A Major Project report

On

RAILWAY TRACK SECURITY SYSTEM

A dissertation Submitted in partial fulfillment of the

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In

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by

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2016-2020

CERTIFICATE

This is to certify that the **MINI PROJECT** work entitled "**RAILWAY TRACK SECURITY SYSTEM**" is carried out by **K. MANIKANTH (16N31A04C1), M. VISHAL(16N31A04D2)**,**P.L. DHAMAN (16N31A04G7)** in partial fulfillment for the award of degree of ***BACHELOR OF TECHNOLOGY*** in Electronics and communication Engineering, Jawaharlal Nehru Technological University ,Hyderabad during the academic year 2019-2020.

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ACKNOWLEDGEMENT

We feel ourselves honored and privileged to place our warm salutation to our college Malla Reddy College of Engineering and Technology (UGC-Autonomous) and our principal **Dr. V.S.K. Reddy** who gave us the opportunity to have experience in engineering and profound technical knowledge.

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We take this opportunity to thank my parents & faculty of MRCET who have been of great moral help finishing the project. Last but not least we would like to thank all those who helped me directly or indirectly in completing my work.

DECLARATION

We hereby declare that the project titled "RAILWAY TRACK SECURITY SYSTEM" submitted to Malla Reddy College of Engineering and Technology (UGC Autonomous), affiliated to Jawaharlal Nehru Technological University Hyderabad (JNTUH) for the award of the degree of Bachelor of Technology in Electronics & Communication Engineering is a result of original research carried-out in this thesis. It is further declared that the project report or any part thereof has not been previously submitted to any University or Institute for the award of degree or diploma.

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ABSTRACT

In India, Railway is the backbone of transport system. Rail accidents occur commonly due to derailments due to cracked tracks than collision or fire in trains. Therefore, there is an immense need to improve crack detection and security system in the Indian Railway. This project is a means to provide a solution for problem of crack detection in the rail tracks. This is to avoid rail accidents by using latest communication technologies. In this paper GSM communication protocols are used to convey the message of crack detection via SMS. proposed GSM (Global System for Mobile communications) communication protocols which can be used to convey the message of crack detection via SMS. Crack detection is achieved by using the concept of eddy current losses implemented in the terms of Darlington pair circuit. With the detection of cracks, the system also alerts the railway authorities facilitating the security system. Crack detection is achieved by using IR sensors attached to a vehicle that moves along the rails. With the detection of cracks, the system also alerts the railway authorities facilitating the security system. There is a view that the current regulatory framework does not provide full set of tools to effectively deal with railway accidents and main-track derailments. It is imperative that the current framework be modernized and better aligned with safety legislation that applies to other modes of transport in India.

In recent years, with the development of railways, capability of the trains is constantly improving. Train traffic is too high and manual labor is unreliable.Long range ultrasonic techniques along with radiography technique are the methods used for crack detection. Wireless sensor network method and electromagnetic system are also used in detecting rail cracks. Transducers are arranged in a suitable array such that selected guided wave modes are generated in rails which allow a reliable long range inspection of the rail.

CHAPTER 1

INTRODUCTION

1.1 Introduction:

India has fourth largest rail network in the world comprising 115,000 km of railway tracks. Approximately, 60 percent of rail accidents are due to derailments, of which, 90 percent are due to cracks problems. In December 2006, the Railway Safety Act Review was promoted by the government as an effort to further improve railway safety in India. This would help promote a safety culture within the railway industry and will at the same time manage to preserve and strengthen the vital role that railway industry plays in the Indian economy. In all transport systems, particularly in case of railways, safety and reliability are highly considered. There is a view that the current regulatory framework does not provide full set of tools to effectively deal with railway accidents and main-track derailments. It is imperative that the current framework be modernized and better aligned with safety legislation that applies to other modes of transport in India. In recent years, with the development of railways, capability of the trains is constantly improving. Train traffic is too high and manual labor is unreliable. Thishas initiated the cause for an automated system to monitorthe presence of crack on the railway lines. The existingsystem includes theconcept using LED (light emitting diode)and LDR (light dependent resistor) sensor assembly. Themain drawback of the system is that LED and LDR should beexactly aligned opposite toeach other to detect the crackalso the true values from LDR to be detected. This paperseeks to develop a device that will be an efficient and cost-effective solution the problemof derailment of trains due tocracks by early detection of these cracks.8051 microcontroller is a low cost, low-power, high-performance, most compatible 8-bit microcontroller. It is a 40 pin IC. It has 8K bytes of flash, 256 bytes of Random-Access Memory (RAM), 32 I/O lines, watchdog timer, two data pointers, three 16-bit timer/counters, a six-vector two-level interrupt architecture, a full duplex serial port, on chip oscillator, and clock circuitry. The MAX232 is an integrated circuit that converts signals from an RS-232 serial port to signals suitable for use in TTL compatible digital logic circuits, so that devices working on TTL logic can share the data with devices connected through serial port (DB9 Connector).

1.2 Block Diagram:

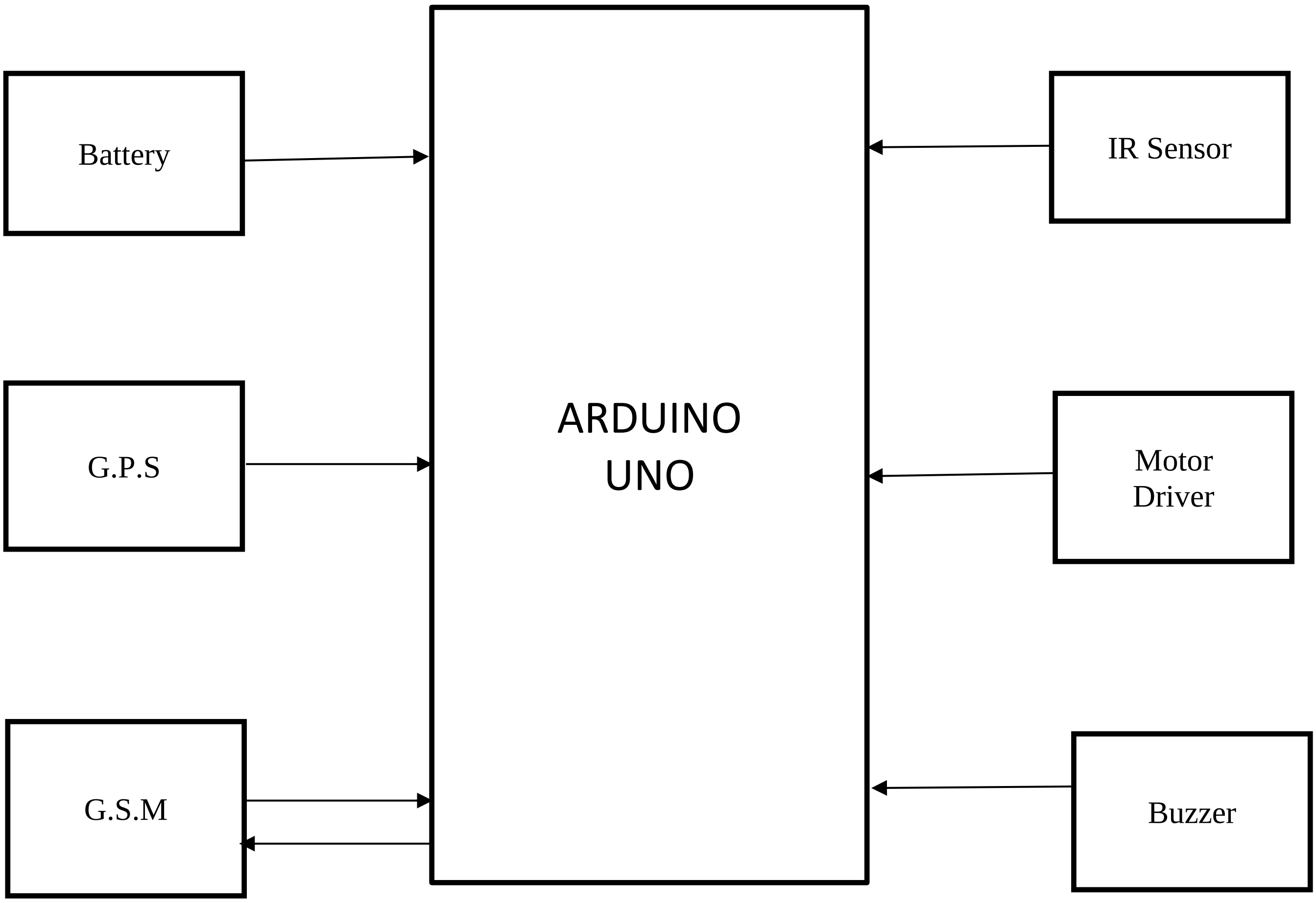

FIG 1.1 Block Diagram of Railway Track Security System

Fig.1.1 shows the implemented small-scale model ofrailway tracks. The scaling modelformed to demonstratethis project has two rails forming part of track. The railtracks are connectedwith a detachable jumper (encircled)in between each track. Presence of jumper in the linkrepresents the ideal case i.e. the railway track without thecrack/flaw.microcontroller which thereafter sendsan SMS through GSM modem and the status of trackcondition is displayed.

1.3 Circuit Diagram:

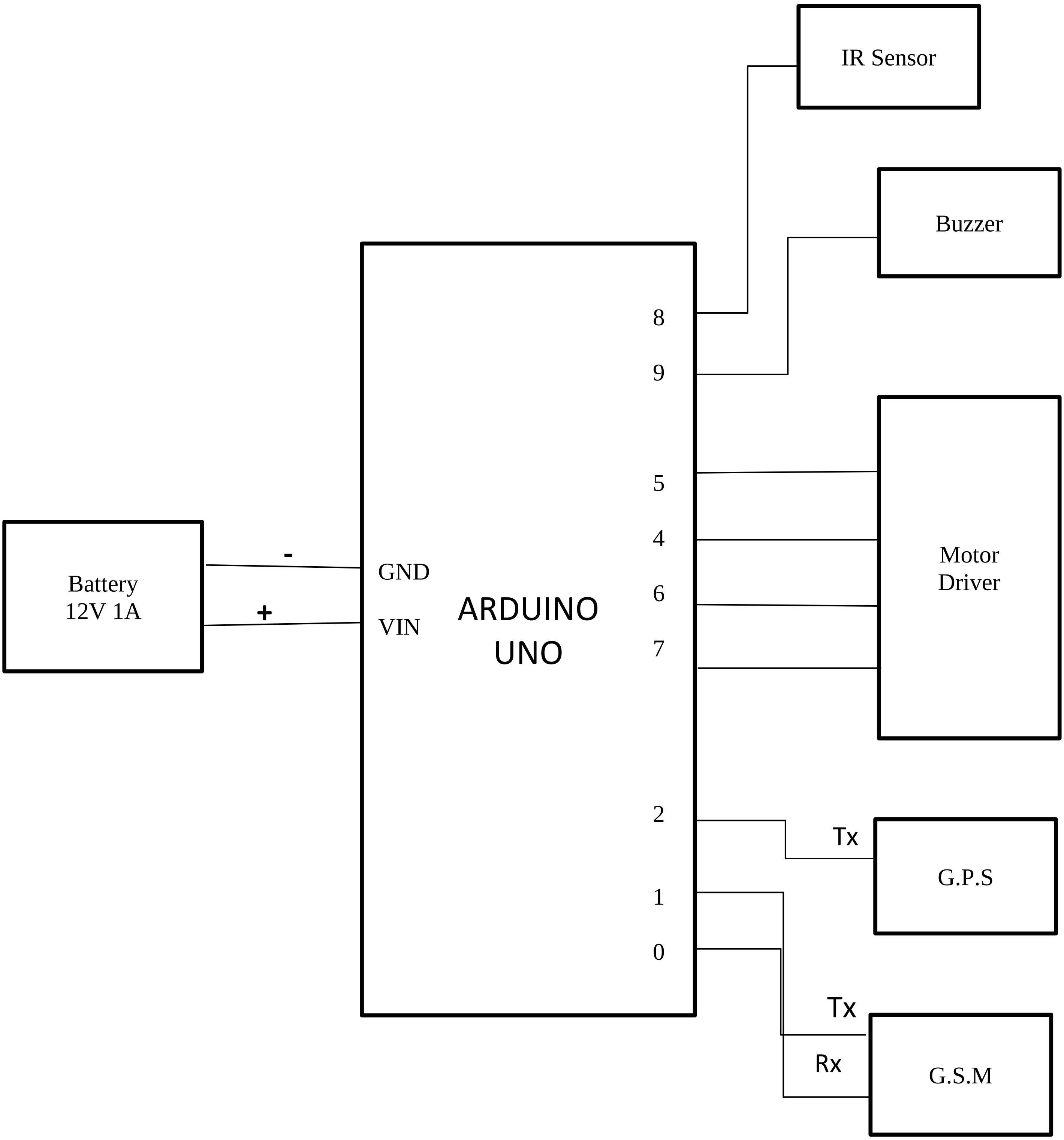

FIG 1.2 Circuit Diagram Of Railway Track Security System

CHAPTER 2

EMBEDDED SYSTEMS

2.1 Embedded Systems

An embedded system is a special-purpose computer system designed to perform one or a few dedicated functions, sometimes with real-time computing constraints. It is usually embedded as part of a complete device including hardware and mechanical parts. In contrast, a general-purpose computer, such as a personal computer, can do many different tasks depending on programming. Embedded systems have become very important today as they control many of the common devices we use.

Since the embedded system is dedicated to specific tasks, design engineers can optimize it, reducing the size and cost of the product, or increasing the reliability and performance. Some embedded systems are mass-produced, benefiting from economies of scale.

Physically, embedded systems range from portable devices such as digital watches and MP3 players, to large stationary installations like traffic lights, factory controllers, or the systems controlling nuclear power plants. Complexity varies from low, with a single microcontroller chip, to very high with multiple units, peripherals and networks mounted inside a large chassis or enclosure.

In general, "embedded system" is not an exactly defined term, as many systems have some element of programmability. For example, Handheld computers share some elements with embedded systems — such as the operating systems and microprocessors which power them — but are not truly embedded systems, because they allow different applications to be loaded and peripherals to be connected.

An embedded system is some combination of computer hardware and software, either fixed in capability or programmable, that is specifically designed for a kind of application device. Industrial machines, automobiles, medical equipment, cameras, household appliances, airplanes, vending machines, and toys (as well as the more obvious cellular phone and PDA) are among the myriad possible hosts of an embedded system. Embedded systems that are programmable are provided with a programming interface, and embedded systems programming is a specialized occupation.

Certain operating systems or language platforms are tailored for the embedded market, such as Embedded Java and Windows XP Embedded. However, some low-end consumer products use very inexpensive microprocessors and limited storage, with the application and operating system both part of a single program. The program is written permanently into the system's memory in this case, rather than being loaded into RAM (random access memory), as programs on a personal computer are.

2.2 Need for Embedded Systems

The uses of embedded systems are virtually limitless, because every day new products are introduced to the market that utilizes embedded computers in novel ways. In recent years, hardware such as microprocessors, microcontrollers, and FPGA chips have become much cheaper. So, when implementing a new form of control, it's wiser to just buy the generic chip and write your own custom software for it. Producing a custom-made chip to handle a task or set of tasks costs far more time and money. Many embedded computers even come with extensive libraries, so that "writing your own software" becomes a very trivial task indeed. From an implementation viewpoint, there is a major difference between a computer and an embedded system. Embedded systems are often required to provide Real-Time response. The main elements that make embedded systems unique are its reliability and ease in debugging.

2.2.1 Debugging

Embedded debugging may be performed at different levels, depending on the facilities available. From simplest to most sophisticate they can be roughly grouped into the following areas:

- Interactive resident debugging, using the simple shell provided by the embedded operating system (e.g. Forth and Basic)
- External debugging using logging or serial port output to trace operation using either a monitor in flash or using a debug server like the Remedy Debugger which even works for heterogeneous multi core systems.
- An in-circuit debugger (ICD), a hardware device that connects to the microprocessor via a JTAG or Nexus interface. This allows the operation of the microprocessor to be

controlled externally, but is typically restricted to specific debugging capabilities in the processor.

- An in-circuit emulator replaces the microprocessor with a simulated equivalent, providing full control over all aspects of the microprocessor.
- A complete emulator provides a simulation of all aspects of the hardware, allowing all of it to be controlled and modified and allowing debugging on a normal PC.
- Unless restricted to external debugging, the programmer can typically load and run software through the tools, view the code running in the processor, and start or stop its operation. The view of the code may be as assembly code or source-code.

Because an embedded system is often composed of a wide variety of elements, the debugging strategy may vary. For instance, debugging a software (and microprocessor) centric embedded system is different from debugging an embedded system where most of the processing is performed by peripherals (DSP, FPGA, co-processor). An increasing number of embedded systems today use more than one single processor core. A common problem with multi-core development is the proper synchronization of software execution. In such a case, the embedded system design may wish to check the data traffic on the busses between the processor cores, which requires very low-level debugging, at signal/bus level, with a logic analyzer, for instance.

2.2.2 Reliability

Embedded systems often reside in machines that are expected to run continuously for years without errors and in some cases recover by them if an error occurs. Therefore the software is usually developed and tested more carefully than that for personal computers, and unreliable mechanical moving parts such as disk drives, switches or buttons are avoided. Specific reliability issues may include:

- The system cannot safely be shut down for repair, or it is too inaccessible to repair. Examples include space systems, undersea cables, navigational beacons, bore-hole systems, and automobiles.
- The system must be kept running for safety reasons. "Limp modes" are less tolerable. Often backup s are selected by an operator. Examples include aircraft navigation,

reactor control systems, safety-critical chemical factory controls, train signals, engines on single-engine aircraft.

- The system will lose large amounts of money when shut down: Telephone switches, factory controls, bridge and elevator controls, funds transfer and market making, automated sales and service.

A variety of techniques are used, sometimes in combination, to recover from errors both software bugs such as memory leaks, and also soft errors in the hardware:

- Watchdog timer that resets the computer unless the software periodically notifies the watchdog
- Subsystems with redundant spares that can be switched over to
- software "limp modes" that provide partial function
- Designing with a Trusted Computing Base (TCB) architecture[6] ensures a highly secure & reliable system environment
- An Embedded Hypervisor is able to provide secure encapsulation for any subsystem component, so that a compromised software component cannot interfere with other subsystems, or privileged-level system software. This encapsulation keeps faults from propagating from one subsystem to another, improving reliability. This may also allow a subsystem to be automatically shut down and restarted on fault detection.
- Immunity Aware Programming.

2.3 Applications of embedded system:

We are living in the Embedded World. You are surrounded with many embedded products and your daily life largely depends on the proper functioning of these gadgets. Television, Radio, CD player of your living room, Washing Machine or Microwave Oven in your kitchen, Card readers, Access Controllers, Palm devices of your work space enable you to do many of your tasks very effectively. Apart from all these, many controllers embedded in your car take care of car operations between the bumpers and most of the times you tend to ignore all these controllers.

In recent days, you are showered with variety of information about these embedded controllers in many places. All kinds of magazines and journals regularly dish out details about latest technologies, new devices; fast applications which make you believe that your basic survival is controlled by these embedded products. Now you can agree to the fact that these embedded products have successfully invaded into our world. You must be wondering about these embedded controllers or systems. What is this Embedded System?

The computer you use to compose your mails, or create a document or analyze the database is known as the standard desktop computer. These desktop computers are manufactured to serve many purposes and applications.

You need to install the relevant software to get the required processing facility. So, these desktop computers can do many things. In contrast, embedded controllers carryout a specific work for which they are designed. Most of the time, engineers design these embedded controllers with a specific goal in mind. So these controllers cannot be used in any other place.

Theoretically, an embedded controller is a combination of a piece of microprocessor based hardware and the suitable software to undertake a specific task.

These days designers have many choices in microprocessors/microcontrollers. Especially, in 8 bit and 32 bit, the available variety really may overwhelm even an experienced designer. Selecting a right microprocessor may turn out as a most difficult first step and it is getting complicated as new devices continue to pop-up very often.

In the 8 bit segment, the most popular and used architecture is Intel's 8031. Market acceptance of this particular family has driven many semiconductor manufacturers to develop something new based on this particular architecture. Even after 25 years of existence, semiconductor manufacturers still come out with some kind of device using this 8031 core.

2.3.1 Military and aerospace software applications:

From in-orbit embedded systems to jumbo jets to vital battlefield networks, designers of mission-critical aerospace and defense systems requiring real-time performance, scalability, and high-availability facilities consistently turn to the LynxOS® RTOS and the LynxOS-178 RTOS for software certification to DO-178B.Rich in system resources and networking services, LynxOS provides an off-the-shelf software platform with hard real-time response backed by powerful distributed computing (CORBA), high reliability, software certification, and long-term support optionsThe LynxOS-178 RTOS for software certification, based on the RTCA DO-178B standard, assists developers in gaining certification for their mission- and safety-critical systems. Real-time systems programmers get a boost with LynuxWorks' DO-178B RTOS training courses.

2.3.2 Communications applications:

"Five-nine" availability, CompactPCI hot swap support, and hard real-time response—LynxOS delivers on these key requirements and more for today's carrier-class systems. Scalable kernel configurations, distributed computing capabilities, integrated communications stacks, and fault-management facilities make LynxOS the ideal choice for companies looking for a single operating system for all embedded telecommunications applications—from complex central controllers to simple line/trunk cards.

LynuxWorks Jumpstart for Communications package enables OEMs to rapidly develop mission-critical communications equipment, with pre-integrated, state-of-the-art, data networking and porting software components—including source code for easy customization.

The Lynx Certifiable Stack (LCS) is a secure TCP/IP protocol stack designed especially for applications where standards certification is required.

2.3.3 Electronics applications and consumer devices:

As the number of powerful embedded processors in consumer devices continues to rise, the BlueCat® Linux® operating system provides a highly reliable and royalty-free option for systems designers.

And as the wireless appliance revolution rolls on, web-enabled navigation systems, radios, personal communication devices, phones and PDAs all benefit from the cost-effective dependability, proven stability and full product life-cycle support opportunities associated with BlueCat embedded Linux. BlueCat has teamed up with industry leaders to make it easier to build Linux mobile phones with Java integration.

For makers of low-cost consumer electronic devices who wish to integrate the LynxOS real-time operating system into their products, we offer special MSRP-based pricing to reduce royalty fees to a negligible portion of the device's MSRP.

2.3.4 Industrial automation and process control software:

Designers of industrial and process control systems know from experience that LynuxWorks operating systems provide the security and reliability that their industrial applications require.

From ISO 9001 certification to fault-tolerance, POSIX conformance, secure partitioning and high availability, we've got it all. Take advantage of our 20 years of experience.

2.4 Microcontroller versus microprocessor:

What is the difference between a Microprocessor and Microcontroller? By microprocessor is meant the general-purpose Microprocessors such as Intel's X86 family (8086, 80286, 80386, 80486, and the Pentium) or Motorola's 680X0 family (68000, 68010, 68020, 68030, 68040, etc.). These microprocessors contain no RAM, no ROM, and no I/O ports on the chip itself. For this reason, they are commonly referred to as general-purpose Microprocessors.

A system designer using a general-purpose microprocessor such as the Pentium or the 68040 must add RAM, ROM, I/O ports, and timers externally to make them functional. Although the addition of external RAM, ROM, and I/O ports makes these systems bulkier and much more expensive, they have the advantage of versatility such that the designer can decide on the amount of RAM, ROM and I/O ports needed to fit the task at hand. And as the wireless appliance revolution rolls on, web-enabled navigation systems, radios, personal communication devices, phones and PDAs all benefit from the cost-effective dependability, proven stability and full product life-cycle support opportunities associated with BlueCat embedded Linux. Blue Cat has teamed up with industry leaders to make it easier to build Linux mobile phones with Java integration. This is not the case with Microcontrollers. the LynxOS real-time operating system into their products, we offer special MSRP-based pricing to reduce royalty fees to a negligible portion of the device's MSRP.

A Microcontroller has a CPU (a microprocessor) in addition to a fixed amount of RAM, ROM, I/O ports, and a timer all on a single chip. In other words, the processor, the RAM, ROM, I/O ports and the timer are all embedded together on one chip; therefore, the designer

CHAPTER 3

Introduction to the Arduino Board

The Arduino is a family of microcontroller boards to simplify electronic design, prototyping and experimenting for artists, hackers, hobbyists, but also many professionals. People use it as brains for their robots, to build new digital music instruments, or to build a system that lets your house plants tweet you when they're dry. Arduinos (we use the standard Arduino Uno) are built around an ATmegamicrocontrolleressentially a complete computer with CPU, RAM, Flash memory, and input/output pins, all on a single chip. Unlike, say, a Raspberry Pi, it's designed to attach all kinds of sensors, LEDs, small motors and speakers, servos, etc. directly to these pins, which can read in or output digital or analog voltages between 0 and 5 volts. The Arduino connects to your computer via USB, where you program it in a simple language (C/C++, similar to Java) from inside the free Arduino IDE by uploading your compiled code to the board. Once programmed, the Arduino can run with the USB link back to your computer, or stand-alone without it — no keyboard or screen needed, just power.

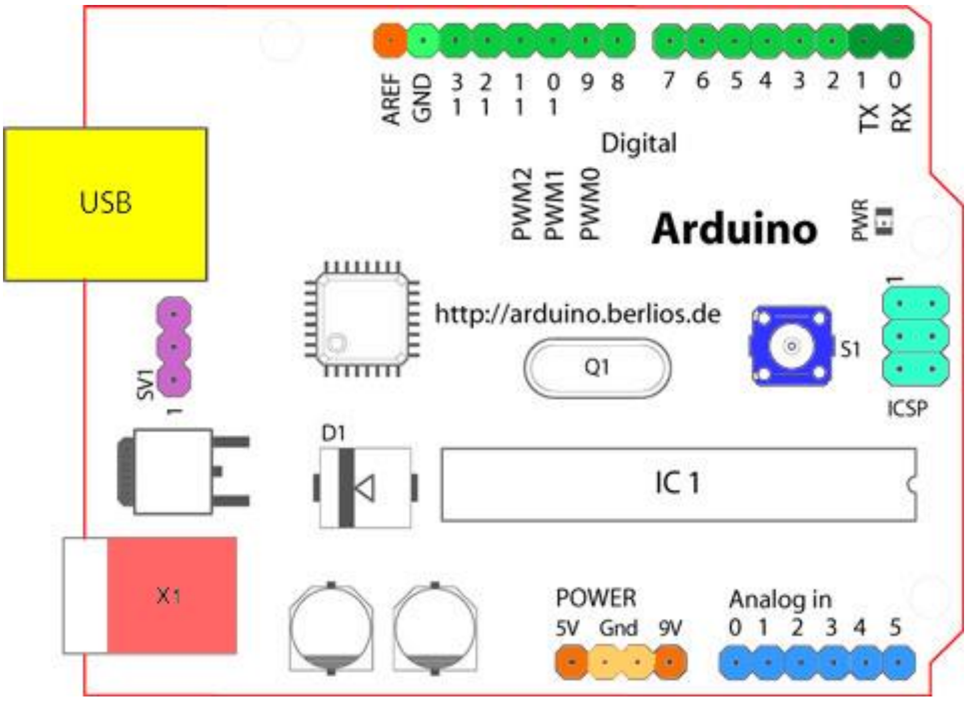

Figure 3.1 Structure of Arduino Board

Looking at the board from the top down, this is an outline of what you will see (parts of the board you might interact with in the course of normal use are highlighted)

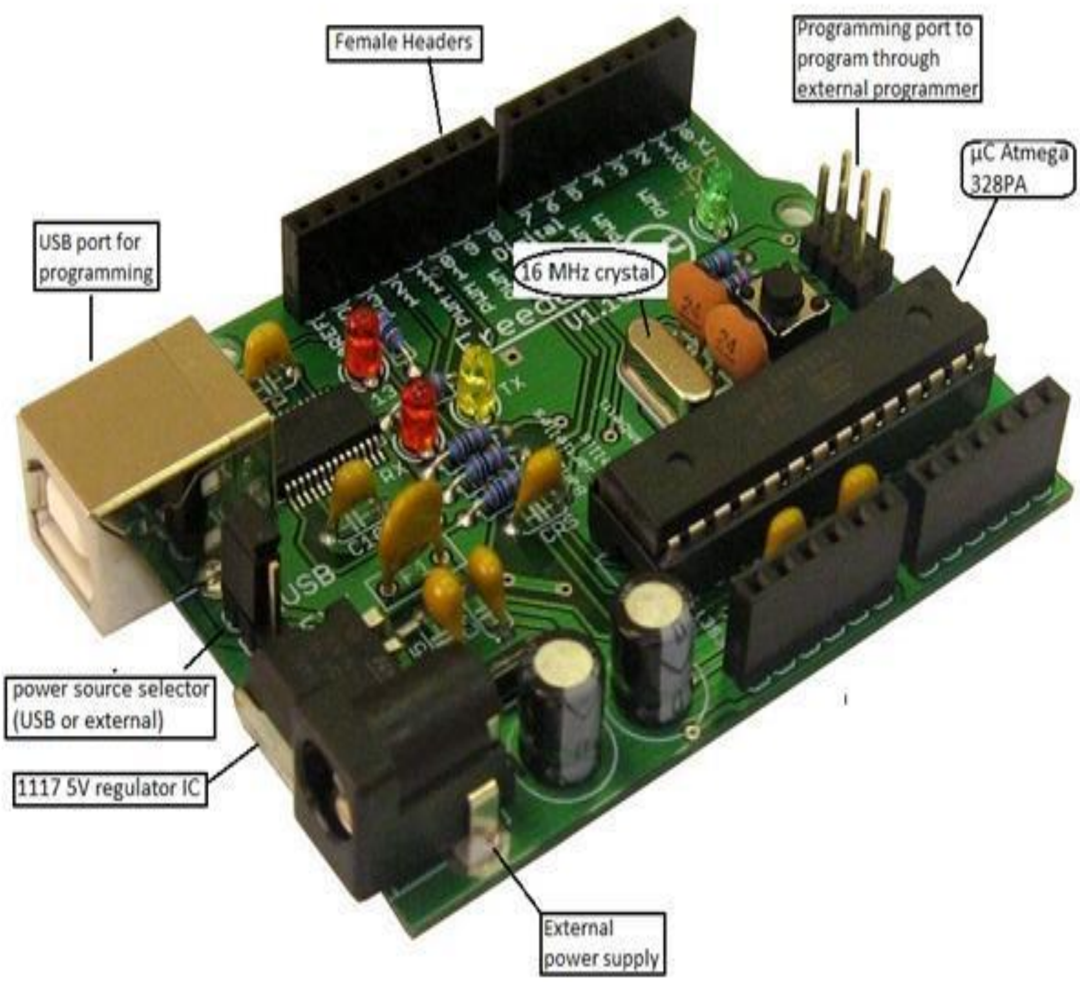

Figure 3.2 Arduino Board

Starting clockwise from the top center:

- Analog Reference pin (orange)
- Digital Ground (light green)
- Digital Pins 2-13 (green)
- Digital Pins 0-1/Serial In/Out - TX/RX (dark green) - These pins cannot be used for digital i/o (Digital Read and Digital Write) if you are also using serial communication (e.g. Serial. Begin).
- Reset Button - S1 (dark blue)
- In-circuit Serial Programmer (blue-green)
- Analog in Pins 0-5 (light blue)

- Power and Ground Pins (power: orange, grounds: light orange)
- External Power Supply In (9-12VDC) - X1 (pink)
- Toggles External Power and USB Power (place jumper on two pins closest to desired supply) - SV1 (purple)
- USB (used for uploading sketches to the board and for serial communication between the board and the computer; can be used to power the board) (yellow

3.1 Pins

3.1.1 Digital Pins :

In addition to the specific functions listed below, the digital pins on an Arduino board can be used for general purpose input and output via the pin Mode(), Digital Read(), and Digital Write() commands. Each pin has an internal pull-up resistor which can be turned on and off using digital Write() (w/ a value of HIGH or LOW, respectively) when the pin is configured as an input. The maximum current per pin is 40mA.

- **Serial: 0 (RX) and 1 (TX).** Used to receive (RX) and transmit (TX) TTL serial data. On the Arduino Diecimila, these pins are connected to the corresponding pins of the FTDI USB-to-TTL Serial chip. On the Arduino BT, they are connected to the corresponding pins of the WT11Bluetooth module. On the Arduino Mini and LilyPad Arduino, they are intended for use with an external TTL serial module (e.g. the Mini-USB Adapter).
- **External Interrupts: 2 and 3.** These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value. See the attach Interrupt()function for details.
- **PWM: 3, 5, 6, 9, 10, and 11** Provide 8-bit PWM output with the analog Write()function. On boards with an ATmega8, PWM output is available only on pins 9, 10, and 11.
- **BT Reset: 7.** (Arduino BT-only) Connected to the reset line of the Bluetooth module.
- **SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK).** These pins support SPI communication, which, although provided by the underlying hardware, is not currently included in the Arduino language.
- **LED: 13.** On the Diecimila and LilyPad, there is a built-in LED connected to digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.

3.1.2 Analog Pins :

In addition to the specific functions listed below, the analog input pins support 10-bit analog-to-digital conversion (ADC) using the analog Read() function. Most of the analog inputs can also be used as digital pins: analog input 0 as digital pin 14 through analog input 5 as digital pin 19. Analog inputs 6 and 7 (present on the Mini and BT) cannot be used as digital pins.

- **I^2C: 4 (SDA) and 5 (SCL).** Support I^2C (TWI) communication using the Wire library (documentation on the Wiring website).

A system designer using a general-purpose microprocessor such as the Pentium or the 68040 must add RAM, ROM, I/O ports, and timers externally to make them functional. Although the addition of external RAM, ROM, and I/O ports makes these systems bulkier and much more expensive, they have the advantage of versatility such that the designer can decide on the amount of RAM, ROM and I/O ports needed to fit the task at hand. This is not the case with Microcontrollers.

3.1.3 Power Pins :

- **VIN** (sometimes labeled "9V"): 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. Also note that the Lily Pad has no VIN pin and accepts only a regulated input.
- **5V:** The regulated power supply used to power the microcontroller and other components on the board. This can come either from VIN via an on-board regulator, or be supplied by USB or another regulated 5V supply.
- **3V3** (Diecimila-only): A 3.3-volt supply generated by the on-board FTDI chip.
- **GND:** Ground pins.
- **AREF:** Reference voltage for the analog inputs. Used with analog Reference().
- **Reset:** (Diecimila-only) Bring this line LOW to reset the microcontroller. Typically used to add a reset button to shields which block the one on the board.

CHAPTER 4

Description of Hardware Components

4.1 IR- SENSORS :

Infrared is an energy radiation with a frequency below our eye's sensitivity, so we cannot see it Even that we cannot "see" sound frequencies, we know that it exists, we can listen them.

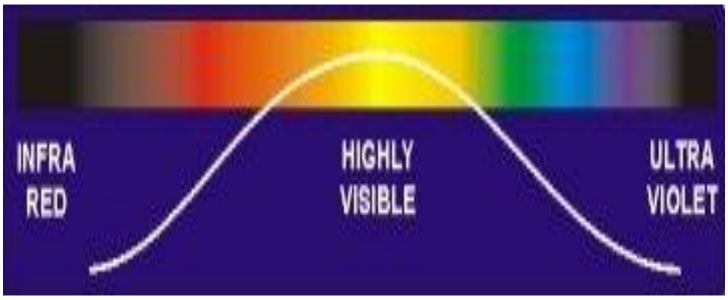

Figure 4.1 Spectrum

Even that we cannot see or hear infrared, we can feel it at our skin temperature sensors. When you approach your hand to fire or warm element, you will "feel" the heat, but you can't see it. You can see the fire because it emits other types of radiation, visible to your eyes, but it also emits lots of infrared that you can only feel in your skin.

INFRARED IN ELECTRONICS

Infra-Red is interesting, because it is easily generated and doesn't suffer electromagnetic interference, so it is nicely used to communication and control, but it is not perfect, some other light emissions could contain infrared as well, and that can interfere in this communication. The sun is an example, since it emits a wide spectrum or radiation.

The adventure of using lots of infra-red in TV/VCR remote controls and other applications, brought infra-red diodes (emitter and receivers) at very low cost at the market.

From now on you should think as infrared as just a "red" light. This light can mean something to the receiver, the "on or off" radiation can transmit different meanings.Lots of things can generate infrared, anything that radiate heat do it, including out body, lamps, stove, oven, friction your hands together, even the hot water at the faucet.

To allow a good communication using infra-red, and avoid those "fake" signals, it is imperative to use a "key" that can tell the receiver what is the real data transmitted and what is fake. As an analogy, looking eye naked to the night sky you can see hundreds of stars, but you can spot easily a faraway airplane just by its flashing strobe light. That strobe light is the "key", the "coding" element that alerts us.

Similar to the airplane at the night sky, our TV room may have hundreds of tinny IR sources, our body and the lamps around, even the hot cup of tea. A way to avoid all those other sources, is generating a key, like the flashing airplane. So, remote controls use to pulsate its infrared in a certain frequency. The IR receiver module at the TV, VCR or stereo "tunes" to this certain frequency and ignores all other IR received. The best frequency for the job is between 30 and 60 KHz, the most used is around 36 KHz

IR GENERATION

To generate a 36 KHz pulsating infrared is quite easy, more difficult is to receive and identify this frequency. This is why some companies produce infrared receives, that contains the filters, decoding circuits and the output shaper, that delivers a square wave, meaning the existence or not of the 36kHz incoming pulsating infrared.

It means that those 3 dollars small units, have an output pin that goes high (+5V) when there is a pulsating 36kHz infrared in front of it, and zero volts when there is not this radiation.

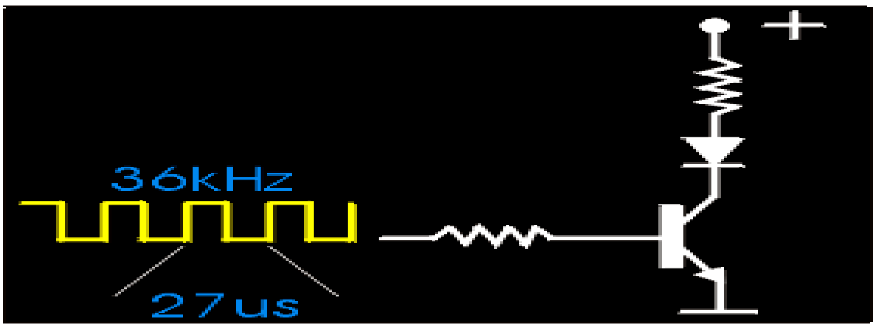

Figure 4.2:IR Generator

A square wave of approximately 27uS (microseconds) injected at the base of a transistor, can drive an infrared LED to transmit this pulsating light wave. Upon its presence, the commercial receiver will switch its output to high level (+5V).If you can turn on and off this frequency at the transmitter, your receiver's output will indicate when the transmitter is on or off.

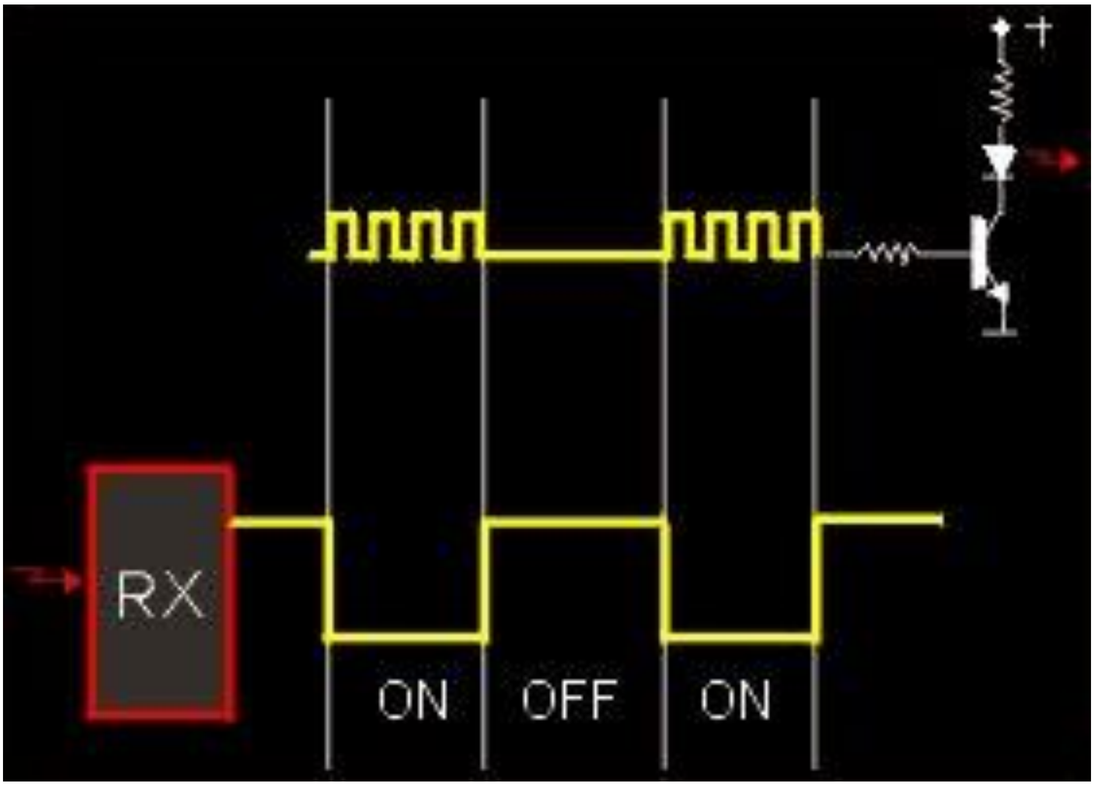

Figure 4.3 IR Demodulator

Those IR demodulators have inverted logic at its output, when a burst of IR is sensed it drives its output to low level, meaning logic level = 1.

The TV, VCR, and Audio equipment manufacturers for long use infra-red at their remote controls. To avoid a Philips remote control to change channels in a Panasonic TV, they use different codification at the infrared, even that all of them use basically the same transmitted frequency, from 36 to 50 KHz. So, all of them use a different combination of bits or how to code the transmitted data to avoid interference.

RC-5

Various remote-control systems are used in electronic equipment today. The RC5 control protocol is one of the most popular and is widely used to control numerous home appliances, entertainment systems and some industrial applications including utility consumption remote meter reading, contact-less apparatus control, telemetry data transmission, and car security systems. Philips originally invented this protocol and virtually all Philips' remotes use this protocol. Following is a description of the RC5. When the user pushes a button on the hand-held remote, the device is activated and sends modulated infrared light to transmit the command. The remote separates command data into packets. Each data packet consists of a 14-bit data word, which is repeated if the user continues to push the remote button. The data packet structure is as follows:

- 2 start bits,
- 1 control bit,
- 5 address bits,
- 6 command bits.

The start bits are always logic '1' and intended to calibrate the optical receiver automatic gain control loop. Next, is the control bit. This bit is inverted each time the user releases the remote button and is intended to differentiate situations when the user continues to hold the same button or presses it again. The next 5 bits are the address bits and select the destination device. A number of devices can use RC5 at the same time. To exclude possible interference, each must use a different address. The 6 command bits describe the actual command. As a result, a RC5 transmitter can send the 2048 unique commands. The transmitter shifts the data word, applies Manchester encoding and passes the created one-bit sequence to a control carrier frequency signal amplitude modulator. The amplitude modulated carrier signal is sent to the optical transmitter, which radiates the infrared light. In RC5 systems the carrier frequency has been set to 36 kHz. Figure below displays the RC5 protocol.

The receiver performs the reverse function. The photo detector converts optical transmission into electric signals, filters it and executes amplitude demodulation. The receiver output bit stream can be used to decode the RC5 data word. This operation is done by the microprocessor typically, but complete hardware implementations are present on the market as well. Single-die optical receivers are being mass produced by a number of companies such as Siemens, Temic, Sharp, Xiamen Hualian, Japanese Electric and others. Please note that the receiver output is inverted (log. 1 corresponds to illumination absence).

4.2 Micro Controller (ATmega328p):

ATmega328 is a complex microcontroller with more peripheral units than can be supported within the 64 locations reserved in the Opcode for the IN and OUT instructions. For the Extended I/O space from 0x60 - 0xFF in SRAM, only the ST/STS/STD and LD/LDS/LDD instructions can be used.

The lower 768/1280/1280/2303 data memory locations address both the Register File, the I/O memory, Extended I/O memory, and the internal data SRAM. The first 32 locations address the Register File, the next 64 location the standard I/O memory, then 160 locations of Extended I/O memory, and the next 512/1024/1024/2048 locations address the internal data SRAM. This operation is done by the microprocessor typically, but complete hardware implementations are present on the market as well. Single-die optical receivers are being mass produced by a number of companies such as Siemens, Temic, Sharp, Xiamen Hualian, Japanese Electric and others. The five different addressing modes for the data memory cover: Direct, Indirect with Displacement, Indirect, Indirect with Pre-decrement, and Indirect with Post-increment. In the Register File, Registers R26 to R31 Feature the indirect addressing pointer registers. The direct addressing reaches the entire data space. The Indirect with Displacement mode reaches 63 address locations from the base address given by the Y- or Z register.

When using register indirect addressing modes with automatic pre-decrement and post-increment, the address registers X, Y, and Z are decremented or incremented. The 32 general purpose working registers, 64 I/O Registers, 160 Extended I/O Registers, and the 512/1024/1024/2048 bytes of internal data SRAM in the ATmega328 are all accessible through all these addressing modes.

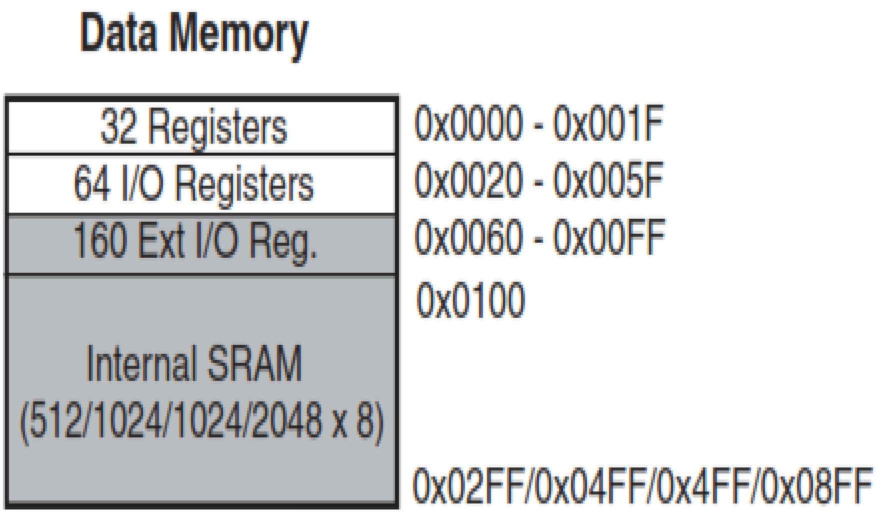

Figure 4.4 Data Memory Map

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 a 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.
- Atmega 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.

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.

4.3 GPS:

The Skylab GPS Simulator provides a complete suite for all your GPS simulating needs and more. The Skylab GPS Simulator uses the international standardized protocol NMEA-0183 for GPS data exchange. This standard is specified by the National Marine Electronics Association and contains mechanisms to exchange data in an interoperable way. The Skylab GPS Simulator provides the simulation of a GPS reciever on several interfaces. Some of these interfaces can be used at the same time. Such as:

• Serial port (RS232)

• Network (TCP/IP)

• Bluetooth (Serial Port Profile)

A serial port only provides exclusive access, the network and Bluetooth interfaces provide multi-threaded access. That means the Skylab GPS Simulator can be used as a multiplexer as well. Furthermore, it provides several input methods for GPS data:

• Manual Input

• Map Input

• Logfile Playback

• Forwarded Input To provide as much flexibility as possible the user can choose one of the four input options to specify where the simulated positioning data comes from. With the Manual Input method, it is possible to enter an exact position that will be sent to the output interface(s). The Map Input method lets the user choose a position visually from a map, which can be fetched from a OGC Web Map Service. The Logfile Playback 4 Skylab GPS Simulator method is for those users who have a recorded GPS logfile and want to use this as an input for other devices. The Forwarded Input method works like a multiplexer where the user can connect to a GPS receiver over a serial- or network port. The data from this gpsreciever will be send unchanged over the output interfaces. That makes it for example possible to map a serial GPS receiver to Bluetooth.

GPS Software Development If you are a software developer and you want to write GPS based software, the Skylab GPS Simulator lets you improve your developing and debugging abilities. The result will be a more flexible and faster development cycle. Transforming a GPS Receiver Interface If you have a GPS receiver that only provides one interface (e.g. serial port or USB) like most of them do, the Skylab GPS Simulator provides you the ability to use this device on other interfaces. Such interfaces are serial ports, network and Bluetooth. So you will be able to enable your serial port based GPS receivers for Bluetooth devices. Every possible position may be entered here. In opposite to the logfile and forward input it is possible to change the data while running a simulation. The following screenshot shows the manual input area of the GPS Simulator. This is the default input method and also the default tab that will be shown on start up.It is possible to change these values during runtime. The data will be sendimmediately to the output interface(s). You can enter the following data:

- Latitude (Formats: DD°MM.MM’, DD°MM’MM”, DD. DDDD°)
- Longitude (Formats: DD°MM.MM’, DD°MM’MM”, DD. DDDD°) 12 Skylab GPS Simulator
- Height (meter or feet)
- Speed (meter per second or miles per hour;)
- Heading (degrees)
- Satellites
- Use system time in UTC or specify a fix date and time Map Input

The map input is a full featured interoperable Web Map Client according to the OGC WMS specifications. Additionally, to standard GIS functions like zooming and panning you can visually select any position on the map to use it as an input for the simulator. You can use any WMS server in your network or the internet to let the client fetch maps for your needs.

4.4 DC-Motor:

Here DC Motor is used to rotate the panel in the required direction. Let us study in detail about the DC Motor.

Principles of Operation

In any electric motor, operation is based on simple electromagnetism. A current-carrying conductor generates a magnetic field; when this is then placed in an external magnetic field, it will experience a force proportional to the current in the conductor, and to the strength of the external magnetic field. As you are well aware of from playing with magnets as a kid, opposite (North and South) polarities attract, while like polarities (North and North, South and South) repel. The internal configuration of a DC motor is designed to harness the magnetic interaction between a current-carrying conductor and an external magnetic field to generate rotational motion. Let's start by looking at a simple 2-pole DC electric motor (here red represents a magnet or winding with a "North" polarization, while green represents a magnet or winding with a "South" polarization).

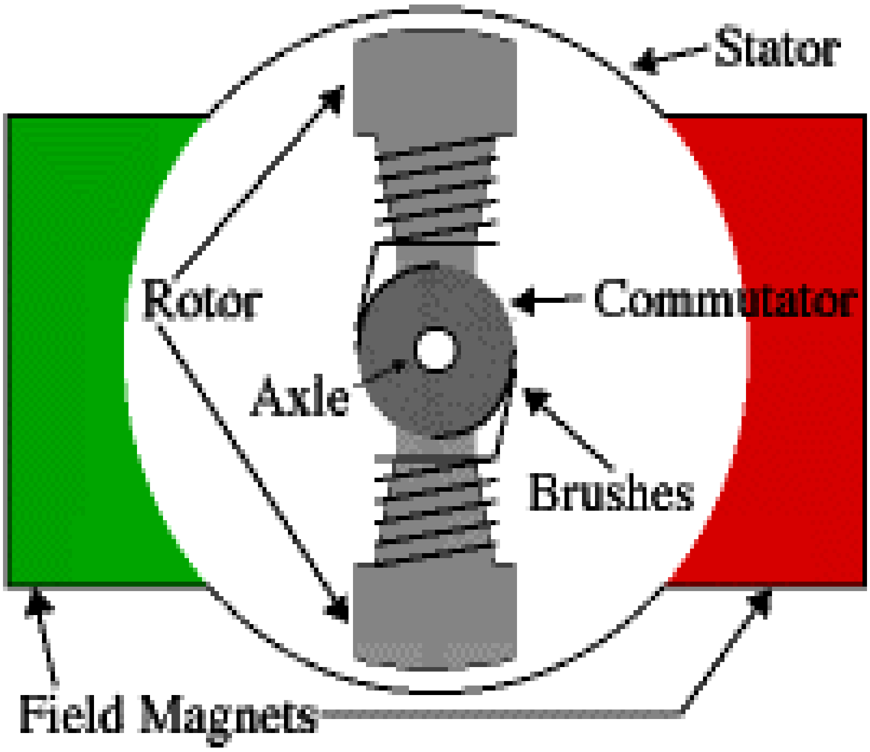

Figure 4.5 Internal structure DC motor

Every DC motor has six basic parts. They are axle, rotor (a.k.a., armature), stator, commutator, field magnet(s), and brushes. In most common DC motors the external magnetic field is produced by high-strength permanent magnets[1]. The stator is the stationary part of the motor -- this includes the motor casing, as well as two or more permanent magnet pole pieces. The rotor (together with the axle and attached commutator) rotates with respect to the stator.

The rotor consists of windings (generally on a core), the windings being electrically connected to the commutator. The above diagram shows a common motor layout with the rotor inside the stator (field) magnets.

The geometry of the brushes, commutator contacts, and rotor windings are such that when power is applied, the polarities of the energized winding and the stator magnet(s) are misaligned, and the rotor will rotate until it is almost aligned with the stator's field magnets. As the rotor reaches alignment, the brushes move to the next commutator contacts, and energize the next winding. Given our example two-pole motor, the rotation reverses the direction of current through the rotor winding, leading to a "flip" of the rotor's magnetic field, driving it to continue rotating.

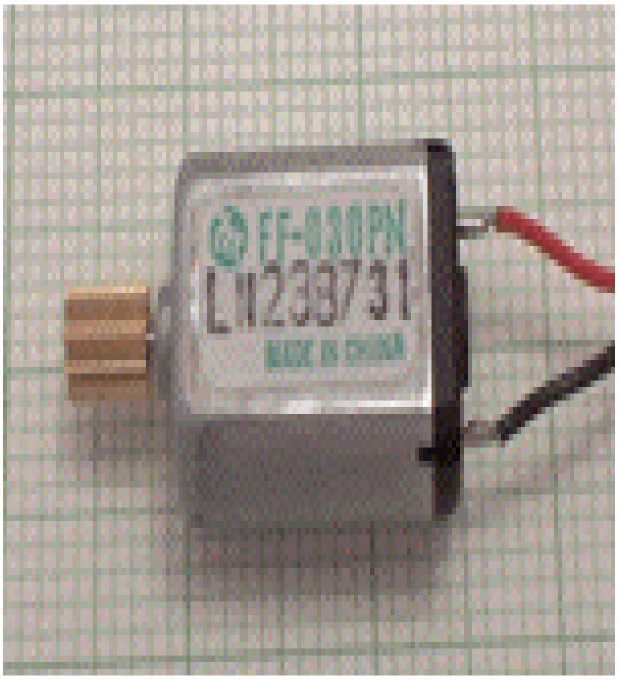

Figure 4.6 DC Motor

The use of an iron core armature (as in the Mabuchi, above) is quite common, and has a number of advantages2. First off, the iron core provides a strong, rigid support for the windings -- a particularly important consideration for high-torque motors. The core also conducts heat away from the rotor windings, allowing the motor to be driven harder than might otherwise be the case. Iron core construction is also relatively inexpensive compared with other construction types. But iron core construction also has several disadvantages. The iron armature has a relatively high inertia which limits motor acceleration. This construction also results in high winding inductances which limits brush and commutates life. In small motors, an alternative design is often used which features a 'coreless' armature winding. This design depends upon the coil wire itself for structural integrity. As a result, the armature is hollow, and the permanent magnet can be mounted inside the rotor coil. Coreless DC motors have much lower armature inductance than iron-core motors of comparable size, extending brush and commutator life. The coreless design also allows manufacturers to build smaller motors; meanwhile, due to the lack of iron in their rotors, coreless motors are somewhat prone to overheating. As a result, this design is generally used just in small, low-power motors. BEAMers will most often see coreless DC motors in the form of pager motors. Consider the g a DC motor. A DC motor will have two terminals. Let the terminals are D1 and D2. If we give positive voltage to D1 and negative voltage to D2 (simply voltage at D1 should be more positive than the voltage at D2) the rotor will rotate in forward direction. Alternatively if the voltage at D1 is negative and D2 is positive (or in other words voltage at D1 is more negative than D2) then the motor will rotate in reverse direction.

Basics of Dc Motor:

The speed of a DC motor is directly proportional to the supply voltage, so if we reduce the supply voltage from 12 Volts to 6 Volts, the motor will run at half the speed. The speed controller works by varying the average voltage sent to the motor. It could do this by simply adjusting the voltage sent to the motor, but this is quite inefficient to do. A better way is to switch the motor's supply on and off very quickly. If the switching is fast enough, the motor doesn't notice it, it only notices the average effect. Now imagine a light bulb with a switch. When we close the switch, the bulb goes on and is at full brightness, say 100 Watts. When we open the switch, it goes off (0 Watts).

H-Bridge:

An H-bridge is an electronic circuit which enables DC electric motors to be run forwards or backwards. These circuits are often used in robotics. H-bridges are available as integrated circuits, or can be built from discrete components.

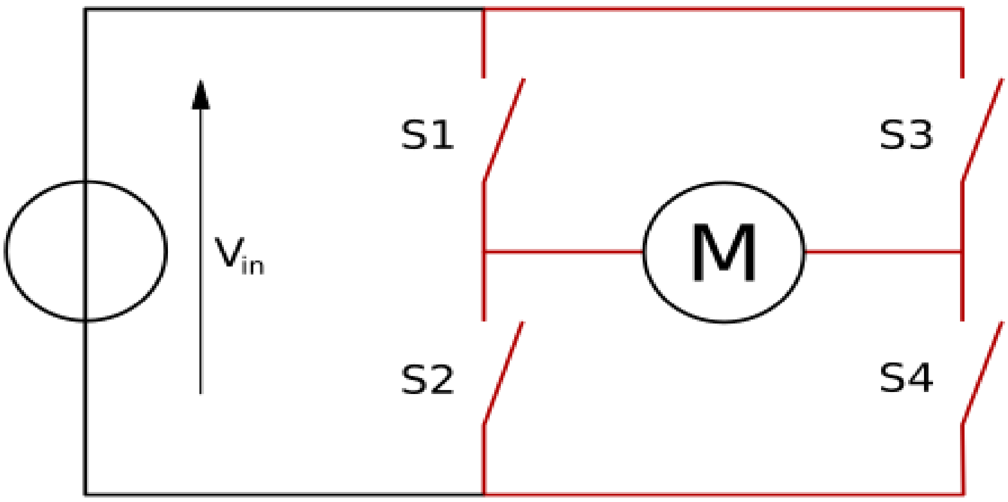

Figure 4.7 H-Bridge Circuit

The term "H-bridge" is derived from the typical graphical representation of such a circuit. An H-bridge is built with four switches (solid-state or mechanical). When the switches S1 and S4 (according to the first figure) are closed (and S2 and S3 are open) a positive voltage will be applied across the motor. By opening S1 and S4 switches and closing S2 and S3 switches,

4.5 GSM:

An embedded system is a special-purpose system in which the computer is completely encapsulated by or dedicated to the device or system it controls. Unlike a general-purpose computer, such as a personal computer, an embedded system performs one or a few pre-defined tasks, usually with very specific requirements. Since the system is dedicated to specific tasks, design engineers can optimize it, reducing the size and cost of the product. Embedded systems are often mass-produced, benefiting from economies of scale.

4.5.1 What is GSM:

Global System for Mobile Communication (GSM) is a set of ETSI standards specifying the infrastructure for a digital cellular service. The standard is used in approx. 85 countries in the world including such locations as Europe, Japan and Australia[1].

4.5.2 GSM Call Routing:

Mobile Subscriber Roaming

When a mobile subscriber roams into a new location area (new VLR), the VLR automatically determines that it must update the HLR with the new location information, which it does using an SS7 Location Update Request Message. The Location Update Message is routed to the HLR through the SS7 network, based on the global title translation of the IMSI that is stored within the SCCP Called Party Address portion of the message. The HLR responds with a message that informs the VLR whether the subscriber should be provided service in the new location.

Mobile Subscriber ISDN Number (MSISDN) Call Routing

When a user dials a GSM mobile subscriber's MSISDN, the PSTN routes the call to the Home MSC based on the dialed telephone number. The MSC must then query the HLR based on the MSISDN, to attain routing information required to route the call to the subscribers' current location.

The MSC stores global title translation tables that are used to determine the HLR associated with the MSISDN. When only one HLR exists, the translation tables are trivial. When more than one HLR is used however, the translations become extremely challenging; with one translation record per subscriber (see the example below). Having determined the appropriate HLR address, the MSC sends a Routing Information Request to it.

When the HLR receives the Routing Information Request, it maps the MSISDN to the IMSI, and ascertains the subscribers' profile including the current VLR at which the subscriber is registered. The HLR then queries the VLR for a Mobile Station Roaming Number (MSRN). The MSRN is essentially an ISDN telephone number at which the mobile subscriber can currently be reached. The MSRN is a temporary number that is valid only for the duration of a single call.

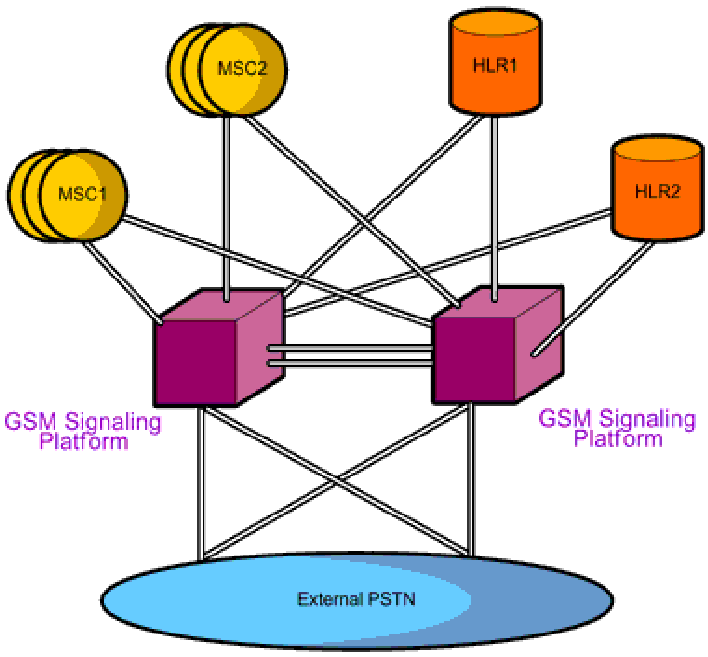

Fig 4.8: Diagram Of MSISDN

GSM (Global System for Mobile communication) is a digital mobile telephone system that is widely used in many parts of the world. GSM uses a variation of Time Division Multiple Access (TDMA) and is the most widely used of the three digital wireless telephone technologies (TDMA, GSM, and CDMA). GSM digitizes and compresses data, then sends it down a channel with two other streams of user data, each in its own time slot. GSM operates in the 900MHz, 1800MHz, or 1900 MHz frequency bands.

GSM has been the backbone of the phenomenal success in mobile telecoms over the last decade. Now, at the dawn of the era of true broadband services, GSM continues to evolve to meet new demands. One of GSM's great strengths is its international roaming capability, giving consumers a seamless service. This has been a vital driver in growth, with around 300 million. In the Americas, today's 7 million subscribers are set to grow rapidly, with market potential of 500 million in population, due to the introduction of GSM 800, which allows operators using the 800 MHz band to have access to GSM technology too.

GSM together with other technologies is part of an evolution of wireless mobile telecommunication that includes High-Speed Circuit-Switched Data (HCSD), General Packet Radio System (GPRS), Enhanced Data GSM Environment (EDGE), and Universal Mobile TelecommunicationsService(UMTS).

GSM security issues such as theft of service, privacy, and legal interception continue to raise significant interest in the GSM community. The purpose of this portal is to raise awareness of these issues with GSM security.

The mobile communications has become one of the driving forces of the digital revolution. Everyday, millions of people are making phone calls by pressing a few buttons. Little is known about how one person's voice reaches the other person's phone that is thousands of miles away. Even less is known about the security measures and protection behind the system. The complexity of the cell phone is increasing as people begin sending text messages and digital pictures to their friends and family. The cell phone is slowly turning into a handheld computer. All the features and advancements in cell phone technology require a backbone to support it. The system has to provide security and the capability for growth to accommodate future enhancements. General System for Mobile Communications, GSM, is one of the many solutions out there. GSM has been dubbed the "Wireless Revolution" and it doesn't take much to realize why GSM provides a secure and confidential method of communication.

Digital containers offer an alternative way of securely delivering content to consumers. They can offer many advantages, particularly for content delivery over mobile phone networks:
Scalability
Micro transactions/Micro payments compatibility
Content channel neutrality (heterogeneous networks, unicast /multicast/broadcast etc)
Possibility of DRM
Consumer anonymity
Etc.

GSM Modems

A GSM modem can be an external modem device, such as the Wavecom FASTRACK Modem. Insert a GSM SIM card into this modem, and connect the modem to an available serial port on your computer.

A GSM modem can be a PC Card installed in a notebook computer, such as the Nokia Card Phone.

A GSM modem could also be a standard GSM mobile phone with the appropriate cable and software driver to connect to a serial port on your computer. Phones such as the Nokia 7110 with a DLR-3 cable, or various Ericsson phones, are often used for this purpose.

A dedicated GSM modem (external or PC Card) is usually preferable to a GSM mobile phone. This is because of some compatibility issues that can exist with mobile phones. For example, if you wish to be able to receive inbound MMS messages with your gateway, and you are using a mobile phone as your modem, you must utilize a mobile phone that does not support WAP push or MMS. This is because the mobile phone automatically processes these messages, without forwarding them via the modem interface. Similarly some mobile phones will not allow you to correctly receive SMS text messages longer than 160 bytes (known as "concatenated SMS" or "long SMS"). This is because these long messages are actually sent as separate SMS messages, and the phone attempts to reassemble the message before forwarding via the modem interface. (We've observed this latter problem utilizing the Ericsson R380, while it does not appear to be a problem with many other Ericsson models.)

When you install your GSM modem, or connect your GSM mobile phone to the computer, be sure to install the appropriate Windows modem driver from the device manufacturer. To simplify configuration, the Now SMS/MMS Gateway will communicate with the device via this driver. An additional benefit of utilizing this driver is that you can use Windows diagnostics to ensure that the modem is communicating properly with the computer.

The Now SMS/MMS gateway can simultaneously support multiple modems, provided that your computer hardware has the available communications port resources.

Fig 4.9: GSM smart modem

4.5.3 SMART MODEM (GSM/GPRS)

INTRODUCTION : Analogic's GSM Smart Modem is a multi-functional, ready to use, rugged and versatile modem that can be embedded or plugged into any application. The Smart Modem can be customized to various applications by using the standard AT commands. The modem is fully type-approved and can directly be integrated into your projects with any or all the features of Voice, Data, Fax, SMS, and Internet etc.

Smart Modem kit contain the following items:

Analogic's GSM/GPRS Smart Modem

SMPS based power supply adapter.

3 dBi antenna with cable (optional: other types)

Data cable (RS232)

User Manual

PRODUCT DESCRIPTION:

The connectors integrated to the body, guarantee the reliable output and input connections. An extractible holder is used to insert the SIM card (Micro-SIM type). Status LED indicates the operating mode.

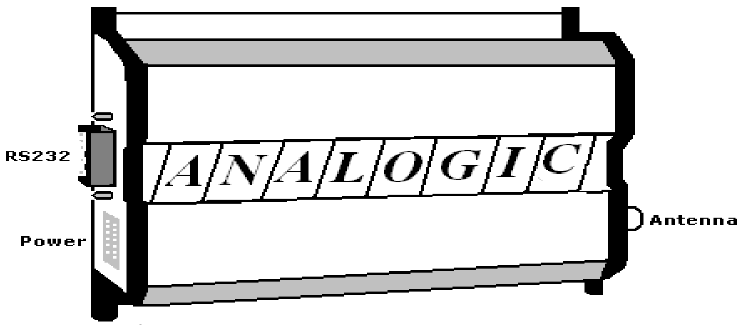

Fig 4.10 : Block diagram of modem with key connections

Physical Characteristics

Dimensions	100 x 78 x 32 mm (excluding connectors)
Weight	125 grams
Housing	Aluminum Profiled

Table 4.1: Physical characteristics of SIM

Temperature Range:

Operating temperature: from -20^{0}C to +55^{0}C

Storage temperature: from -25^{0}C to +70^{0}C

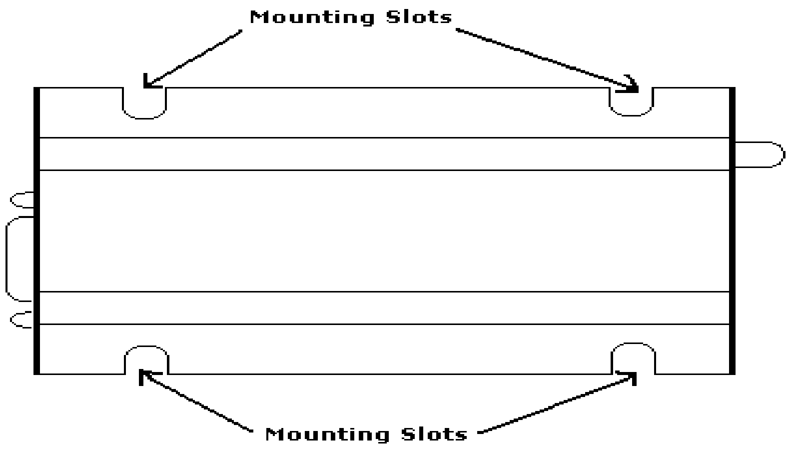

Fig 4.11 : Internal diagram of GSM modem

Installing the modem:

To install the modem, plug the device on to the supplied SMPS Adapter. For Automotive applications fix the modem permanently using the mounting slots (optional as per your requirement dimensions).

Inserting/ Removing the SIM Card:

To insert or Remove the SIM Card, it is necessary to press the SIM holder ejector button with Sharp edged object like a pen or a needle. With this, the SIM holder comes out a little, then pulls it out and insert or remove the SIM Card

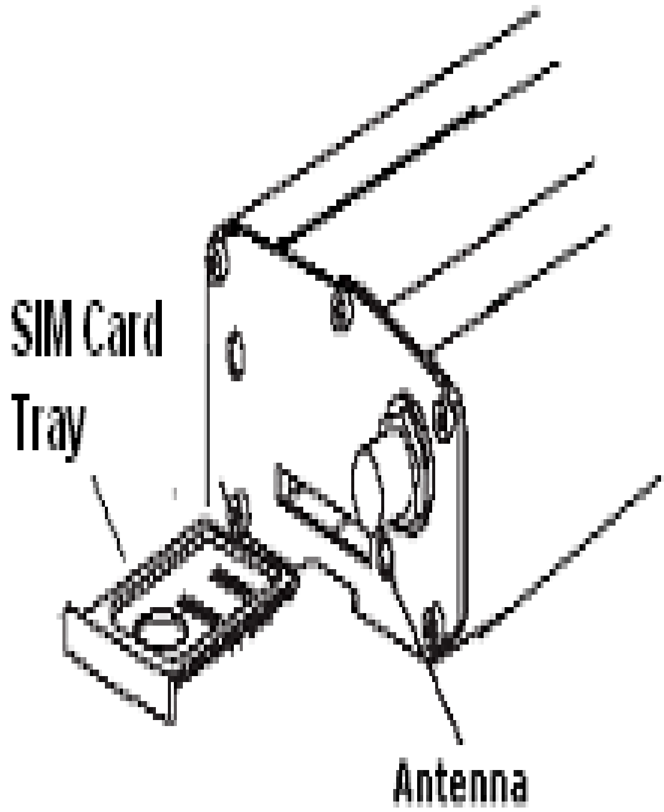

Fig 4.12: Inserting/Removing the sim card into the modem

Make sure that the ejector is pushed out completely before accessing the SIM Card holder do not remove the SIM card holder by force or tamper it (it may permanently damage). Place the SIM Card Properly as per the direction of the installation. It is very important that the SIM is placed in the right direction for its proper working condition

Connecting External Antenna:

Connect GSM Smart Modem to the external antenna with cable end with SMA male. The Frequency of the antenna may be GSM 900/1800 MHz. The antenna may be (0dbi, 3 dbi or short length L-type antenna) as per the field conditions and signal conditions.

DC Supply Connection

The Modem will automatically turn ON when connection is given to it. The following is the Power Supply Requirement:

Parameters	MIN	Avg	Max
Supply Voltage	5 V	9 V	12 V
Peak Current at 5 V supply			1.8 A (during transmission)
Average Current at 5 V supply in idle Mode			35 mA
Average Current at 5 V supply in idle Mode and RS232 Power Saving Activated			13 mA

Table 4.2: Requirements of Power Supply

Connecting Modem to external devices:

RS232 can be used to connect to the external device through the D-SUB/ USB (for USB model only) device that is provided in the modem.

Connectors:

Connector	**Function**
SMA	RF Antenna connector
15 pin or 9 pin D-SUB USB (optional)	RS232 link Audio link (only for 15 D-SUB) Reset (only for 15 D-SUB) USB communication port (optional)
2 pin Phoenix tm	Power Supply Connector
SIM Connector	SIM Card Connection
RJ11 (For 9 D-SUB and USB only)	Audio link Simple hand set connection (4 wire) 2 wire desktop phone connection

Table 4.3: Differences Between Connectors and Function

Description of the interfaces:

The modem comprises several interfaces:

LED Function including operating Status

External antenna (via SMA)

Serial and control link

Power Supply (Via 2 pin Phoenix ^{tm}contact)

SIM card holder

LED Status Indicator:

The LED will indicate different status of the modem:

OFF	Modem Switched off
ON	Modem is connecting to the network
Flashing Slowly	Modem is in idle mode
Flashing rapidly	Modem is in transmission/communication (GSM only)

9 – PIN D-SUB Female Connector

PIN	NAME	Designation	Type
1	X None	NC	NC
2	TX	Transmit Data	Input
3	Rx	Receive Data	Output
4	DSR	Data Set Ready	Output
5	GND	Ground	Ground
6	DTR	Data Terminal Ready	Input
7	CTS	Clear to send	Output
8	RTS	Request to send	Input
9	X None	NC	NC

Table 4.4: 9 PIN D-SUB Connector

Protecting Modem:

Do not expose to the modem to extreme conditions such as High temperatures, direct sunlight, High Humidity, Rain, Chemicals, Water, Dust etc. For these details see the specifications given.

Do not drop, Shake or hit the Modem. (Warranty may void)

The Modem should not be used in extreme vibrating conditions

Handle the Antenna and cable with care.

AT commands features:

Line settings:

A serial link handler is set with the following default values Autobaud, 8 bits data, 1 stop bit, no parity, flow control.

Command line

Commands always start with AT (which means attention) and finish with a <CR> character.

Information responses and result codes

Responses start and end with <CR><LF>,.

If command syntax is incorrect, an ERROR string is returned.

If command syntax is correct but with some incorrect parameters, the +CME ERROR: <Err> or +CMS ERROR: <SmsErr> strings are returned with different error codes.

If the command line has been performed successfully, an OK string is returned.

In some cases, such as “AT+CPIN?” or (unsolicited) incoming events, the product does not return the OK string as a response.

Services provided by GSM

GSM was designed having interoperability with ISDN in mind, and the services provided by GSM are a subset of the standard ISDN services. Speech is the most basic, and most important, teleservice provided by GSM.

In addition, various data services are supported, with user bit rates up to 9600 bps. Specially equipped GSM terminals can connect with PSTN, ISDN, Packet Switched and Circuit Switched Public Data Networks, through several possible methods, using synchronous or asynchronous transmission. Also supported are Group 3 facsimile service, videotex, and teletex. Other GSM services include a cell broadcast service, where messages such as traffic reports, are broadcast to users in particular cells.

A service unique to GSM, the Short Message Service, allows users to send and receive point-to-point alphanumeric messages up to a few tens of bytes. It is similar to paging services, but much more comprehensive, allowing bi-directional messages, store-and-forward delivery, and acknowledgement of successful delivery.

Supplementary services enhance the set of basic teleservices. In the Phase I specifications, supplementary services include variations of call forwarding and call barring, such as Call Forward on Busy or Barring of Outgoing International Calls. Many more supplementary services, including multiparty calls, advice of charge, call waiting, and calling line identification presentation will be offered in the Phase 2 specifications.

4.5.4 Architecture of the GSM network:

A GSM network is composed of several functional entities, whose functions and interfaces are specified. Figure 1 shows the layout of a generic GSM network. The GSM network can be divided into three broad parts. The Mobile Station is carried by the subscriber. The Base Station Subsystem controls the radio link with the Mobile Station. The Network Subsystem, the main part of which is the Mobile services Switching Center (MSC), performs the switching of calls between the mobile users, and between mobile and fixed network users. The MSC also handles the mobility management operations. Not shown are the Operations

A GSM network is composed of several functional entities, whose functions and interfaces are specified. Figure 1 shows the layout of a generic GSM network. The GSM network can be divided into three broad parts. Subscriber carries the Mobile Station. The Base Station Subsystem controls the radio link with the Mobile Station. The Network Subsystem, the main part of which is the Mobile services Switching Center (MSC), performs the switching of calls between the mobile users, and between mobile and fixed network users.

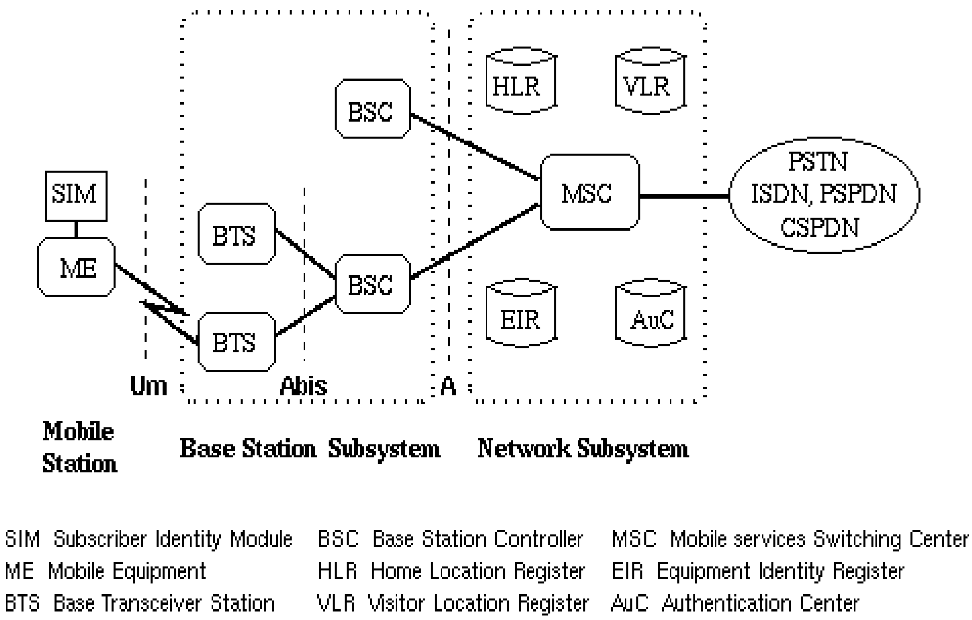

Fig 4.13: General architecture of a GSM network

Mobile Station:

The mobile station (MS) consists of the mobile equipment (the terminal) and a smart card called the Subscriber Identity Module (SIM). The SIM provides personal mobility, so that the user can have access to subscribed services irrespective of a specific terminal. By inserting the SIM card into another GSM terminal, the user is able to receive calls at that terminal, make calls from that terminal, and receive other subscribed services.

The mobile equipment is uniquely identified by the International Mobile Equipment Identity (IMEI). The SIM card contains the International Mobile Subscriber Identity (IMSI) used to identify the subscriber to the system, a secret key for authentication, and other information.

The IMEI and the IMSI are independent, thereby allowing personal mobility. The SIM card may be protected against unauthorized use by a password or personal identity number.

Base Station Subsystem:

The Base Station Subsystem is composed of two parts, the Base Transceiver Station (BTS) and the Base Station Controller (BSC). These communicate across the standardized Abs interface, allowing (as in the rest of the system) operation between components made by different suppliers.

The Base Transceiver Station houses the radio transceivers that define a cell and handles the radio-link protocols with the Mobile Station. In a large urban area, there will potentially be a large number of BTSs deployed, thus the requirements for a BTS are ruggedness, reliability, portability, and minimum cost.

The Base Station Controller manages the radio resources for one or more BTSs. It handles radio-channel setup, frequency hopping, and handovers, as described below. The BSC is the connection between the mobile station and the Mobile service Switching Center (MSC).

4.5.5 Network Subsystem:

The central component of the Network Subsystem is the Mobile services Switching Center (MSC). It acts like a normal switching node of the PSTN or ISDN, and additionally provides all the functionality needed to handle a mobile subscriber, such as registration, authentication, location updating, handovers, and call routing to a roaming subscriber. These services are provided in conjunction with several functional entities, which together form the Network Subsystem. The MSC provides the connection to the fixed networks (such as the PSTN or ISDN). Signalling between functional entities in the Network Subsystem uses Signaling System Number 7 (SS7), used for trunk signalling in ISDN and widely used in current public networks.

The Home Location Register (HLR) and Visitor Location Register (VLR), together with the MSC, provide the call-routing and roaming capabilities of GSM. The HLR contains all the administrative information of each subscriber registered in the corresponding GSM network, along with the current location of the mobile. The location of the mobile is typically in the form of the signaling address of the VLR associated with the mobile as a distributed database station. The actual routing procedure will be described later. There is logically one HLR per GSM network, although it may be implemented

The Visitor Location Register (VLR) contains selected administrative information from the HLR, necessary for call control and provision of the subscribed services, for each mobile currently located in the geographical area controlled by the VLR. Although each functional entity can be implemented as an independent unit, all manufacturers of switching equipment to date implement the VLR together with the MSC, so that the geographical area controlled by the MSC corresponds to that controlled by the VLR, thus simplifying the signalling required. Note that the MSC contains no information about particular mobile stations --- this information is stored in the location registers.

The other two registers are used for authentication and security purposes. The Equipment Identity Register (EIR) is a database that contains a list of all valid mobile equipment on the network, where each mobile station is identified by its International Mobile Equipment Identity (IMEI). An IMEI is marked as invalid if it has been reported stolen or is not type approved. The Authentication Center (AuC) is a protected database that stores a copy of the secret key stored in each subscriber's SIM card, which is used for authentication and encryption over the radio channel.

4.6 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: 3.8 shows Hi-Watt 9V battery

Figure 4.14: 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: 3.9 shows pencil battery of 1.5V.

Figure 4.15: Pencil Battery of 1.5V

Rectification:

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

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.

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.

Bridge full wave rectifier:

The Bridge rectifier circuit is shown in fig: 3.10, 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

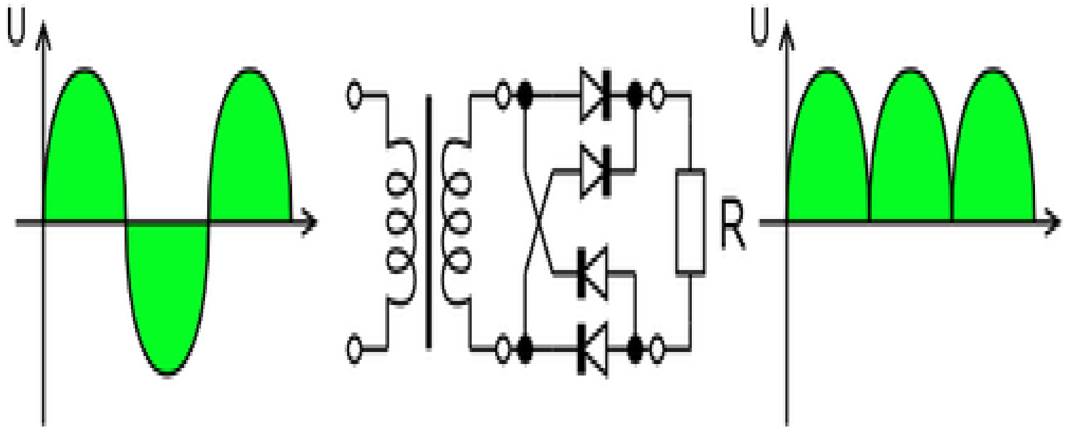

Figure 4.16: Bridge rectifier: a full-wave rectifier using 4 diodes

Filtration:

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

Filters:

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

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.

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.

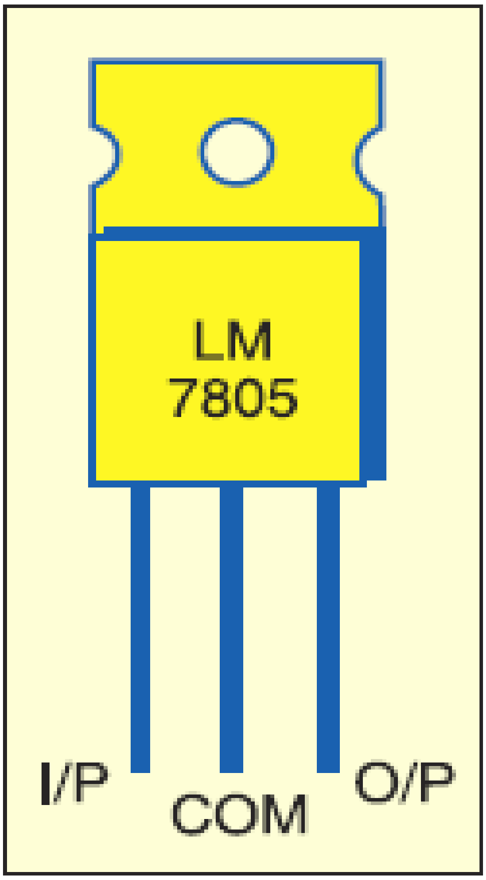

Figure 4.17: Voltage Regulator

CHAPTER – 5

RESULTS

5.1 Screenshots with detailed explanation: -

The microcontroller that is used is PIC16F883. It is preferred over 8051 because of its RISC (reduced instruction set computer) architecture which helps carry out several commands in short time. The IR pair gives input to the controller. The pair of motors that is used is connected to PIC through a dual H-bridge motor driver IC.

It is used to convert the small current that PIC provides to the range that the motor requires for its operation (about 350 mA). In motor drivers low-current control signal is taken and converted into a higher-current signal. Thus, they behave as current amplifiers. This higher current signal used to drive the motors. L293D contains two inbuilt H-bridge driver circuits. When it is working in its common mode of operation, two DC motors can be driven simultaneously, both in forward and reverse direction.

A voltage regulator (LM7805) is used to convert the 12V DC voltage from battery to 5V, required to power the all the components. GSM modem is a highly flexible plug and play GSM 300modem for direct and easy integration RS232, voltage range for the power supply and audio interface make this device perfect solution for system integrators and single user. It also comes with license free integrated Python. Python is a powerful easy to learn programming language. This terminalis driven by Python and is 5 times better and faster and 5times cheaper than standard PLC(programmable logic device)/RTU(remote terminal unit). These, however, have communication interface and external GSM / GPRS modem.

The existing systems are more complicated and time-consuming. Hence, this paper proposes a more reliable and less time-consuming mode of crack detection in the railway tracks. This is a real time application which can be performed easily.

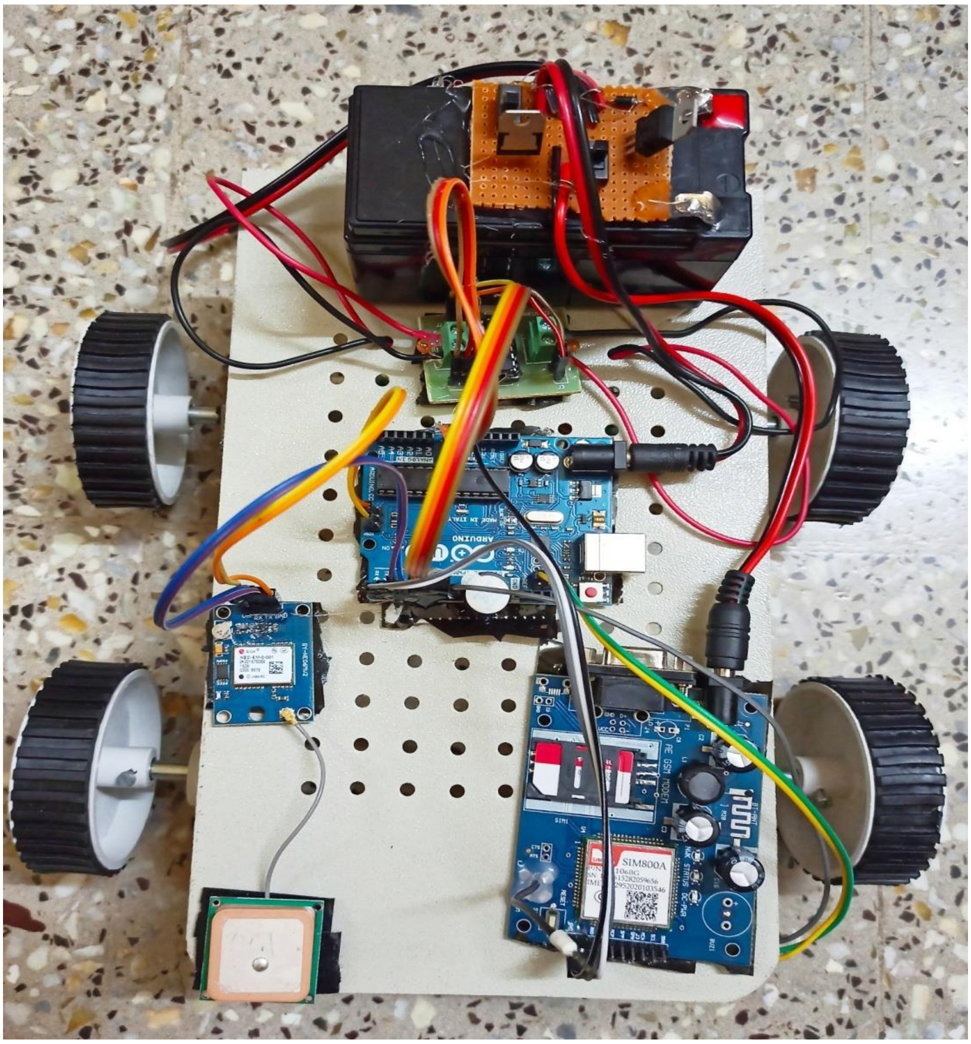

Fig 5.1 :The control setup of the system which includes all the components

The software tools required to build the system is

- ✓ Arduino IDE
- ✓ Embedded c

The fact that GSM Modem supports popular AT command set allows users to develop applications quickly. The product has SIM Card holder to which activated SIM card is inserted for normal use. The power to this unit can be given from UPS to provide uninterrupted operation. This product can be used economically in remote location. This allows devices in such places to stay connected even though these are places where telephone lines do not exist. A third generation POT (Patch Antenna On Top) GPS modules used. This POT GPS

receiver provides a solution of high position and speed accuracy performances together with improved sensitivity and tracking capabilities in urban conditions. They also provide standard NMEA0183 strings in "raw" mode for any microcontroller. The module provides current time, date, latitude, longitude, speed, altitude and travel direction/heading and several other data. It can also be used in a host of applications, for example, navigation, tracking systems, fleet management, mapping and robotics. This is a standalone GPS Module and is built with internal Back up battery. It can be directly connected to Microcontroller's USART (universal synchronous/asynchronous receiver transmitter) and requires no external components except power supply decoupling capacitors. The module also has an option for
connecting external active antenna if the need arises.

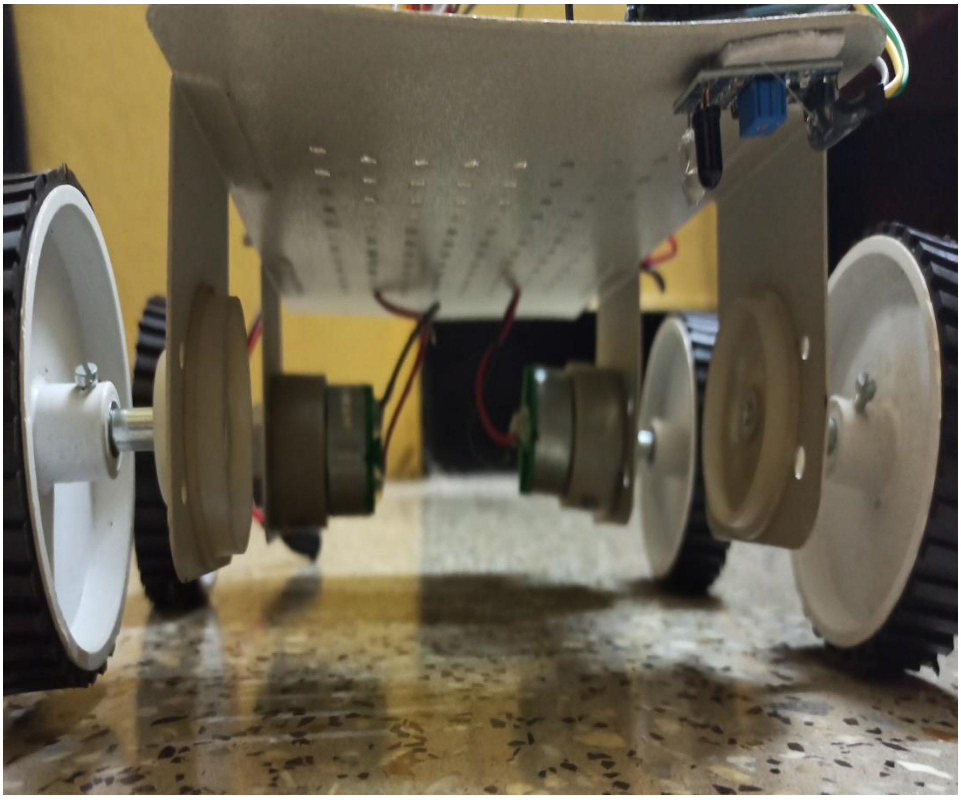

Fig 5.2 IR sensor with Driver Motors

the output of the experiment when it was performed. An SMS is sent to the phone number (that is already programmed into the device) as shown. The message reads 'Crack Detected' and also gives the co-ordinates of the location at which the crack has occurred. It is possible to obtain this location on a map using Google Map Apps.

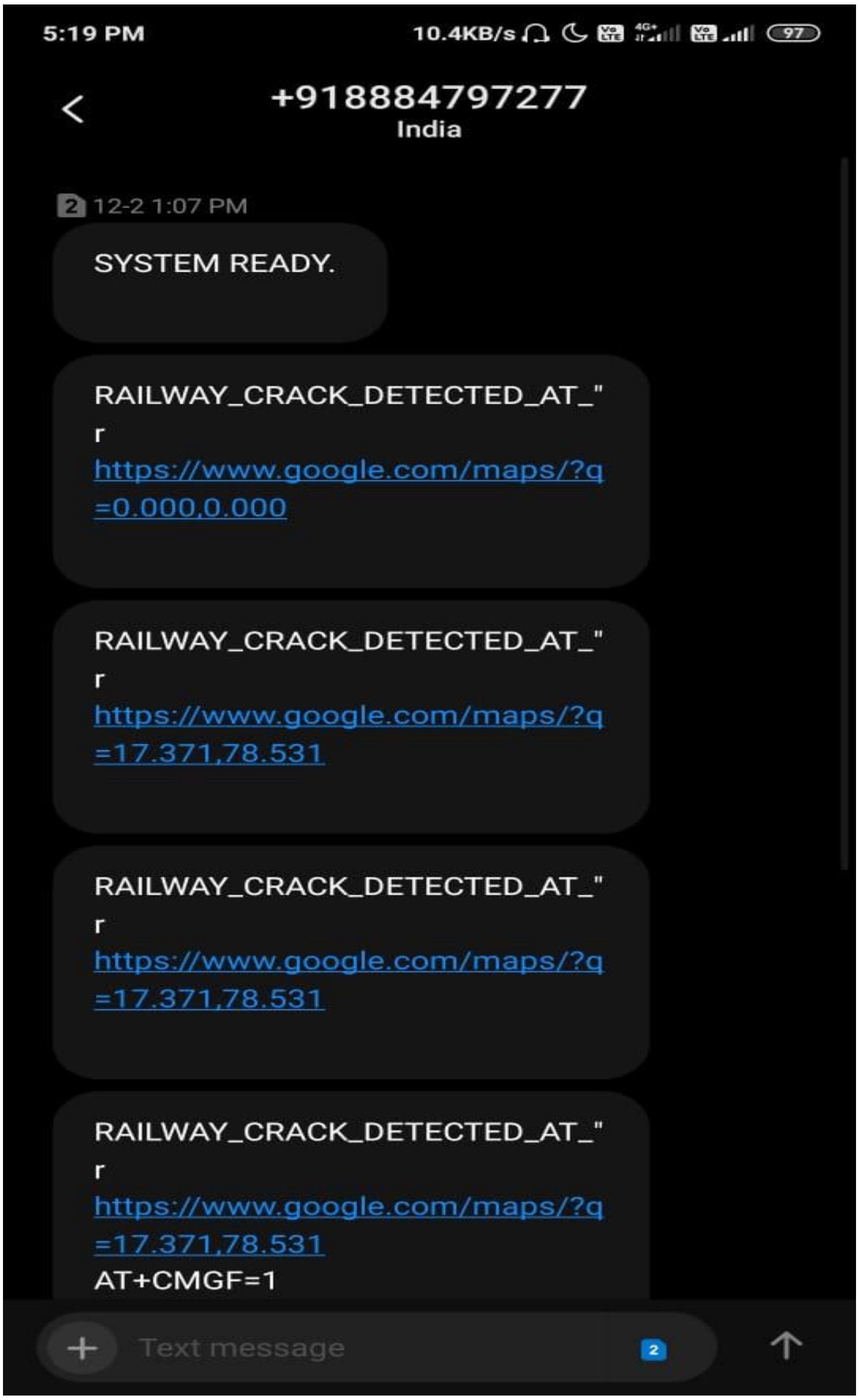

Fig: 5.3 Output on the phone

IR sensors have been used for sensing and detecting cracks and the information is processed using PIC microcontroller. The use of GSM and GPS module for conveying the information of the crack along with its location makes this method more useful.

CHAPTER -6

Conclusions and Future Scope

6.1 Advantages:

The proposed system sets an example on how to use wireless network efficiently for railway track crack detection and the technology can be used at domestic and at commercial places. Instead of manual method of crack detection a more advanced technology is used to alert the railway office about the detected cracks immediately.

The scaling model formed to demonstrate this project has two rails forming part of track. The rail tracks are connected with a detachable jumper (encircled) in between each track. Presence of jumper in the link represents the ideal case i.e. the railway track without the crack/flaw. Removing the jumpers result in delivering a different logic to the microcontroller which thereafter sends an SMS through GSM modem and the status of track condition is displayed.

The both face to face collision and crack on track are detected 4-5km before by the continuous monitoring of ultrasonic metal detecting sensors which are fixed at the engines, and once detected the train automatically applies brake to stop and even pantographs could be disengaged. But, the de-railment could be controlled by detecting not presences of next compartment. Then an alert is given to driver and automatic emergency brake control is applied. If this system is brought in railways, the accidents could be controlled and the place of damage could be sent automatically to control room and since its completely automated system this can be used in village areas by which man power is reduced and time is saved.

1. Introduction of automation for Indian railway.
2. The project saves human effort and time.
3. Easy to use.
4. It is cost effective.
5. It will also increase the security for both rails and passenger

6.2 Disadvantages:

Only disadvantage is the climatic conditions and time constraints such assubmerging of railway tracks and communication loss in some remote areas.

6.3 Future Scope:

Future work will aim to implement this method in all places where the track runs. But for this, range and WIFI connections must be set up even in the remote places. Or else, newer methods can be developed which will ensure that this system of rail crack detection can be used even in the remote places. Also, if range of IR sensors can be improved, then the device can reach longer distances in shorter time.

In the future we can use CCTV systems with IP based camera for monitoring visual videos captured from track. The power supply for motor operation and signal lights is a disadvantage. This can be avoided by using a battery charged with solar cell. The obstacle detection part can be implemented using Fuzzy logic. As it thinks in different angles and aspects, the system will work more efficiently.

6.4 Conclusion:

The working model for efficient and cost-effective crack detection on the rail tracks has been developed successfully. IR sensors have been used for sensing and detecting cracks and the information is processed using PIC microcontroller.

The use of GSM and GPS module for conveying the information of the crack along with its location makes this method more useful. This helps reduces the dependence on manual detection and thereby reduces the chances of error and accidents. Although initial cost is high it will not require a lot of maintenance thereafter. It is possible to add other features to this device to make it more versatile. Equipment's can be added to check for the quality of the rails.

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APPENDIX-A

SOURCE CODE

```
#include <TinyGPS++.h>
#include <SoftwareSerial.h>
static const int RXPin = 2, TXPin = 3;
static const uint32_t GPSBaud = 9600;
#define ir_sen 8
#define buz1 9
#define buz2 12
#include <LiquidCrystal.h>
//At Work Place AmBTech
//ZBT TG621
//LAT:17.368839
//LON:78.530784
//NEO Tiny
//LAT:17.368835
//LON:78.530761
int flag1=1;
//LiquidCrystallcd (8,9,10,11,12,13);
LiquidCrystallcd(A0, A1, A2, A3, A4, A5);
#define m1 5
#define m2 4
#define m3 6
#define m4 7

TinyGPSPlusgps;
SoftwareSerialss(RXPin, TXPin);
  static const double LONDON_LAT = 51.508131, LONDON_LON = -0.128002;
void buz_beep(int t){
for(int bt=0;bt<t;bt++){
digitalWrite(buz1,1);digitalWrite(buz2,0);delay(500);
```

```
digitalWrite(buz1,0);digitalWrite(buz2,0);delay(100);}
}
void setup()
{
pinMode(ir_sen,INPUT_PULLUP);
pinMode(m1, OUTPUT);
pinMode(m2, OUTPUT);
pinMode(m3, OUTPUT);
pinMode(m4, OUTPUT);

pinMode(buz1, OUTPUT);
pinMode(buz2, OUTPUT);
digitalWrite(buz1,0);
digitalWrite(buz2,0);
digitalWrite(m1,0);
digitalWrite(m2,0);
digitalWrite(m3,0);
digitalWrite(m4,0);
buz_beep(1);
Serial.begin(9600);
ss.begin(GPSBaud);
  //Serial.println(TinyGPSPlus::libraryVersion());
SendMessage("SYSTEM READY.");
buz_beep(2);

delay(1000);
motor_run();
//get_gps();
}

void SendMessage(String msg1)
```

```
{
  //Serial.println("Sending sms");
  String cmd1=msg1;
Serial.println("AT+CMGF=1");
delay(2000);
Serial.println("AT+CMGS=\"9701928282\"");//919959409194
delay(2000);
Serial.println(cmd1);
delay(2000);
Serial.write(0X1A);
delay(2000);
  //Serial.println("sent sms");

}
void motor_run()
{
digitalWrite(m1,1);
digitalWrite(m2,0);
digitalWrite(m3,1);
digitalWrite(m4,0);
}

void motor_stop(){
digitalWrite(m1,0);
digitalWrite(m2,0);
digitalWrite(m3,0);
digitalWrite(m4,0);
}
void loop()
{
if(digitalRead(ir_sen)==1)
{
```

```
motor_stop();buz_beep(3);
get_gps();delay(5000);get_gps();
     flag1=0;
     }
else{
   if(flag1==1){motor_run();}
  }
}
void get_gps()
{
//Serial.print("LAT:");
//lcd.begin(16, 2);
lcd.setCursor(0,0);
lcd.print("LAT:");
//lcd.setCursor(7,0);
//lcd.print("LT:");
printFloat(gps.location.lat(), gps.location.isValid(), 11, 6);
lcd.setCursor(5,0);
//lcd.setCursor(10,0);
lcd.print(gps.location.lat());
lcd.print(gps.location.isValid());
//Serial.print("\r\n");
delay(1000);
////////////////////////////////////////////////////////////////////////////////
//Serial.print("LON:");
lcd.setCursor(0,1);
lcd.print("LON:");
//lcd.setCursor(7,1);
//lcd.print("LN:");
printFloat(gps.location.lng(), gps.location.isValid(), 12, 6);
lcd.setCursor(5,1);
//lcd.setCursor(10,1);
```

```
lcd.print(gps.location.lng());
lcd.print(gps.location.isValid());

///////////////////////////////////////////
String  cmd2="RAILWAY_CRACK_DETECTED_AT_\"r\n""https://www.google.com/maps/?q="
+ String(gps.location.lat()) + String(gps.location.isValid())+","
        + String(gps.location.lng())+ String(gps.location.isValid());
//Serial.println("Sending sms");
Serial.println("AT+CMGS=\"9701928282\"");
delay(2000);
Serial.println(cmd2);
delay(2000);
Serial.write(0X1A);
delay(5000);
 // Serial.println("sent sms");

///////////////////////////////////////////

///////////////////////////////////////////
/*
//Serial.println("Sending sms");
Serial.println("AT+CMGS=\"9985787078\"");
delay(2000);
Serial.println(cmd2);
delay(2000);
Serial.write(0X1A);
delay(5000);
  //Serial.println("sent sms");
  */
//////////////////////////////////////////
  //Serial.print("\r\n");
delay(1000);
```

```
  unsigned long distanceKmToLondon =
    (unsigned long)TinyGPSPlus::distanceBetween(
gps.location.lat(),
gps.location.lng(),
      LONDON_LAT,
      LONDON_LON) / 1000;
  double courseToLondon =
TinyGPSPlus::courseTo(
gps.location.lat(),
gps.location.lng(),
      LONDON_LAT,
      LONDON_LON);
  const char *cardinalToLondon = TinyGPSPlus::cardinal(courseToLondon);
  //Serial.println();
smartDelay(1000);
if (millis() > 5000 &&gps.charsProcessed() < 10)
  {
    //Serial.println(" ");
  }
}
static void smartDelay(unsigned long ms)
{
  unsigned long start = millis();
  do
  {
    while (ss.available())
gps.encode(ss.read());
  } while (millis() - start <ms);
}
static void printFloat(float val, bool valid, int len, int prec)
{
  if (!valid)
```

```
  {
    while (len-- > 1)
    {
    }
    //Serial.print(' ');
  }
  else
  {
    //Serial.print(val, prec);
    int vi = abs((int)val);
    int flen = prec + (val<0.0 ?2 : 1); // . and -
flen += vi >= 1000 ?4 : vi >= 100 ? 3 : vi >= 10 ? 2 : 1;
    for (int i=flen; i<len; ++i);
      //Serial.print(' ');
  }
smartDelay(0);
}

static void printInt(unsigned long val, bool valid, int len)
{
  char sz[32] = "*****************";
  if (valid)
sprintf(sz, "%ld", val);
sz[len] = 0;
  for (int i=strlen(sz); i<len; ++i)
sz[i] = ' ';
  if (len> 0)
sz[len-1] = ' ';
smartDelay(0);
}

static void printDateTime(TinyGPSDate&d, TinyGPSTime&t)
```

```
{
  if (!d.isValid())
  {
  }
  else
  {
  }

  if (!t.isValid())
  {
  }
  else
  {
  }
smartDelay(0);
}
static void printStr(const char *str, int len)
{
  int slen = strlen(str);
  for (int i=0; i<len; ++i)
smartDelay(0);
}
```

\

APPENDIX-B

PIN DIAGRAM

Fig:Pin Configuration of Atmega328

I. Pin Description

II. VCC:

III. Digital supply voltage.

IV. GND:

V. Ground.

VI. Port A (PA7-PA0):

VII. Port A serves as the analog inputs to the A/D Converter. Port A also serves as an 8-bit bi-directional I/O port, if the A/D Converter is not used. Port pins can provide internal pull-up resistors (selected for each bit). The Port A output buffers have symmetrical drive characteristics with both high sink and source capability. When pins PA0 to PA7 are used as inputs and are externally pulled low, they will source current if the internal pull-up resistors are activated. The Port A pins are tri-stated when a reset condition becomes active, even if the clock is not running.

VIII. Port B (PB7-PB0):

IX. Port B is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port B output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port B pins that are externally pulled low will source current if the pull-up resistors are activated. The Port B pins are tri-stated when a reset condition becomes active, even if the clock is not running. Port B also serves the functions of various special features of the ATmega32.

X. Port C (PC7-PC0):

XI. Port C is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port C output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port C pins that are externally pulled low will source current if the pull-up resistors are activated. The Port C pins are tri-stated when a reset condition becomes active, even if the clock is not running. If the JTAG interface is enabled, the pull-up resistors on pins PC5(TDI), PC3(TMS) and PC2(TCK) will be activated even if a reset occurs. The TD0 pin is tri-stated unless TAP states that shift out data are entered. Port C also serves the functions of the JTAG interface.

XII. Port D (PD7-PD0):

XIII. Port D is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port D output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port D pins that are externally pulled low will source current if the pull-up resistors are activated. The Port D pins are tri-stated when a reset condition becomes active, even if the clock is not running. Port D also serves the functions of various special features of the ATmega32.

XIV. Reset (Reset Input):

XV. A low level on this pin for longer than the minimum pulse length will generate a reset, even if the clock is not running. Shorter pulses are not guaranteed to generate a reset.

We are living in the Embedded World. You are surrounded with many embedded products and your daily life largely depends on the proper functioning of these gadgets. Television, Radio, CD player of your living room, Washing Machine or Microwave Oven in your kitchen, Card readers, Access Controllers, Palm devices of your work space enable you to do many of your tasks very effectively. Apart from all these, many controllers embedded in your car take care of car operations between the bumpers and most of the times you tend to ignore all these controllers.

In recent days, you are showered with variety of information about these embedded controllers in many places. All kinds of magazines and journals regularly dish out details about latest technologies, new devices; fast applications which make you believe that your basic survival is controlled by these embedded products. Now you can agree to the fact that these embedded products have successfully invaded into our world. You must be wondering about these embedded controllers or systems.