AUTOMATIC RAILWAY GATE CROSSING CONTROL AND TRACK CRACK DETECTION SYSTEM USING IOT

Submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering Degree in Electronics and Communication Engineering

by

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COMMUNICATION ENGINEERING

BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of BODABALLA VAMSI KRISHNA (37130061) and ALLAM KARTHIK (37130017) who carried out the project entitled **"AUTOMATIC RAILWAY GATE CROSSING CONTROL AND TRACK CRACK DETECTION SYSTEM USING IOT"** under our supervision from September 2020 to March 2021.

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DECLARATION

We,**BODABALLA VAMSI KRISHNA(37130061)** and **ALLAM KARTHIK(37130017)** hereby declare that the Project Report entitled **"AUTOMATIC RAILWAY GATE CROSSING CONTROL AND TRACK CRACK DETECTION SYSTEM USING IOT"** done by us under the guidance of **Dr.E.ANNA DEVI, M.E., Ph.D.** is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in Electronics and Communication Engineering.

1)

2)

DATE:

PLACE: **SIGNATURE OF THE CANDIDATES**

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ABSTRACT:

Railway system is the most commonly used transportation system especially in India. But due to miscommunication about the railway schedules and lack of coordination, accidents happen. According to survey, 60 % of the accidents happen either at crossings or cracks in railway tracks. To avoid these situations, it is necessary to have an accurate system for both of them. This paper proposes a system which includes automated railway gates at crossings and also automatic crack detection in railway tracks. This model is implemented using sensor technique. The sensors are placed at a certain distance from the gate and they detect the approaching train and accordingly control the operation of the gate. After detecting the crack, the coordinates are tracked and sent back to control room for further actions. This system includes IR sensors, ARDUINO MEGA(ATmega2560) microcontroller along with GPS and GSM modules. This system is going to be developed by using Internet of Things (IOT) technology. This will help in detecting the cracks and functioning of gates get done without any human intervention.

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LIST OF ABBREVIATIONS

LED	LIGHT EMITTING DIODE
IDE	INTEGRATED DEVELOPMENT ENVIRONMENT
ICSP	IN-CIRCUIT SERIAL PROGRAMMING
ESCP	ESPESSIF SYSTEMS SMART CONNECTIVITY PLATFORM
ROM	READ ONLY MEMORY
GSM	GLOBAL SYSYTEM FOR MOBILE COMMUNICATION
LCD	LIQUID CRYSTAL DISPLAY
HLR	HOME LOCATION REGISTER
VLR	VISITOR LOCATION REGISTER

CHAPTER 1

INTRODUCTION

The Indian Railways has one in all the greatest rail route networks inside the world, emergencies organic interaction one,15,000 kilometer in distance, wherever Asian country. Robotized entryway - free rail route activities are uncommon these days due the human carelessness and miscommunications which prompts mishaps and deferral in appearance of the train; the way or the region where street and rail lines meet is realized rail line crossing Gates are physically worked, blunders which may give rise while shutting and opening, the strategy proposed here, Our venture presents an entirely different method of computerizing the things. In this proposed work attempts to build up a strategy which does the robotization door tasks (opening and shutting) utilizing Two IR sensor put in two ways and utilizing Motor for shutting and opening of an entryway. Track Crack recognition - ongoing investigations revealed that more than twenty fifth of the track length is in might want of substitution thanks because of the improvement of breaks on it. Manual recognition of breaks is troublesome and not completely successful which prompts a lot of time. Our work presents an undertaking that points in planning hearty rail line break location plot (RRCDS) utilizing wired association all through the track at whatever point the association between wires lost, get together framework that identifies the breaks on railroad tracks. And furthermore fit for alarming the experts as SMS. We will get the longitude and scope area where the break occurred by GPS module. We likewise get refreshed in IOT site.

CHAPTER 2

LITERATURE REVIEW AND OBJECTIVE

E Amarnatha Reddy, Ilaiah Kavati, K Srinivas Rao, G Kiran Kumar have made a project to develop a prototype that control the railway gate using the micro-controller. Whenever train touches base at the sensor, caution is activated at the railway crossing so that the general population get instruction that entryway will be shut. This logic was implemented in Embedded C and dumped to the Raspberry.[1]

Dr.Velayutham.R, Sangeethavani.T, Sundaralakshmi.K have made a track and detect the arrival of the train by using GPS and not by the sensors. This way of train tracking using GPS is embedded with our mobile application. Using this application, the engine driver controls the railway gate.[2]

Miss. Sandhya Sharma, (Prof.) Dr. Neetesh Kumar Gupta have made a project a genetic algorithm is proposed that segment the image in defined part. After segmentation crack detection was done by analyzing image using TBLR threshold. Experiment is done real as well as artificial dataset.[3]

Afsana Ahmed, Kazi Rifah Noor, Tanveer Rahman have made a project, that proposed a method which is capable of controlling rail gate for level crossing which is totally automated. Couple of Sensors are connected with Wemos D1 for control autonomous rail gate with measuring distance and Thing Speak server has been used to centrally control. [4]

Marwa M. Eid, M. I. Fath Allah have made a project that is established on an Arduino UNO embedded platform to introduce automatic control crossing gates, switching train tracks and detecting line cracks with the aid of electronic sensors like IR sharp sensor, ultrasonic sensor, and gyroscopes. [5]

OBJECTIVE:

➢ **It proposes a system called Automated railway gates at crossings.**

- In this system, we use ARDUINO MEGA (ATmega2560) microcontroller which acts as brain of the system, because the entire system program instruction stored in it.
- We have IR sensor is used here for determining the arrival and departure of train so that opening and closing of gate can be operate automatically using servo motor.

➢ **To find the cracks present on the railway tracks using IOT.**

- Here we use GPS and GSM,whenever crack detected on the track LED will be on and buzzer make sound and send the location to the respective department using GPS and GSM for the security alert.
- All the data fetch with the help of sensors are update to cloud therefore all the operations are controlled and monitored by IOT.

CHAPTER-3

AIM AND SCOPE

EMBEDDED SYSTEMS:

Embedded System is a framework made out of equipment, application programming and continuous working framework. It very well may be a little independent gadget or an enormous multi-framework blend. Our Embedded System instructional exercise covers all parts of the theme, including qualities, design, processors, microcontrollers, devices, tending to modes, low level computing construct, interferes, implanted C programming, driven flickering, and the sky is the limit from there.

SYSTEM:

A system is a technique for working, orchestrating, or doing at least one undertakings as per a bunch of rules, a timetable, or a methodology. It is an arrangement where the entirety of the units cooperate to finish an undertaking progressively by adhering to a bunch of laws. It can likewise be depicted as a strategy for working, masterminding, or finishing at least one errands as per a foreordained timetable. An Embedded System is a PC equipment framework that has programming implanted in it, permitting it to be utilized for an assortment of utilizations or a specific piece of an application or item, or as a feature of a bigger frameworkAn Embedded System is a computer-hardware system that has software embedded in it, allowing it to be used for a variety of applications or a particular part of an application or product, or as part of a larger system.

CHARACTERISTICS OF EMBEDDED SYSTEM:

➤ An embedded system is a computer system with software embedded in it that can be used for a number of purposes.

➤ Embedded systems are typically used to perform particular tasks and provide real-time output based on the embedded system's various characteristics.

➤ A smaller component of a larger device may be used for serving a more specific application to perform a variety of tasks using a hardware-software intermixing configuration in an embedded system.

➤ It has a high level of reliability and can perform calculations in real time.

EXISTING SYSTEM: In the existing system, humans have no facility to operate railway gate automatically. The system we have now cannot detect crack on track.

Drawbacks of existing system

➤ The possibility of security measure is comparatively less.

➤ Crack detection on track can be done by manually

PROPOSED SYSTEM: In the proposed system, we can monitor as well as control safety status of the crack as well as railway gate. The system which implement detection of crack on railway track and less human effort.

Advantages of proposed system:

➤ The system can be operated automatically using sensors.

➤ Opening and closing of gate without any human participation.

➤ Crack detection of track can be notified automatically.

BLOCK DIAGRAM:
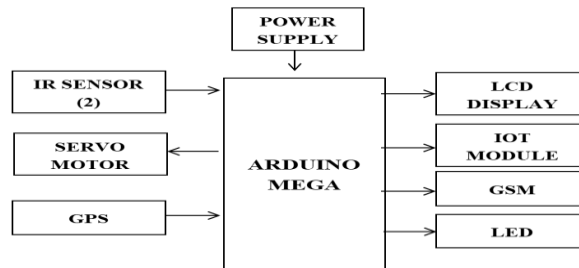
Fig-3.1 BLOCK DIAGRAM

HARDWARE REQUIREMENTS:

- ➢ ARDUINO MEGA
- ➢ IOT MODULE
- ➢ LCD DISPLAY
- ➢ GPS
- ➢ GSM
- ➢ IR SENSOR (2)
- ➢ SERVO MOTOR
- ➢ LED

SOFTWARE REQUIREMENTS:

- ➢ EMBEDDED C
- ➢ ARDUINO IDE

CHAPTER 4

MATERIALS AND METHODS USED

4.1 ARDUINO MICRO-CONTROLLER

INTRODUCTION TO ARDUINO

Arduino is an open-source gadgets stage that utilizes basic equipment and programming to make it simple to utilize. Arduino sheets can understand inputs - like light on a sensor, a finger on a catch, or a Twitter message - and convert them to yields - like turning on a LED, setting off an engine, or distributing something on the web. By sending a progression of directions to the board's microcontroller, you can instruct it.

A great many undertakings have utilized Arduino throughout the long term, going from straightforward family things to modern logical instruments. Understudies, specialists, artists, designers, and experts from everywhere the world have accumulated around this open-source organization, and their commitments have amounted to an unfathomable measure of open information that can be of extraordinary assistance to learners and specialists the same.

Arduino was made at the Ivrea Interaction Design Institute as a straightforward device for fast prototyping focused at understudies with no past experience with hardware or programming. When it acquired a bigger after, the Arduino board started to advance to fulfill new needs and difficulties, developing from fundamental 8-digit sheets to items for IoT, wearables, 3D printing, and installed conditions. All Arduino sheets are open-source, permitting clients to make them all

alone and customise them to meet their specific needs. The software is also open-source, and it is evolving thanks to contributions from users all over the world.

WHY ARDUINO?

On account of its basic and available client experience, Arduino has been utilized in huge number of various tasks and applications. The Arduino programming is not difficult to-use for fledglings, yet adaptable enough for cutting edge clients. It runs on Mac, Windows, and Linux. Educators and understudies use it to fabricate minimal effort logical instruments, to demonstrate science and physical science standards, or to begin with programming and advanced mechanics. Originators and modelers assemble intelligent models, performers and craftsmen use it for establishments and to try different things with new instruments. Producers, obviously, use it to fabricate a considerable lot of the tasks displayed at the Maker Faire, for instance. Arduino is a critical instrument to learn new things. Anybody - youngsters, specialists, craftsmen, developers - can begin dabbling simply adhering to the bit by bit directions of a unit, or sharing thoughts online with different individuals from the Arduino people group.

There are numerous other microcontrollers and microcontroller stages accessible for actual figuring. Parallax Basic Stamp, Netmedia's BX-24, Phidgets, MIT's Handyboard, and numerous others offer comparable usefulness. These devices take the muddled subtleties of microcontroller programming and envelop it with a simple to-utilize bundle. Arduino additionally improves on the way toward working with microcontrollers, yet it offers some benefit for instructors, understudies, and intrigued novices over different frameworks:

Inexpensive - In comparison to other microcontroller platforms, Arduino boards are relatively inexpensive. The Arduino module's cheapest version can be built by hand, and even pre-assembled Arduino modules cost less than $50.

➢ **Cross-platform** - The Arduino Software (IDE) is compatible with Windows, Macintosh OSX, and Linux. The majority of microcontroller systems are only compatible with Windows.

➢ **Simple, transparent programming environment** - The Arduino Software (IDE) is simple to use for beginners while still being versatile enough for experienced users. It's focused on the Processing programming environment, which is convenient for teachers and students learning to programme in that environment will be familiar with how the Arduino IDE works.

➢ **Open source and extensible software** - The Arduino software is available as open source tools for advanced programmers to extend. People who want to learn more about the language should use C++ libraries, and those who want to learn more about the technical specifics should move from Arduino to the AVR C programming language. Similarly, if you want to, you can use AVR-C code directly in your Arduino programmes.

➢ **Hardware that is open source and extensible** - The Arduino board plans are made available under a Creative Commons licence, allowing professional circuit designers to create their own version of the module, expanding and enhancing it. The breadboard version of the module can be built by even novice users in order to understand how it works and save money.

ARDUINO MEGA:

The MEGA 2560 is designed for more complex projects. With 54 digital I/O pins, 16 analog inputs and a larger space for your sketch it is the

recommended board for 3D printers and robotics projects. This gives your projects plenty of room and opportunities.

4.2 ARDUINO MEGA 2560

Fig 4.2 Arduino mega 2560

The ATmega2560 is the basis for the Arduino Mega 2560 microcontroller board. It has 54 digital input/output pins, 16 analogue inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB link, a power jack, an ICSP header, and a reset button. It comes with everything you'll need to get started with the microcontroller; simply plug it into a device with a USB cable or power it with an AC-to-DC adapter or battery. Most shields designed for the Uno and previous boards Duemilanove or Diecimila are compatible with the Mega 2560 board.

4.3 TECHNICAL SPECIFICATIONS:

Microcontroller	ATmega2560
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limit)	6-20V
Digital I/O Pins	54 (of which 15 provide PWM output)
Analog Input Pins	16
DC Current per I/O Pin	20 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	256 KB of which 8 KB used by boot loader
SRAM	8 KB
EEPROM	4 KB
Clock Speed	16 MHz
LED_BUILTIN	13
Length	101.52 mm
Width	53.3 mm

HARDWARE:

Arduino is a piece of equipment that is allowed to utilize. The equipment reference plans are accessible on the Arduino site under a Creative Commons Attribution Share-Alike 2.5 permit. A few renditions of the equipment have format and creation records accessible also.

Not withstanding the way that the equipment and programming plans are openly accessible under copyleft licenses, the engineers have requested that the name Arduino be held for the authority item and not utilized in subsidiary works without authorization. The authority strategy record on the use of the Arduino name focuses on that the undertaking is available to coordinating others' work into the last product.Several Arduino-viable items industrially delivered have kept away from the venture name by utilizing different names finishing off with arduino. An early Arduino board with a RS-32 interface (upper left) and an Atmel ATmega8 microcontroller chip (dark, lower right); the 14 computerized I/O pins are at the top, the 6 simple info pins at the lower right, and the force connector at the lower left.

Most Arduino sheets have various amounts of blaze memory, pins, and highlights (ATmega8, ATmega168, ATmega328, ATmega1280, ATmega2560). In 2012, the 32-cycle Arduino Due, in light of the Atmel SAM3X8E, was delivered. Single or twofold line pins or female headers are utilized on the sheets to make associations for programming and joining into different circuits simpler. Safeguards are add-on modules that can be associated with these. An I2C sequential transport might be utilized to separately address a few and potentially stacked safeguards. A 5 V straight controller and a 16 MHz gem or clay resonator are standard on most boards.Some plans, like the LilyPad, run at 8 MHz and shed the locally available voltage controller because of explicit structure factor limitations.

The boot loader on Arduino microcontrollers is pre-customized to make transferring projects to the on-chip streak memory simpler. The optiboot bootloader is the Arduino UNO's default bootloader. A sequential connect to another gadget is utilized to stack program code onto the sheets. A level shifter circuit is remembered for some sequential Arduino sheets to switch between RS-232 rationale levels and TTL level signs. Arduino sheets are presently customized through USB utilizing USB-to-chronic connector chips like the FTDI-FT232. A few sheets, as later-model Uno sheets, supplant the FTDI chip with a different AVR chip that contains USB-to-sequential firmware that can be reconstructed with its own ICSP header.Other variations, like the Arduino Mini and the informal Boarduino, utilize a separable USB-to-chronic connector board or link, Bluetooth or different strategies. At the

point when utilized with conventional microcontroller apparatuses, rather than the Arduino IDE, standard AVR ,ISP writing computer programs is used.An official Arduino Uno R2 with portrayals of the I/O areas

The greater part of the microcontroller's I/O pins are uncovered on the Arduino board and can be utilized by different circuits. The Diecimila,[a] Duemilanove,[b] and current Uno[c] each have 14 computerized I/O pins, six of which can create pwm signs, and six simple information sources that can likewise be utilized as advanced I/O pins. Female 0.1-inch (2.54 mm) headers interface these pins to the highest point of the casing. Economically accessible module gadget safeguards are additionally accessible. Male header pins on the underside of the Arduino Nano, just as Arduino-viable Bare Bones Board and Boarduino sheets, might be utilized to interface with solderless breadboards.

There are various Arduino-viable and Arduino-inferred sheets accessible. Some capacity similarly as an Arduino and can be utilized conversely. Numerous individuals improve the fundamental Arduino by adding yield drivers, which are additionally utilized in school-level instruction to make carriages and little robots simpler. Others are electrically comparable however have an alternate structure factor, which might be viable with safeguards. Various processors are utilized in a few variants, with differing levels of similarity.

PROGRAMMING:

The Arduino IDE can be used to programme the Mega 2560 board (Software).

The boot loader on the ATmega2560 on the Mega 2560 comes preprogrammed, allowing you to upload new code to it without the use of an external hardware programmer. It uses the original STK500 protocol to communicate (Refernce, C header files).

You may also use Arduino ISP or similar to bypass the boot loader and programme the microcontroller directly via the ICSP (In-Circuit Serial Programming) header.

The ATmega16U2 (or 8U2 in the rev1 and rev2 boards) firmware source code is available in the Arduino repository. The ATmega16U2/8U2 is loaded with a DFU boot loader, which can be activated by:

- **On Rev1 boards:** connecting the solder jumper on the back of the board (near the map of Italy) and then resetting the 8U2.

- **On Rev2 or later boards:** there is a resistor that pulling the 8U2/16U2 HWB line to ground, making it easier to put into DFU mode. You can then use FLIP(Windows)or the DFU (Mac OS X and Linux) to load a new firmware. Or you can use the ISP header with an external programmer (overwriting the DFU boot loader).

- **WARNINGS:**

A resettable poly fuse protects your computer's USB ports from shorts and overcurrent with the Mega 2560. Although most computers have their own built-in protection, the fuse adds another layer of security. The fuse will immediately break the link if more than 500 mA is added to the USB port before the short or overload is removed.

POWER:

The Mega 2560 can be fueled either by USB or by an outer force source. The force source is naturally picked.

An AC-to-DC connector (divider mole) or a battery can give outside (non-USB) power. Associating the connector is just about as basic as connecting a 2.1mm focus positive fitting into the board's force jack.

Leads from a battery can be embedded in the GND and Vin pin headers of the POWER connector.

The board can work on an outside supply of 6 to 20 volts. Whenever provided with under 7V, in any case, the 5V pin may supply under five volts and the board may get precarious. In the event that utilizing more than 12V, the voltage controller may overheat and harm the board. The prescribed reach is 7 to 12 volts.

  ➢ The force pins are as per the following:

  ➢ **Vin**-When using an external power source, Vin is the input voltage to the board (as opposed to 5 volts from the USB connection or other regulated power source). This pin may be used to supply voltage or to access voltage if it is supplied through the power jack.

  ➢ 5 volts This pin receives a controlled 5V from the board's regulator. The board can be powered by the DC power jack (7 - 12V), the USB connector (5V), or the VIN pin on the board (7-12V). Using the 5V or 3.3V pins to supply voltage bypasses the regulator and may cause damage to your board. We don't recommend it.

  ➢ **3V3**. A 3.3 volt supply generated by the on-board regulator. Maximum current draw is 50 mA.

  ➢ **GND**. Ground pins.

IOREF. The voltage reference with which the microcontroller operates is provided by this pin on the board. The IOREF pin voltage can be read by a correctly calibrated shield, which can then pick the necessary power source or power supply enable voltage translators on the outputs for working with the 5V or 3.3V.

4.4 Arduino Mega 2560 PIN diagram

Fig 4.4 Arduino mega 2560 pin diagram

4.5 Arduino Mega 2560 PIN mapping table

Pin Number	Pin Name	Mapped Pin Name
1	PG5 (OC0B)	Digital pin 4 (PWM)
2	PE0 (RXD0/PCINT8)	Digital pin 0 (RX0)
3	PE1 (TXD0)	Digital pin 1 (TX0)
4	PE2 (XCK0/AIN0)	
5	PE3 (OC3A/AIN1)	Digital pin 5 (PWM)
6	PE4 (OC3B/INT4)	Digital pin 2 (PWM)
7	PE5 (OC3C/INT5)	Digital pin 3 (PWM)
8	PE6 (T3/INT6)	
9	PE7 (CLKO/ICP3/INT7)	
10	VCC	VCC
11	GND	GND
12	PH0 (RXD2)	Digital pin 17 (RX2)
13	PH1 (TXD2)	Digital pin 16 (TX2)
14	PH2 (XCK2)	
15	PH3 (OC4A)	Digital pin 6 (PWM)

16	PH4 (OC4B)	Digital pin 7 (PWM)
17	PH5 (OC4C)	Digital pin 8 (PWM)
18	PH6 (OC2B)	Digital pin 9 (PWM)
19	PB0 (SS/PCINT0)	Digital pin 53 (SS)
20	PB1 (SCK/PCINT1)	Digital pin 52 (SCK)
21	PB2 (MOSI/PCINT2)	Digital pin 51 (MOSI)
22	PB3 (MISO/PCINT3)	Digital pin 50 (MISO)
23	PB4 (OC2A/PCINT4)	Digital pin 10 (PWM)
24	PB5 (OC1A/PCINT5)	Digital pin 11 (PWM)
25	PB6 (OC1B/PCINT6)	Digital pin 12 (PWM)
26	PB7 (OC0A/OC1C/PCINT7)	Digital pin 13 (PWM)
27	PH7 (T4)	
28	PG3 (TOSC2)	
29	PG4 (TOSC1)	
30	RESET	RESET
31	VCC	VCC
32	GND	GND
33	XTAL2	XTAL2

34	XTAL1	XTAL1
35	PL0 (ICP4)	Digital pin 49
36	PL1 (ICP5)	Digital pin 48
37	PL2 (T5)	Digital pin 47
38	PL3 (OC5A)	Digital pin 46 (PWM)
39	PL4 (OC5B)	Digital pin 45 (PWM)
40	PL5 (OC5C)	Digital pin 44 (PWM)
41	PL6	Digital pin 43
42	PL7	Digital pin 42
43	PD0 (SCL/INT0)	Digital pin 21 (SCL)
44	PD1 (SDA/INT1)	Digital pin 20 (SDA)
45	PD2 (RXDI/INT2)	Digital pin 19 (RX1)
46	PD3 (TXD1/INT3)	Digital pin 18 (TX1)
47	PD4 (ICP1)	
48	PD5 (XCK1)	
49	PD6 (T1)	
50	PD7 (T0)	Digital pin 38
51	PG0 (WR)	Digital pin 41

52	PG1 (RD)	Digital pin 40
53	PC0 (A8)	Digital pin 37
54	PC1 (A9)	Digital pin 36
55	PC2 (A10)	Digital pin 35
56	PC3 (A11)	Digital pin 34
57	PC4 (A12)	Digital pin 33
58	PC5 (A13)	Digital pin 32
59	PC6 (A14)	Digital pin 31
60	PC7 (A15)	Digital pin 30
61	VCC	VCC
62	GND	GND
63	PJ0 (RXD3/PCINT9)	Digital pin 15 (RX3)
64	PJ1 (TXD3/PCINT10)	Digital pin 14 (TX3)
65	PJ2 (XCK3/PCINT11)	
66	PJ3 (PCINT12)	
67	PJ4 (PCINT13)	
68	PJ5 (PCINT14)	
69	PJ6 (PCINT 15)	

70	PG2 (ALE)	Digital pin 39
71	PA7 (AD7)	Digital pin 29
72	PA6 (AD6)	Digital pin 28
73	PA5 (AD5)	Digital pin 27
74	PA4 (AD4)	Digital pin 26
75	PA3 (AD3)	Digital pin 25
76	PA2 (AD2)	Digital pin 24
77	PA1 (AD1)	Digital pin 23
78	PA0 (AD0)	Digital pin 22
79	PJ7	
80	VCC	VCC
81	GND	GND
82	PK7 (ADC15/PCINT23)	Analog pin 15
83	PK6 (ADC14/PCINT22)	Analog pin 14
84	PK5 (ADC13/PCINT21)	Analog pin 13
85	PK4 (ADC12/PCINT20)	Analog pin 12
86	PK3 (ADC11/PCINT19)	Analog pin 11
87	PK2 (ADC10/PCINT18)	Analog pin 10

88	PK1 (ADC9/PCINT17)	Analog pin 9
89	PK0 (ADC8/PCINT16)	Analog pin 8
90	PF7 (ADC7)	Analog pin 7
91	PF6 (ADC6)	Analog pin 6
92	PF5 (ADC5/TMS)	Analog pin 5
93	PF4 (ADC4/TMK)	Analog pin 4
94	PF3 (ADC3)	Analog pin 3
95	PF2 (ADC2)	Analog pin 2
96	PF1 (ADC1)	Analog pin 1
97	PF0 (ADC0)	Analog pin 0
98	AREF	Analog Reference
99	GND	GND
100	AVCC	VCC

Utilizing the pinmode(), digitalWrite(), and digitalread() keys, every one of the Mega's 54 advanced pins can be utilized as an info or yield. They are fueled by 5 volts. Each pin has a 20-50 k ohm inward draw up resistor (separated naturally) and can give or get 20 mA as a suggested working condition. To forestall perpetual harm to the microcontroller, a most extreme current of 40mA should not be surpassed.

In addition, some pins have specialized functions:

- **Serial:** 0 (RX) and 1 (TX); Serial 1: 19 (RX) and 18 (TX); Serial 2: 17 (RX) and 16 (TX); Serial 3: 15 (RX) and 14 (TX); Serial 1: 19 (RX) and 18 (TX); Serial 2: 17 (RX) and 16 (TX); Serial 3: 15 (RX) and 14 (TX); Serial 3: 15 (RX) and 14 (TX (TX). TTL serial data is received (RX) and transmitted (TX) using this device. Pins 0 and 1 are also wired to the ATmega16U2 USB-to-TTL Serial chip's corresponding pins.

- **External Interrupt**:2 (interrupt 0), 3 (interrupt 1), 18 (interrupt 5), 19 (interrupt 4), 20 (interrupt 3), and 21 (interrupt 3). (interrupt 2). On a low level, a rising or falling lip, or a shift in level, these pins can be programmed to cause an interrupt.

- **PWM** ranges from 2 to 13 and 44 to 46. The anaologfunction() function generates 8-bit PWM performance.

- **SPI**: 50 (MISO), 51 (MOSI), 52 (SCK), 53 (SS). These pins support SPI communication using the SPI library. The SPI pins are also broken out on the ICSP header, which is physically compatible with the Arduino /Genuino Uno and the old Duemilanove and Diecimila Arduino boards.

- **LED**: 13. A built-in LED is attached to the digital pin. 13. The LED is turned on when the pin is HIGH, and it is turned off when the pin is LOW.

- **TWI**: 20 (SDA) and 21 (SDA) (SCL). Using the Wire library, support TWI communication. The TWI pins on the old Duemilanove and Diecimila Arduino boards are not in the same position as these pins.

- The Mega 2560 has 16 analogue inputs, each with a resolution of 10 bits (i.e. 1024 different values). They measure from ground to 5 volts by default, but the AREF pin and analogRefernce() function can be used to adjust the upper end of their range.

- On the board, there are a few more pins:

- **AREF**. Reference voltage for the analog inputs. Used with analogReference().

- **Reset**. Bring this line LOW to reset the microcontroller. Typically used to add a reset button to shields which block the one on the board.

COMMUNICATION:

A screen, another board, or other microcontrollers would all be able to be spoken with utilizing the Mega 2560 board. For TTL (5V) sequential correspondence, the ATmega2560 has four equipment UARTs. One of these is diverted over USB by an ATmega16U2 (ATmega 8U2 on correction 1 and modification 2 sheets) on the board, which gives a virtual com port to programming on the gadget (Windows machines will require a.inf register, yet OSX and Linux machines will perceive the board as a COM port consequently). A chronic screen is remembered for the Arduino Software (IDE), which permits basic text based information to be shipped off and from the board. At the point when information is being communicated preposterous, the RX and TX LEDs on the board will enlighten. ATmega8U2/ATmega16U2 chip and USB association with the PC (yet not

for sequential correspondence on pins 0 and 1).A software library allows for serial communication on any of the Mega 2560's digital pins.

The Mega 2560 also supports TWI and SPI communication. The Arduino Software (IDE) includes a Wire library to simplify use of the TWI bus.

APPLICATIONS:

- ➢ Arduboy, an Arduino-based handheld game console.
- ➢ The Arduinome is a MIDI controller that looks like the Monome.
- ➢ Drone software and hardware from Arduipilot.
- ➢ Ardusat is an Arduino-based cubesat.
- ➢ C-STEM is an acronym that stands for "Comprehensive Science, Technology, and Stduio is a robotics-based platform for hands-on learning in computing, science, technology, engineering, and mathematics (C-STEM).
- ➢ For scientific analysis, data loggers are used.
- ➢ OBDuino is a trip machine that works with most modern cars' on-board diagnostics interface.

4.6 INTERNET OF THINGS

The web of things (IoT) is an organization of actual gadgets, vehicles, houses, and different things that are outfitted with hardware, programming, sensors, actuators, and organization correspondence to catch and share information. The Internet of Things (IoT) was portrayed as "the framework of the data society" by the Global Standards Initiative on Internet of Things (IoT-GSI) in 2013. The Internet of Things permits objects to be detected and overseen distantly over existing organization foundation, considering more straightforward actual world consolidation into PC

based frameworks. frameworks, and bringing about improved productivity, precision and monetary advantage. As IoT is joined with sensors and actuators, it is named a digital actual gadget, which incorporates keen matrices, keen structures, insightful transportation, and savvy urban areas. Every thing is interestingly unmistakable because of its implanted figuring framework, however it can likewise speak with different things on the Internet. Specialists anticipate that by 2020, the Internet of Things would have almost 50 billion things.

Framework:

The Internet of Things has gotten imbued in our day by day lives. It, including water, power, phone, TV, and, most as of late, the Internet, has become a fundamental piece of our general framework. The Internet of Things (as a component of the Future Internet) would interface regular articles with a reasonable fuse into the actual world, while the current Internet for the most part connects full-scale PCs.

1. Attachment and-play usefulness

There is a lot of variety in IoT-related advances accessible today. It's just utilized for unmistakable purposes, and setting it up takes a great deal of innovative skill and can be time-consuming.To accomplish a genuine Internet of Things we need to move away from such limited scope, vertical application storehouses, towards an even framework on which an assortment of utilizations can run at the same time.

2.Infrastructure Functionality

The foundation should help applications in finding the assets they need. Anyplace, even on the actual things, an application will run. The time it takes to discover something isn't restricted to the time it takes for an application to fire up. At the point when significant new things become open, things become inaccessible, or the situation with things changes, programmed transformation is required.The

infrastructure must be able to facilitate the monitoring of such changes as well as the necessary adaptation as a result of the changes..

3.Physical Location and Position

Since the Internet of Things is so profoundly established in reality, actual area and spot are basic, for finding things as well as for acquiring data. Accordingly, the foundation should help discovering things dependent on their position (for example geo-area based revelation). Confinement advances, which consider flexibility, will assume a significant part in the Internet of Things and can get coordinated in its foundation.

4. Classification and security

Furthermore, a security and protection framework should uphold capacities like confirmation, privacy, genuineness, and non-repudiation.Here the heterogeneity and the requirement for interoperability among various ICT frameworks conveyed in the foundation and the asset restrictions of IoT gadgets (e.g., Nano sensors) must be considered.

Information Management

In the Internet of Things, information preparing is basic. The measure of delivered information and the cycles engaged with its taking care of become significant while considering a universe of interconnected articles consistently trading a wide range of data. Machine-to-Machine (M2M) figuring, which is one of the empowering advancements for the Internet of Things, is a drawn out market for remote interchanges chip creators. This innovation can be utilized in a wide assortment of circumstances. In spite of the fact that everybody concurs that M2M is a promising development territory, investigator gauges on the size of the market contrast by a factor of four [16].

Traditionalist evaluations expect about 80 million to 90 million M2M units will be sold in 2014, while more hopeful projections figure deals of 300 million units. Unit deals in M2M could increment by a factor of ten throughout the following five years, as indicated by verifiable examinations of appropriation bends for related troublesome advancements, for example, compact MP3 players and electronically monitored slowing mechanisms for vehicles (see Figure 2.29 [16]). In the IoT foundation, there are a few advancements and components engaged with "information the board." coming up next are probably the main rules that assist us with liking the difficulties and chances of information the executives:• Data Collection and Analysis

• Big Data

• Semantic Sensor Networking

• Virtual Sensors

• Complex Event Processing.

APPLICATION AREAS:

The advancement of business sectors and applications, and consequently their financial potential and impacts in tending to social turns of events and difficulties in the coming many years, has changed radically over the most recent couple of years. As demonstrated in Figure 2.15, cultural examples are separated into five classes: wellbeing and prosperity, transportation and portability, insurance and security, energy and environment, network, and e-society. Shopper gadgets, auto hardware, clinical applications, organizing, and different enterprises are for the most part seeing significant development because of these turns of events. More-Moore and More-than-innovations, systems administration, organizations, and programming all benefit straightforwardly from these applications.

a)**Cities**

Smart Parking: Monitoring of parking spaces availability in the city.

Structural health: Monitoring of vibrations and material conditions in buildings, bridges and historical monuments.

Waste Management: Detection of rubbish levels in containers to optimize the trash collection routes.

b)Environment

Forest Fire Detection: Monitoring of combustion gases and preemptive fire conditions to define alert zones.

**Air Pollution:** Control of CO_2 emissions of factories, pollution emitted by

c)Water

Water Quality: Study of water suitability in rivers and the sea for fauna and Eligibility for drinkable use.

Water Leakages: Detection of liquid presence outside tanks and pressure variations along pipes.

4.7 ESP-12E BASED NODEMCU

The Espressif ESP8266 is a microcontroller made by Espressif Systems. The ESP8266 is an independent Wi-Fi organizing framework that can work as an extension between existing microcontrollers and Wi-Fi, just as run independent applications. This module has an inherent USB connector just as an enormous number of pin-outs. You can join the NodeMCU devkit to your PC through a miniature USB link and glimmer it very much like NODEMCU.
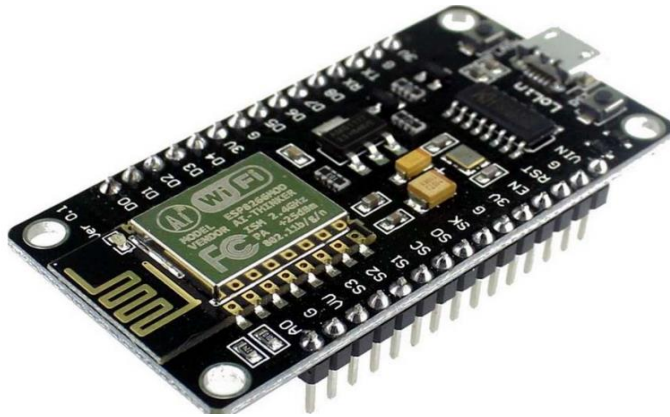
Fig 4.7-ESP-12E BASED NODEMCU

Simulated intelligence scholar Team made the ESP-12E Wi-Fi module. Tensilica L106 consolidates industry-driving super low force 32-digit MCU miniature, with the 16-cycle short mode, Clock speed support 80 MHz, 160 MHz, upholds the RTOS, coordinated Wi-Fi MAC/BB/RF/PA/LNA, on-board recieving wire in more modest sizes of the module. The module incorporates a full TCP/IP convention stack and supports standard IEEE802.11 b/g/n arrangement. Clients can associate modules to a current gadget's organizing or make their own organization regulator. ESP8266 is a high-combination remote SOC intended for versatile stage architects with restricted space and power.It gives magnificent capacity to insert Wi-Fi abilities inside different frameworks, or to work as an independent application, with the least expense, and negligible space necessity or to function as a standalone application, with the lowest cost, and minimal space requirement.
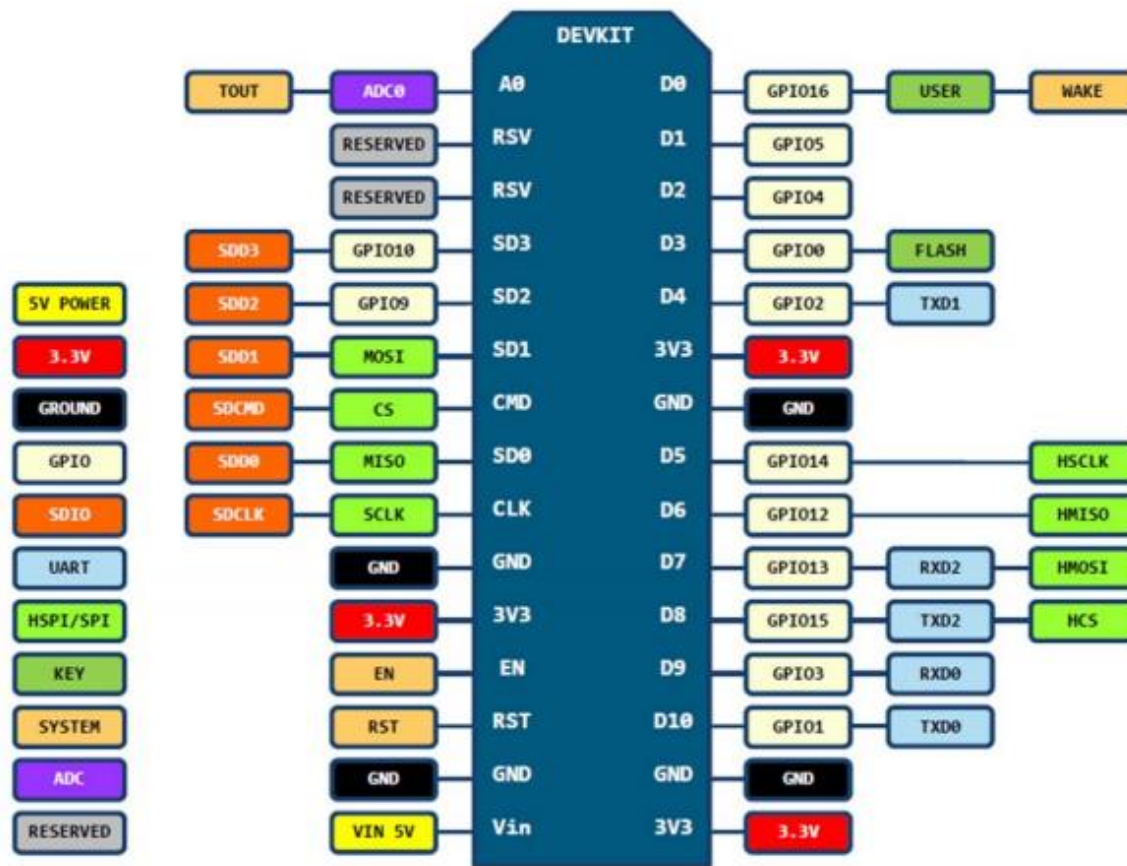
Fig 4.8 NODEMCU PIN CONFIGURATION

The ESP8266EX is a finished and independent Wi-Fi organizing arrangement that can either have or offload Wi-Fi organizing capacities from another application processor. As the ESP8266EX runs the program, it does as such from an outer glimmer drive. To expand the framework's presentation in such applications, it has an incorporated store. Then again, any microcontroller-based plan with simple network (SPI/SDIO or I2C/UART interface) can be utilized as a Wi-Fi connector to give remote web access. The ESP8266EX is one of the business' most incorporated Wi-Fi chips, including recieving wire switches, RF balun, power enhancer, low commotion get intensifier, and filter.power the executives modules, it requires negligible outer hardware, and the whole arrangement, including front-end module, is intended to possess insignificant PCB region.

ESP-12E ARCHITECTURE

Beside Wi-Fi, the ESP8266EX incorporates a redesigned rendition of Tensilica's L106 Diamond arrangement 32-digit processor with on-chip SRAM. Through its GPIOs, the ESP8266EX is regularly associated with outer sensors and other application-explicit gadgets; codes for such applications are remembered for the SDK's models. Speedy rest/wake setting exchanging for energy-productive VoIP and versatile radio biasing are among the complex framework level highlights exhibited by Espressif Systems' Smart Connectivity Platform (ESCP). Low-power activity, progressed signal handling, and radio conjunction usefulness for basic cell, Bluetooth, DDR, LVDS, and LCD impedance relief

Features

- 802.11 b/g/n
- Integrated low power 32-bit MCU
- Integrated 10-bit ADC
- Integrated TCP/IP protocol stack
- Integrated TR switch, balun, LNA, power amplifier and matching network
- Integrated PLL, regulators, and power management units
- Supports antenna diversity
- Wi-Fi 2.4 GHz, support WPA/WPA2
- Support STA/AP/STA+AP operation modes
- Support Smart Link Function for both Android and iOS devices
- Support Smart Link Function for both Android and iOS devices
- SDIO 2.0, (H) SPI, UART, I2C, I2S, IRDA, PWM, GPIO
- STBC, 1x1 MIMO, 2x1 MIMO
- A-MPDU & A-MSDU aggregation and 0.4s guard interval

- Deep sleep power < 5uA

- Wake up and transmit packets in < 2ms

- Standby power consumption of < 1.0mW (DTIM3)

- +20dBm output power in 802.11b mode

- Operating temperature range -40C ~ 125C

4.9 ESP-12E PIN CONFIGURATION

PIN MODE

Mode	GPIO15	GPIO0	GPIO2
UART	Low	Low	High
Flash Boot	Low	High	High

Receiver Sensitivity

Parameters	Min	Typical	Max	Unit
Input frequency	2412		2484	MHz
Input impedance		50		Ω
Input reflection			-10	dB
Output power of PA for 72.2Mbps	15.5	16.5	17.5	dBm
Output power of PA for 11b mode	19.5	20.5	21.5	dBm
Sensitivity				
DSSS, 1Mbps		-98		dBm
CCK, 11Mbps		-91		dBm
6Mbps (1/2 BPSK)		-93		dBm
54Mbps (3/4 64-QAM)		-75		dBm
HT20, MCS7 (65Mbps, 72.2Mbps)		-72		dBm
Adjacent Channel Rejection				
OFDM, 6Mbps		37		dB
OFDM, 54Mbps		21		dB
HT20, MCS0		37		dB
HT20, MCS7		20		dB

Schematic
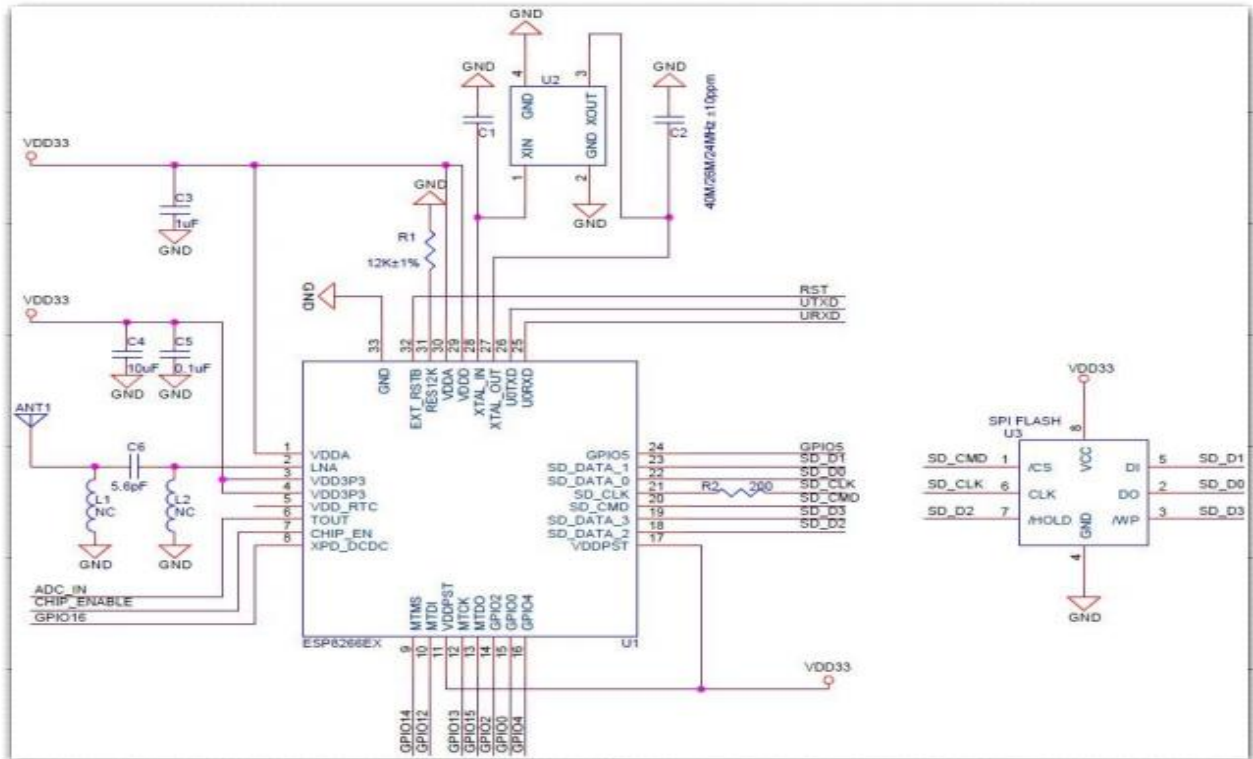
Fig 4.10 Schematics of Esp-12E Wi-Fi Module

Functional Descriptions

MCU

Tensilica L106 32-bit micro controller (MCU) with extra low power consumption and 16-bit RSIC is integrated in the ESP8266EX. The CPU runs at a frequency of 80 MHz. It has a maximum frequency of 160 MHz. Via its GPIOs, the ESP8266EX is frequently connected to external sensors and other unique devices; examples of such applications are included in the SDK.

Memory Organization

Internal SRAM and ROM

The ESP8266EX Wi-Fi SoC includes a memory controller with SRAM and ROM. Via iBus, dBus, and AHB interfaces, the MCU can communicate with the memory units. Both memory units may be visited on demand, and a memory arbiter can determine the running sequence based on the time the processor receives these requests. The SRAM space that is open to users is allocated as follows, according to our current version of SDK:

When the ESP8266EX is in station mode and linked to the router, the amount of programmable space available to the user in the heap and data portion is about 36kB.)

▪ There is no programmable ROM in the SoC, therefore, user program must be stored in an external SPI flash.

4.11 GLOBAL SYSTEM FOR MOBILE COMMUNICATION (GSM)

DEFINITION:

The Global System for Mobile Communication (GSM) is a digital cellular communication protocol that is universally recognised. GSM stands for Global System for Mobile Communications, and it was established in 1982 with the aim of developing a popular European mobile telephone standard that would define requirements for a pan-European mobile cellular radio system operating at 900 MHz. Many countries outside of Europe are expected to join the GSM alliance.

INTRODUCTION: THE EVOLUTION OF MOBILE TELEPHONE SYSTEMS:

Perhaps the most quickly developing and testing broadcast communications applications is cell. Today, it represents a steadily expanding level of all new telephone memberships around the world. There are as of now in excess of 45 million cell endorsers around the world, with practically 50% of them dwelling in the United States. Cell networks dependent on computerized advancements are relied upon to turn into the standard method of correspondence. Forecasters gauge that by 2005, there will be more than 100 million cell endorsers around the world. It has likewise been anticipated that continuously 2000, a few nations would have more cells than fixed telephones.
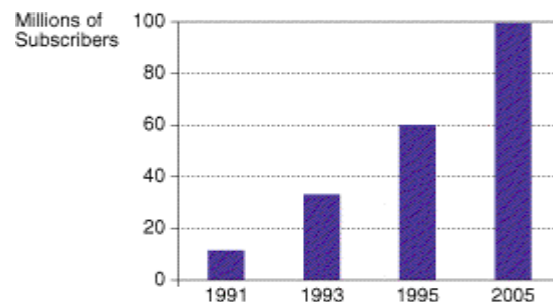
Fig 4.12 CELLULAR SUBSCRIBER GROWTH WORLDWIDE

Cell administration depends on the utilization of low-power transmitters that can reuse frequencies inside a local district. In the mid 1970s, Bell Labs in the United States concocted the idea of a cell-based versatile radio help. With the appearance of the Nordic Mobile Telephone (NMT) in 1981, the Nordic nations were quick to embrace cell networks for business use.

In 1983, the high level cell phone administration (AMPS) framework was delivered in the United States, denoting the start of cell organizations. Asia, Latin America, and Oceania have all embraced the AMPS standard, shaping the world's biggest expected cell market.

Numerous cell phone administrations in the mid 1980s were simple as opposed to advanced, as they are currently. One issue that simple frameworks confronted was their powerlessness to satisfy rising force needs in a practical way. Accordingly, arising innovation was energetically embraced. The straightforwardness of flagging, lower levels of interference, and intermingling are altogether advantages of advanced frameworks over simple frameworks.

THE GSM NETWORK:

GSM sets ideas instead of expectations. The GSM determinations broadly expound on the capacities and interface prerequisites, yet they don't cover the equipment. The clarification for this is to confine fashioners as little as could really be expected while likewise permitting administrators to buy hardware from an assortment of providers. The exchanging framework (SS), the base station framework (BSS), and the help and emotionally supportive network (OSS) make up the GSM organization (OSS). The fundamental GSM network components are portrayed in the graph underneath.

GSM NETWORK ELEMENTS:

THE SWITCHING SYSTEM:

The switching system (SS) is responsible for performing call processing and subscriber-related functions. The switching system includes the following functional units:

➢ home area register (HLR)— The HLR is a membership information base that stores and oversees memberships. The HLR is the most important data set since it stores perpetual data about clients, for example, their administration profile, position, and movement status. At the point when an individual buys a membership from one of the PCS administrators, the person is added to that administrator's HLR.

➢ mobile administrations exchanging focus (MSC)— The MSC is responsible for the framework's communication exchanging. It oversees approaching and active calls to and from other telephone and information frameworks. It likewise handles cost tagging, network interfacing, and essential channel motioning, in addition to other things.

➢ visitor area register (VLR)— The VLR is a data set that the MSC uses to store transitory data about endorsers to offer support to visiting supporters. The MSC and the VLR are frequently associated. At the point when a portable station wanders into another MSC area, the VLR related with that MSC will get some information about the versatile station. On the off chance that the portable station settles on a decision later, the VLR will have the subtleties it needs to set up the call without questioning the HLR without fail.

➢ authentication focus (AUC)— The AUC is a gadget that gives validation and encryption standards that check the client's character while additionally guaranteeing the call's secrecy. In the present cell world, the AUC protects network administrators from different types of misrepresentation.

➢ The gear ID register (EIR) is a data set that stores data about the personality of

portable hardware to keep calls from being set by taken, unapproved, or flawed versatile stations. The AUC and EIR can be executed independently or as a solitary AUC/EIR hub.

4.13 SIM 900 GSM/GPRS MODULE:

Fig 4.13 SIM 900 GSM

The GSM/GPRS Modem-RS232 is outfitted with a Dual Band GSM/GPRS motor (SIM900) that works at frequencies of 900 and 1800 MHz. The modem has a RS232 interface, which permits you to associate it to a PC or a microcontroller that has a RS232 chip (MAX232). The baud rate can be changed from 9600 to 115200 utilizing the AT button. The interior TCP/IP stack on the GSM/GPRS Modem permits you to interface with the web through GPRS. In M2M gui, it is appropriate for SMS, Voice, and DATA move applications. You can connect a wide scope of unregulated force supplies to the locally available Controlled Power Supply. You can utilize this modem to settle on sound decisions, send and get SMS, answer approaching calls, and access the web utilizing simple AT orders.

FEATURES:

➢ Dual-Band GSM/GPRS 900/ 1800 MHz.

➢ RS232 interface for direct communication with computer or MCU kit.

➢ Configurable baud rate.

➢ Power controlled using 29302WU IC.

➢ ESD Compliance.

➢ Enable with MIC and SPeaker socket.

➢ With slid in SIM card tray.

➢ With Stub antenna and SMA connector.

➢ Input Voltage: 12V DC.

POWER MODES:

Power down mode:

➢ SIM900A is set power down mode by "AT+CPOWD=0".

➢ There are two methods for the module to enter into low current consumption status.

Minimum Functionality Mode:

➢ Minimum functionality mode reduces the functionality of the module to a minimum and thus minimizes the current consumption to the lowest level.

➢ If SIM900A has been set to minimum functionality by "AT+CFUN=0".

➢ If SIM900A has been set to full functionality by "AT+CFUN=1".

➢ If SIM900A is set "AT+CFUN=4" to disable both the above functionality.

Sleep mode:

Via the DTR signal, we can monitor the SIM900A module to enter or exit the SLEEP mode in customer applications. SIM900A enters SLEEP mode automatically when DTR is set to high and there is no on-air or hardware interrupt (such as GPIO interrupt or data on serial port). The SIM900A can still receive paging

receive paging or SMS from network but the serial port is not accessible.

Wake up SIM900A from sleep mode:

➢ Enable SIM900A is woken up using the DTR pin. This signal will wake up SIM900A from power saving mode if DTR pin is pulled down to a low stage. After DTR has been set to a low level for about 50ms, the serial port will be active.

➢ SIM900A is awakened by receiving a voice or data call from the network.

➢ SIM900A is awakened by receiving an SMS from the network.

4.14 PIN SPECIFICATIONS:

PIN	NAME	DETAILS
1	GND	Power supply ground
2	TX	transmitter
3	RX	receiver
4	Line_r & Line_l	Line input
5	Spk_p & spk_n	Speaker positive & negative
6	Mic_p & mic_n	Mic positive & negative
7	DTR	Data terminal ready
8	CTS	Clear to send
9	RTS	Request to send

WORKING:

Unlike mobile phones, a GSM modem doesn't have a keypad and display to interact with. It just accepts certain commands through a serial interface

and acknowledges for those. AT commands are the abbreviation for these commands. There is a list of AT commands that can be used to tell the modem what to do. Any order begins with the letters "AT." This is why they're referred to as AT orders. AT is an acronym for "attention." The software in our simple project waits for the mobile number to be entered through the keyboard. The software instructs the modem to send the text message using a sequence of AT commands when a ten-digit mobile number is given.

TESTING YOUR GSM MODEM:

- ➤ The GSM modem can be tested by connecting it with a PC. A RS232 cable is included with the modem. Simply link it to the PC through a Serial to USB converter.
- ➤ Now you can use any serial communication application, such as Hyperterminal or minicom, to send commands to the modem. Ascertain that the serial parameters are set to 8N1 and the baudrate is 9600bps.
- ➤ The modem sends you a message for each command you send. Try sending "AT" to the modem as an example. It responds with the result code "OK," indicating that the modem is operational. If something isn't functioning properly, it sends a "ERROR" message.

AT COMMANDS:

- ➤ Set the SIM900 to text mode: AT+CMGF=1\r.
- ➤ Send SMS to a number: AT+CMGS=PHONE_NUMBER (in international format).
- ➤ Read the first SMS from the inbox: AT+CMGR=1\r.
- ➤ Read the second SMS from the inbox: AT+CMGR=2\r.
- ➤ Read all SMS from the inbox: AT+CMGR=ALL\r.
- ➤ Call to a number: ATDP+PHONE_NUMBER (in international format).
- ➤ Hang up a call: ATA

4.15 GLOBAL POSITIONING SYSTEM

The Global Positioning System, or GPS, is a satellite route framework that furnishes clients with area and time data in every single climate condition. Planes, airplane, vehicles, and trucks all utilization GPS for route. Military and regular citizen clients everywhere on the world benefit from the framework's fundamental capacities. GPS is a worldwide situating, route, and timing framework that offers ceaseless constant 3-dimensional situating, route, and timing.

The GPS (Global Positioning System) is a satellite-based route framework with in any event 24 satellites. With no membership charges or arrangement costs, GPS works in any climate circumstance, anyplace on the planet, 24 hours per day. The satellites were at first positioned by the US Department of Defense (USDOD) into space for military use, yet they were made accessible for regular citizen .

Fig 4.15 GPS MODULE

WORKING OF GPS:

In an exact circle, GPS satellites circle the Earth double a day. Each satellite communicates a particular sign and orbital boundaries, which GPS gadgets can decipher and compute the satellite's exact position. This information, alongside trilateration, is utilized by GPS collectors to ascertain a client's definite position. The GPS recipient figures the distance between each satellite when it takes to get a

communicated signal. The recipient will compute a client's area and view it electronically utilizing distance estimations from a couple of more satellites.

A GPS collector should be bolted on to the sign of at any rate one satellite to quantify your 2-D area (scope and longitude) and screen movement.With at least 4 satellites in see, the recipient can decide your 3-D position (scope, longitude and height). By and large, a GPS beneficiary will follow at least 8 satellites, yet that relies upon the hour of day and where you are on the earth. A few gadgets can do the entirety of that from your wrist.Once your position has been determined, the GPS unit can calculate other information, such as:

- Speed.
- Bearing.
- Track.
- Trip distance.
- Distance to destination.
- Sunrise and sunset time.
- And more.

GPS SEGMENT:

The GPS system consists of three segments:

1) The space segment: the GPS satellites

2) The control system, operated by the U.S. military,

3) The user segment, which includes both military and civilian users and their GPS equipment.

SPACE SEGMENT: The space segment is the number of satellites in the constellation. It consists of 29 satellites that circle the earth every 12 hours at an altitude of 12,000 miles. The space segment's job is to route/navigate signals as

well as to store and retransmit the control segment's route/navigation message. The satellites' highly stable atomic clocks power these transmissions. The GPS Space Segment is made up of a satellite constellation with enough satellites to ensure that users have at least four satellites in view at any given time from any point on the Earth's surface.
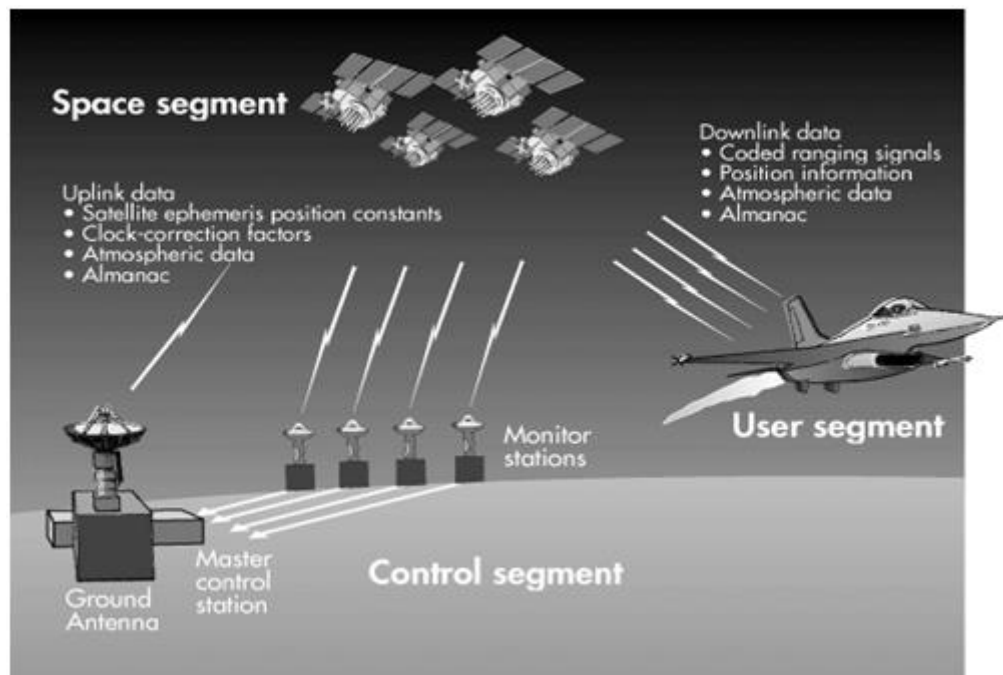
Fig 4.16 Control segment

CONTROL SEGMENT:

A master control station and five display stations equipped with atomic clocks are located around the world in the control section. The five monitor stations track GPS satellite signals and send eligible data to the master control station, where abnormalities are corrected and transmitted to GPS satellites via ground antennas. The control section is also known as the display station.

USER SEGMENT:

The GPS receiver, which receives signals from GPS satellites and determines how far away it is from each satellite, is part of the consumer segment. This section is primarily used by the United States military, missile guidance systems, and civilian GPS applications in almost every region. The majority of civilians use this for everything from surveying to transportation to natural resources, and then on to agriculture and mapping.

Fig 4.17 USER SEGMENT

GPS POSITIONING:

The working/activity of a worldwide situating framework depends on the numerical hypothesis of 'trilateration.' The area is determined utilizing satellite distance estimations. The four satellites are utilized to figure the area of the recipient in the world, as found in the graph. The fourth satellite affirms the objective position. Three satellites are likewise used to screen the area of the area. A fourth satellite is utilized to approve every one of the space apparatus' objective position. Satellites, observing stations, track stations, and collectors make up the worldwide situating framework. The GPS beneficiary gets information from the satellite and uses triangulation.

USING A GPS RECEIVER:

There are several different models and types of GPS receivers. While working with a GPS receiver it is important to have:

- ➤ A map and a compass
- ➤ A GPS cable that has been downloaded, as well as some extra batteries.
- ➤ Knowledge of the GPS receiver's memory ability is essential to avoid data loss, data accuracy degradation, and other issues.
- ➤ Where possible, use an external antenna, particularly in densely forested areas, canyons, or when driving.
- ➤ A GPS receiver that has been set up in accordance with incident or agency standard regulations; coordinate system.
- ➤ Notes in the receiver that explain what you're saving.

ADVANTAGES OF GPS:

- ➤ GPS Vehicle tracking systems are a valuable tool for navy, civ, and normal users who use satellite navigation systems.
- ➤ Turn-by-turning directions can be given by GPS-based navigation systems at a very large speed.

DISADVANTAGES OF GPS:

- ➤ GPS Since satellite signals are weaker than phone signals, they don't function as well indoors, underwater, or under trees.
- ➤ Since line-of-sight between the receiver and the satellite is needed for the highest accuracy, GPS does not function well in urban areas..

APPLICATION OF GPS:

APPLICATION OF THE GLOBAL POSITIONING SYSTEM (GPS) GPS is a dual-use technology, which means it has both military and civilian uses.

- ➤ Blind People's GPS Assists For the blind, real-time GPS, digitised charts, and likely audio capabilities may provide useful navigational capabilities.
- ➤ Tracking and Tracing of Wild Animals GPS receivers and wireless transmitters are installed in animals. The control station receives the GPS-determined location. This data is used to track animals and learn about their nomadic habits.

4.18 LIQUID CRYSTAL DISPLAY:

A LCD screen is an electronic presentation module that can be utilized in an assortment of ways. A 16x2 LCD screen is an exceptionally basic module that can be utilized in an assortment of gadgets and circuits. Seven-section and other multi-portion LEDs are preferred over these modules. The explanations behind this are as per the following: LCDs are cheap; they are easy to program; they have no limitations on showing remarkable and surprisingly custom characters (in contrast to seven fragments), activitys, etc.

A 16x2 LCD can show 16 characters for every line on every one of its different sides. Each character is addressed in a 5x7 pixel framework on this LCD. Order and Data are the two registers on this LCD. The command register keeps track of the commands that have been issued to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen,
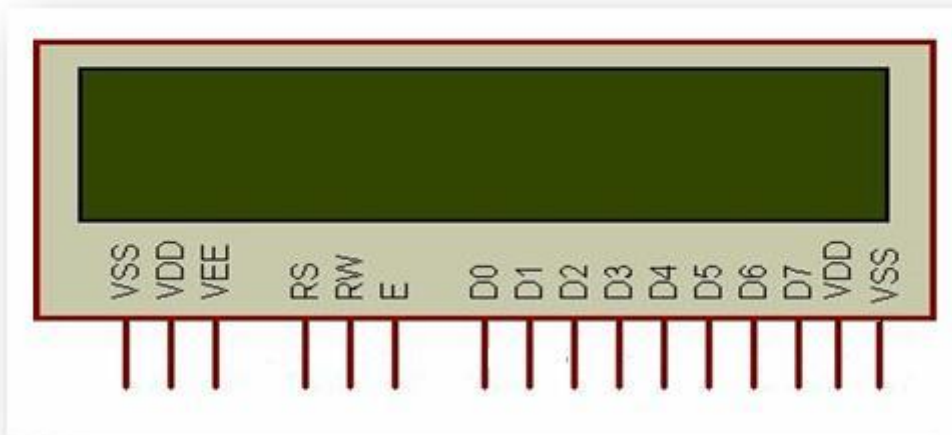
setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD.
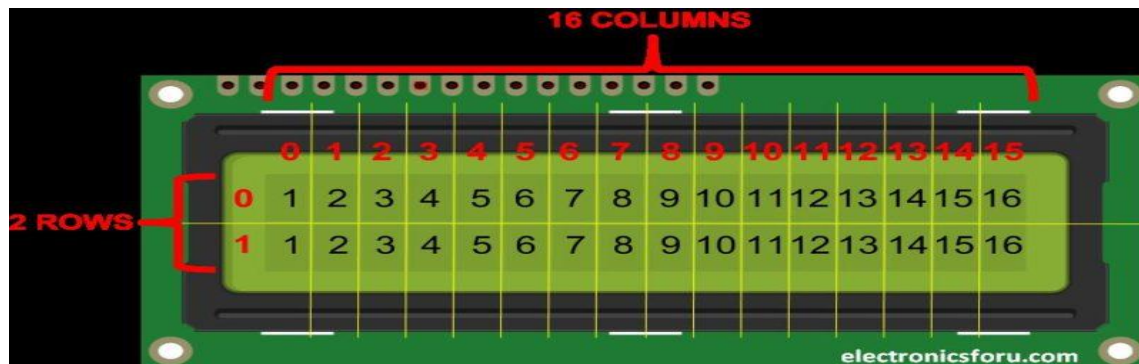
Fig 4.18 LCD

LCD presentations can be seen everywhere. The time is appeared on PCs, adding machines, TVs, cells, and computerized watches utilizing some sort of show. A fluid precious stone presentation (LCD) is an electronic showcase module that delivers a noticeable picture utilizing fluid gem. The 162 LCD screen is a basic module that is regularly utilized in projects. The 162 alludes to a two-line show of 16 characters for each line. Each character is addressed in a 5x7 pixel framework on this LCD.

4.19-16X2 LCD PINOUT DIAGRAM AND TABLE:

PIN NO.	FUNCTION	NAME
1	Ground (0V)	Ground
2	Supply voltage; 5V (4.7V – 5.3V)	VCC
3	Adjusting the contrast is best done with a variable resistor, such as a potentiometer. This pin is connected to the potentiometer's output. To change the LCD contrast, move the potentiometer knob forward and backward.	Vo / VEE
4	Selects command register when low, and data register when high	RS (Register Select)

5	Low to write to the register; High to read from the register	Read/write
6	When a high to low pulse is given, data is sent to data pins; extra voltage push is needed to execute the instruction, and the EN(enable) signal is used for this. We usually set it to en=0 and then set it to high en=1 for a few milliseconds when we want to execute the instruction. After that, we make it ground again, with en=0..	Enable
7	8-bit data pins	DB0
8		DB1
9		DB2
10		DB3
11		DB4
12		DB5
13		DB6
14		DB7
15	Backlight VCC (5V)	Led+
16	Backlight Ground (0V)	Led-

RS (REGISTER SELECT):

The command and data registers are found on a 16X2 LCD. Switching from one register to another is done with the register pick. The command register has the value RS=0, while the data register has the value RS=1..

COMMAND REGISTER:

The command register keeps track of the commands sent to the LCD. A command tells the LCD to perform a specific task, such as initialising it, clearing its screen, setting the cursor location, controlling the monitor, and so on. The command register is where commands are processed..

DATA REGISTER:

THE DATA REGISTER STORES THE DATA THAT WILL BE DISPLAYED ON THE LCD. The ASCII value of the character to be displayed on the LCD is the data. Data is sent to the data register when it is sent to the LCD.

4.20 IMPORTANT COMMAND CODES FOR LCD:

SR.NO.	HEX CODE	COMMAND TO LCD INSTRUCTION REGISTER
1	01	Clear display screen

2	02	Return home
3	04	Decrement cursor (shift cursor to left)
4	06	Increment cursor (shift cursor to right)
5	05	Shift display right
6	07	Shift display left
7	08	Display off, cursor off
8	0A	Display off, cursor on
9	0C	Display on, cursor off
10	0E	Display on, cursor blinking
11	0F	Display on, cursor blinking
12	10	Shift cursor position to left
13	14	Shift cursor position to right
14	18	Shift the entire display to the left
15	1C	Shift the entire display to the right
16	80	Force cursor to beginning (1st line)

17	C0	Force cursor to beginning (2nd line)
18	38	2 lines and 5×7 matrix

4.21 SERVO MOTOR

Although the term servomotor is frequently used to refer to a motor suitable for use in a closed-loop control system, it is not a particular type of motor. To provide position and speed feedback, the motor is connected to an encoder. Only the position is evaluated in the most basic case. The calculated output position is compared to the command position, which is the controller's external input.

If the output position does not match the necessary position, an error signal is produced, causing the motor to rotate in either direction to move the output shaft to the correct position. The error signal decreases as the positions reach zero, and the motor stops.

A servomotor is a rotary or linear actuator that can control angular or linear orientation, velocity, and acceleration with precision. It is made up of a suitable motor and a position feedback sensor. It also necessitates a sophisticated controller, which is often a dedicated module designed specifically for servomotors.

A servomotor is a closed-loop servomechanism that controls its motion and final position using position feedback. The location commanded for the output shaft is represented by a signal, either analogue or digital, that is fed into its power.

FEATURES

☐ Supply voltage: 5VDC

☐ Control signal: Analog or D1igital

☐ High-precision positioning.

APPLICATIONS

☐ Conveyors

☐ Solar Tracking System

☐ Antenna Positioning

☐ Camera Auto Focus

☐ It is used to measure the speed of the output shaft.

4.22 IR SENSOR

An infrared sensor is an electronic system that emits infrared light in order to detect certain aspects of the environment. An infrared sensor can detect motion as well as measure the heat of an object. The term "passive IR sensor" refers to a sensor that only detects infrared radiation rather than emitting it. Almost all objects emit some kind of thermal radiation in the infrared spectrum. These are radiations that are invisible to the naked eye but can be measured by an infrared sensor. The emitter is a simple infrared LED, and the detector is a simple infrared photodiode that detects infrared light of the same wavelength as the IR LED. As IR light hits the photodiode, it causes it to glow.When IR light falls on the photodiode, The resistances and these output voltages, change in proportion to the magnitude of the IR light received.
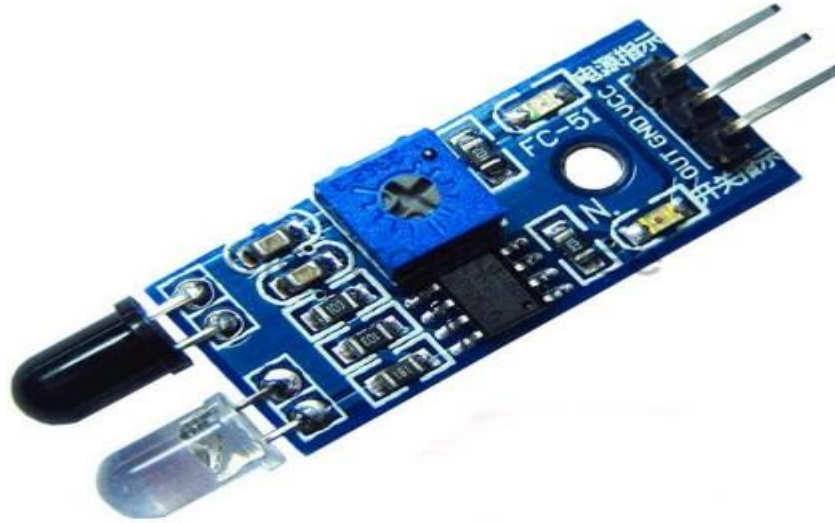
Fig 4.22 IR sensor

4.23 ARDUINO SOFTWARE (IDE):

The Arduino Software (IDE) includes a text editor for writing code, a message field, a text console, a toolbar with buttons for common functions, and a set of menus. It communicates with the Arduino and Genuino hardware by connecting to them and uploading programmes communicate with them.

Fig 4.23 Arduino IDE

4.24 WRITING SKETCHES:

Sketches are programmes created with the Arduino Software (IDE). These sketches were created in a text editor and saved with the.ino file extension. Cutting/pasting, as well as searching/replacing text, are all available in the editor. The message area shows errors and provides input when saving and exporting. The Arduino Software (IDE) outputs text to the console, which includes complete error messages and other information. The designed board and serial port are shown in the window's bottom right corner. You can verify and upload programmes, make, open, and save sketches, and open the serial monitor using the toolbar buttons.NB: Versions of the Arduino Software (IDE) prior to 1.0 saved sketches with the

extension .pde. It is possible to open these files with version 1.0, you will be prompted to save the sketch with the .ino extension on save.

☑	**Verify** Checks your code for errors compiling it.
➡	Uploads the code to the optimised board after it has been compiled. For more details, see the section on uploading below. Note: If you're using an external programmer for your board, you can use this icon when holding down the "move" key on your screen. "Upload using Programmer" would be the new text**.**
🖹	**New** Creates a new sketch.
⬆	**Open** Displays a menu of all of your sketchbook's drawings. When you click one, it will open in the current window, overwriting the content. This menu does not scroll due to a Java bug; if you need to open a sketch that is further down the list, use the File	Sketchbookmenu instead.
⬇	**Save** Saves your sketch.

	Serial Monitor
	Opens the serial monitor.

The five menus File, Edit, Sketch, Tools, and Support include additional commands. The menus are context sensitive, which means they only display things that are important to the work being done at the time.

Computer programmer

When programming a board or chip using a hardware programmer rather than the onboard USB-serial link. You won't normally need this, but you will if you're burning a boot loader to a new microcontroller.

Burning the boot loader

The items in this menu enable you to burn a boot loader onto an Arduino board's microcontroller.This is not required for normal use of an Arduino or Genuino board but is useful if you purchase a new `ATmega` microcontroller (which normally comes without a boot loader). Ensure that you've selected the correct board from the **Boards** menu before burning the boot loader on the target board. This command also set the right fuses.

Help:

You will find a variety of documents that come with the Arduino Software here (IDE). Without an internet connection, you can access Getting Started, Reference, this IDE guide, and other documents locally.The documents are a local copy of the online ones and may link back to our online website.

UPLOADING:

You must pick the correct items from the Tools > Board and Tools > Port menus before uploading your sketch. The boards are listed in the following sections. The serial port on a Mac is possibly /dev/tty.usbmodem241 (for an Uno, Mega2560, or Leonardo), /dev/tty.usbserial-1B1 (for a Duemilanove or earlier USB board), or /dev/tty.USA19QW1b1P1.1 (for a Duemilanove or earlier USB board) (for a serial board connected with a Keyspan USB-to-Serial adapter). It's most likely COM1 or COM2 (for a serial board) or COM4, COM5, COM7, or higher (for a USB board) on Windows; to find out, search for USB serial device in the Windows Device Manager's ports section. It should be /dev/ttyACMx, /dev/ttyUSBx, or something similar on Linux.Once you've selected the correct serial port and board, press the upload button in the toolbar or select the **Upload** item from the **Sketch** menu. Current Arduino boards will reset automatically and begin the upload. With older boards (pre-Diecimila) that lack auto-reset, you'll need to press the reset button on the board just before starting the upload. On most boards, you'll see the RX and TX LEDs blink as the sketch is uploaded. The Arduino Software (IDE) will display a message when the upload is complete, or show an error.

When you upload a sketch, you're using the Arduino **bootloader**, a small program that has been loaded on to the microcontroller on your board. It allows you to upload code without using any additional hardware. The bootloader is active for a few seconds when the board resets; then it starts whichever sketch was most recently uploaded to the microcontroller. The boot loader will blink the on-board (pin 13) LED when it starts (i.e. when the board resets).

LIBRARIES: Libraries add extra functionality to drawings, such as the ability to interact with hardware or manipulate data. Pick a library from the Sketch > Import Library menu to use it in a sketch. This will compile the library with your sketch and add one or more #include statements to the top of the sketch. Libraries take up more room on the board than your sketch since they are uploaded with it. Remove the #include statements from the top of your code if a sketch no longer needs a library.

In the reference section, there is a list of libraries. The Arduino app comes with a few libraries. Others are available for download from a number of places, like the Library Manager.Starting with version 1.0.5 of the IDE, you do can import a library from a zip file and use it in an open sketch.

4.25 EMBEDDED C:

Embedded C is the most widely used programming language in the software industry for creating electronic devices. Embedded software is connected with each processor used in an electronic device.

Embedded C programming is important for the processor to perform specific tasks. We use a variety of electronic devices in our daily lives, such as a cell phone, a washing machine, a digital camera, and so on. All of these devices are controlled by a microcontroller that is programmed in embedded C.

Let's look at how embedded machine programming is represented in a block diagram:
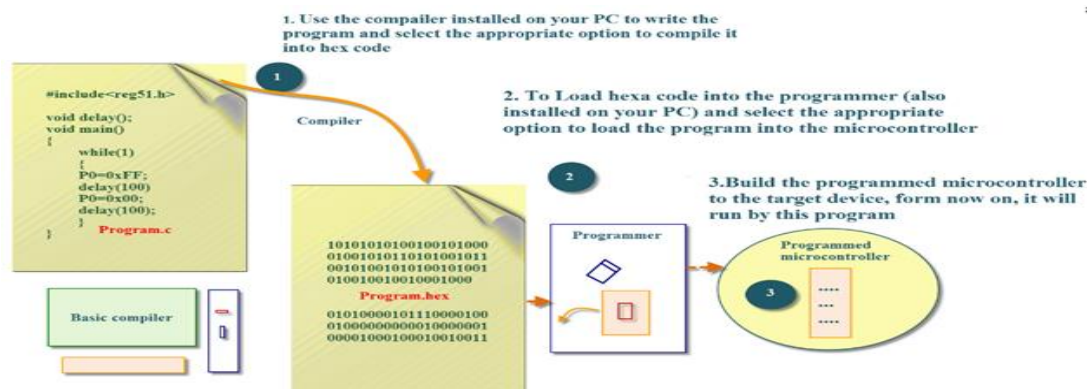
Fig 4.25 Embedded C

The Embedded C code written in above block diagram is used for blinking the LED connected with Port0 of microcontroller.

In embedded system programming C code is preferred over other language. Due to the following reasons:

➢ Easy to understand
➢ High Reliability

➤ Portability

## ➤ **EMBEDDED SYSTEM PROGRAMMING:**

Basic Declaration

A programming language is a collection of one or more functions that are used to perform a specific task. A function is a collection of statements that are used to perform a specific task. Basic elements and grammatical rules exist in every language. Variables, character set, data types, keywords, expressions, and other features of the C programming language are used to write C programmes.

The embedded C programming language is a C language extension. In addition to the features mentioned above, embedded programming in C includes data types, keywords, and a header file, which is defined by #includemicrocontroller name.h>.

CHAPTER 5

RESULT AND LIMITATIONS

- In this system, we use ARDUINO MEGA (ATmega2560) microcontroller which acts as brain of the system, because the entire system program instruction stored in it.

- We have two-IR sensors, they are used here for determining the arrival and departure of train so that opening and closing of gate can be operate automatically using servo motor.

- The led is turned to red color and buzzer makes the sound to alert the people around there.

- Here we use GPS whenever crack detected on the track LED will be on and buzzer makes the sound to alert the workers and send the location to the respective department using GPS and GSM for the security alert.

- All the data fetch with the help of sensors are update to cloud therefore all the operations are controlled and monitored by IOT.
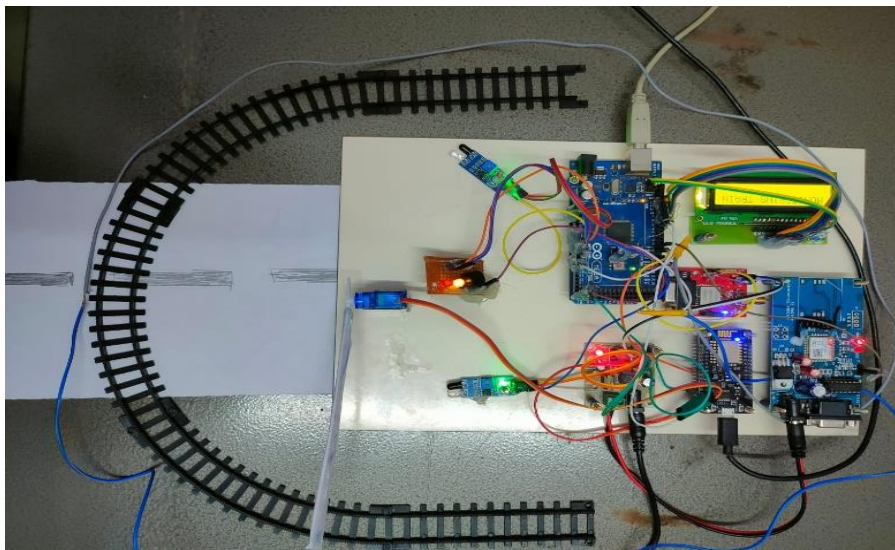
5.1 Finally developed model

LIMITATIONS:

In spite of trying the best to rectify the errors,there are a few limitations under which the model has to be operated.

- ➤ The IR sensor used here detects all the objects irrespective of train, In real time scenario we use Ultrasonic sensor to avoid this situation as this a prototype.
- ➤ The GSM module used here detects only the 2G sim but not the other generation sims.
- ➤ The track we used here is plastic so current doesn't flow through it so we used wires instead of metal tracks.
- ➤ We are using power supply instead of battery it should be continuously turned on.

Applications:

- ➤ Easy to operate.
- ➤ Low power consumption.
- ➤ Automatic Railway Gate Control is implemented with very simple hardware and easy control.
- ➤ Human intervention at level crossings can be removed with the help of this project and many railway level crossing accidents can be prevented.
- ➤ To detect the crack using IOT based tracking details sending SMS.
- ➤ To avoid the accidents at a single track.

CHAPTER 6

CONCLUSION AND FUTURE WORKS

The automation of the railway gate control system is used in this project to reduce the interaction between raising and closing the crossing gate. This makes and prevents cars and people from colliding. Rail crossings have been the source of many accidents and deaths. Automation of the crossing gates makes controlling the gates simple and safe. We've created a system that can be a low-cost, low-power embedded system that improves rail track safety by preventing railway accidents caused by cracks. The IoT-based crack track detection device quickly detects cracks on railway tracks and sends the location via GSM to the appropriate department for updates.

Advantages:

➢ The system can be implemented more efficiently by incorporating more efficient sensor network.

➢ A combination manual wireless control and sensors based control can be used for better operation.

FUTURE WORKS

➢ Additional improvements should be made to increase the precision of the position of the fault.

➢ A zigbee module can also be used to create a low-value short-distance inspecting mechanism that produces sensible properties at a random input value.

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