellites "visible" in the sky.





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

6.4 APPLICATIONS OF GPS

- GPS has become a mainstay of transportation systems worldwide,
- Providing navigation for aviation, ground, and maritime operations.
- Disaster relief and emergency services depend upon GPS for location and timing capabilities in their life-saving missions.
- Everyday activities such as banking,
- Mobile phone operations, and even
- The control of power grids, are facilitated by the accurate timing provided by GPS.
- Farmers, surveyors, geologists and countless others perform their work more efficiently, safely, economically, and accurately using the free and open GPS signals.

6.5 COMMANDS IN GPS

NMEA record	Description
GGA	Global positioning system fixed data
GLL	Geographic position - latitude/longitude
GSA	GNSS DOP and active satellites
GSV	GNSS satellites in view
RMC	Recommended minimum specific GNSS data
VTG	Course over ground and ground speed

- • GGA--- Global Positioning System Fixed Data

- Table 5-2 contains the values for the following example:
- $GPGGA,053740.000,2503.6319,N ,12136.0099,E,1,08,1.1,63.8,M,15. 2,M,,0000*64 Table5- 2 GGA Data Format

Name	Example	Units	Description
Message ID	$GPGGA		GGA protocol header
UTC Time	053740.000		hhmmss.sss
Latitude	2503.6319		ddmm.mmmm
N/S indicator	N		N=north or S=south
Longitude	12136.0099		dddmm.mmmm
E/W Indicator	E		E=east or W=west
Position Fix	1		See Table 5-3
Satellites Used	08		Range 0 to 12
HDOP	1.1		Horizontal Dilution of Precision
MSL Altitude	63.8	mters	
Units	M	mters	
Geoid Separation	15.2	mters	
Units	M	mters	
Age of Diff. Corr.		second	Null fields when DGPS is not used
Diff. Ref. Station ID	0000		
Checksum	*64		
<CR> <LF>			End of message termination

- Table 5-3 Position Fix Indicators

Value	Description
0	Fix not available or invalid
1	GPS SPS Mode, fix valid
2	Differential GPS, SPS Mode,
3-5	Not supported
6	Dead Reckoning Mode, fix

- • GLL--- Geographic Position - Latitude/Longitude Table 5-4 contains the values for the following example:
- $GPGLL,2503.631 9,N,12136.0099,E,

053740.000,A,A*5

2 Table 5-4 GLL

Data Format

Name	Example	Units	Description
Message ID	$GPGLL		GLL protocol header
Latitude	2503.6319		ddmm.mmmm
N/S indicator	N		N=north or S=south
Longitude	12136.0099		dddmm.mmmm
E/W indicator	E		E=east or W=west
UTC Time	053740.000		hhmmss.sss
Status	A		A=data valid or V=data not valid
Mode	A		A=autonomous, D=DGPS, E=DR
Checksum	*52		
<CR> <LF>			End of message termination

- • GSA---GNSS DOP and Active Satellites
- Table 5-5 contains the values for the following example:
- $GPGSA,A,3,24,07

,17,11,28,08,20,04

,,,,,2.0,1.1,1.7*35

Table 5-5 GSA

Data Format

Name	Example	Units	Description
Message ID	$GPGSA		GSA protocol header
Mode 1	A		See Table 5-6
Mode 2	3		See Table 5-7
ID of satellite used	24		Sv on Channel 1
ID of satellite used	07		Sv on Channel 2
….			….
ID of satellite used			Sv on Channel 12
PDOP	2.0		Position Dilution of Precision
HDOP	1.1		Horizontal Dilution of Precision
VDOP	1.7		Vertical Dilution of Precision
Checksum	*35		

<CR> <LF>			End of message termination

- Table 5-6 Mode 1

Value	Description
M	Manual- forced to operate in 2D
A	Automatic-allowed to

- Table 5-7 Mode 2

Value	Description
1	Fix not available
2	2D
3	3D

- • GSV---GNSS Satellites in View
- Table 5-8 contains the values for the following example:
- $GPGSV,3,1,12,28,81,285,42,24,67,302,

46,31,54,354,,20,51,077,46*73

$GPGSV,3,2,12,17,41,328,45,07,32,315,

45,04,31,250,40,11,25,046,41*75

- $GPGSV,3,3,12,08,22,214,38,27,0

8,190,16,19,05,092,33,23,04,127,*7B Table 5-8 GSV Data Format

Name	Example	Units	Description
Message ID	$GPGSV		GSV protocol header
Total number of	3		Range 1 to 3
Message number[1]	1		Range 1 to 3
Satellites in view	12		
Satellite ID	28		Channel 1 (Range 01 to 32)
Elevation	81	degrees	Channel 1 (Range 00 to 90)
Azimuth	285	degrees	Channel 1 (Range 000 to 359)
SNR (C/No)	42	dB-Hz	Channel 1 (Range 00 to 99, null when not
Satellite ID	20		Channel 4 (Range 01 to 32)
Elevation	51	degrees	Channel 4 (Range 00 to 90)
Azimuth	077	degrees	Channel 4 (Range 000 to 359)
SNR (C/No)	46	dB-Hz	Channel 4 (Range 00 to 99, null when not
Checksum	*73		

<CR> <LF>			End of message termination

- 1. Depending on the number of satellites tracked multiple messages of GSV data may be required.
- • RMC---Recommended Minimum Specific GNSS Data
- Table 5-9 contains the values for the following example: $GPRMC,053740.000,A,2503.6319,N,1213

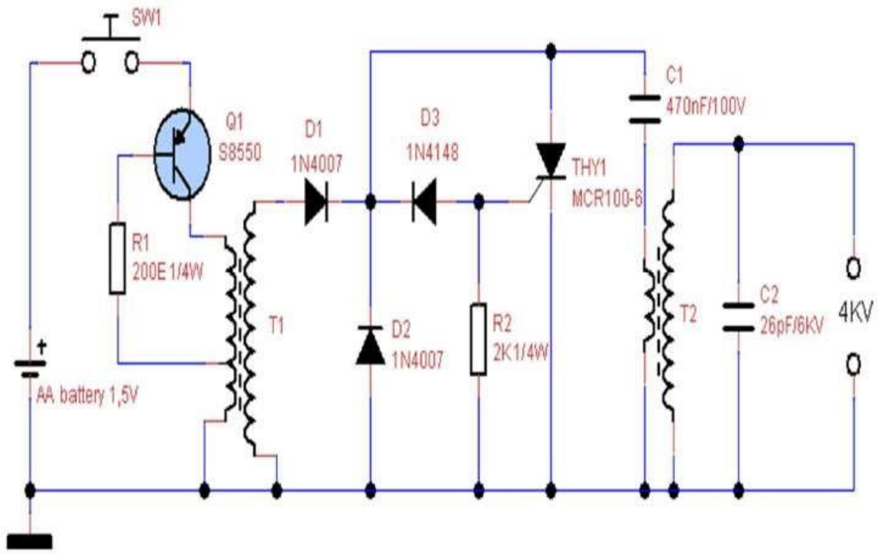
6.0099,E,2.69,79.65,100106,,,A*53 Table

5-9 RMC Data Format

Name	Example	Units	Description
Message ID	$GPRMC		RMC protocol header
UTC Time	053740.000		hhmmss.sss
Status	A		A=data valid or V=data not valid
Latitude	2503.6319		ddmm.mmmm
N/S Indicator	N		N=north or S=south
Longitude	12136.0099		dddmm.mmmm
E/W Indicator	E		E=east or W=west
Speed over ground	2.69	knots	True
Course over ground	79.65	degrees	
Date	100106		Ddmmyy
Magnetic variation		degrees	Not shown
Variation sense			E=east or W=west (Not shown)
Mode	A		A=autonomous, D=DGPS, E=DR
Checksum	*53		
<CR> <LF>			End of message termination

6.6 PROPOSED METHODOLOGY

The proposed smart glove is designed for safety purpose and its design is based on electric shock technology. Smart glove is an electroshock weapon. It delivers an electric shock aimed at temporarily disrupting muscle functions and inflicting pain without causing significant injury [2]. Electric shock glove uses a temporary high-voltage, low-current electrical discharge to override the muscle-triggering mechanisms [3]. The recipient is immobilized via two metal probes connected to the electric shock device. The recipient feels pain, and can be momentarily paralyzed while an electric current is being applied to him/her [4]. Smart glove is an excellent, safe device that can be used in situations where an immediate safety situation requires quick action in order to neutralize an attacker. This device is perfect for such a situation [5]. In electric shock device circuit, the concept of mosquito bat is used [1]. The circuit diagram for the proposed smart glove is shown in fig.1.



Electric shock device is fixed into the glove. Whenever the push button is triggered the shock generated on to the tip of the glove. In electric shock device, circuit the concept of mosquito bat is used [1]. The internal circuits of electric shock device includes an oscillator, resonant circuit (a power inverter), and step-up transformer to achieve an alternating high-voltage discharge. It may be powered by one or more batteries. The output current upon contact with the target will depend on various factors such as target's resistance, skin type, moisture, bodily salinity, clothing, the electric shock weapon's internal circuitry, discharge waveform, and battery conditions [11-12]. Electric shock device which is placed in the glove Is shown in fig.2. The remaining circuit is placed in a box. If someone will try to harass the user, the user will trigger the push button switch. As soon as the button is pressed, it forms a path and a shock is generated at the tip of the glove.

6.7 SOFTWARE DESCRIPTION

The Arduino Nano is a small, complete, and breadboard-friendly board based on the ATmega328P. It offers the same connectivity and specs of the UNO board in a smaller form factor.

The Arduino Nano is programmed using the Arduino Software (IDE), our Integrated Development Environment common to all our boards

Use your Arduino Nano on the Arduino Desktop IDE

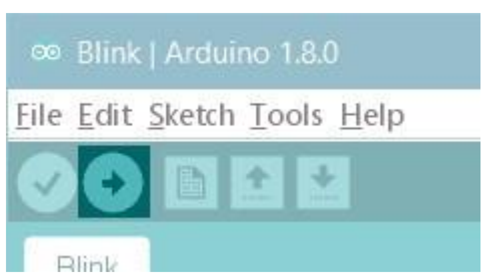
If you want to program your Arduino Nano while offline you need to install the Arduino Desktop IDE To connect the Arduino Nano to your computer, you'll need a Mini-B USB cable. This also provides power to the board, as indicated by the blue LED (which is on the bottom of the Arduino Nano 2.x and the top of the Arduino Nano 3.0).

6.7.1 Select your board type and port

Select Tools > Board > Arduino AVR Boards > Arduino Nano.

6.7.2 Upload and Run your first Sketch

To upload the sketch to the Arduino Nano, click the Upload button in the upper left to load and run the sketch on your board:



Wait a few seconds - you should see the RX and TX LEDs on the board flashing. If the upload is successful, the message "Done uploading." will appear in the status bar

CONCLUSION

1.A smart glove as a weapon is designed successfully for the protection of women from attackers. This smart glove is compact, light in weight and can easily be carried. The components used in this project are easily available and very economical.

2.This smart glove gives the shock to the attackers without killing them. The intensity of the shock is up to 4KV.

3.In future improvement can be done like, the development of waterproof system, fabrication of GSM technology in the glove and use of GPS tracking system into glove.

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