CHAPTER 01

INTRODUCTION

The "Integrated Landslide Alert And Curve Collision Prevention System For Vehicles" project leverages a combination of advanced technologies, to enhance potential landslide risks and road safety in areas with deep curves. It detects the landslide condition or heavy rains it warns on display as a message and closes gates on either sides of ghat till road condition gets normal and a siren that alerts the civilians in hilly and proned regions, this might save thousands of lives.

Also, this system offers real-time assistance to drivers by detecting obstacles, monitoring vehicle dynamics, and providing critical updates on road conditions. Implementing a new technique, have come up with a plan to prevent accidents after determining their causes and effects which alerts the vehicle on the opposite road, where a warning is displayed as a vehicle approaches from the other side of the bend serves as a message to the driver. Deep curves on mountainous roads and the threat of landslides pose significant hazards to drivers and passengers.

These challenges include reduced visibility, limited reaction time, and the potential for sudden obstructions due to landslides. This project aims to address these issues by creating a comprehensive solution to the landslide risks and how it can be acted upon creating less fatal accidents and assists drivers in navigating challenging road conditions while keeping them informed about the possible potential risks.

This project leverages a combination of advanced technologies, including Arduino Uno, IR sensors, ADXL sensors, LCD displays, and Zigbee communication, to enhance road safety in areas with deep curves and potential landslide risks.

This system offers real-time assistance to drivers by detecting obstacles, monitoring vehicle dynamics, and providing critical updates on road conditions.

Deep curves on mountainous roads and the threat of landslides pose significant hazards to drivers and passengers. These challenges include reduced visibility, limited reaction time, and the potential for sudden obstructions due to landslides.

This project aims to address these issues by creating a comprehensive solution that assists drivers in navigating challenging road conditions while keeping them informed about potential landslide risks.

By integrating a suite of advanced sensors, communication technologies, it empowers vehicles to navigate safely through curves while avoiding potential landslide conflict zones.

In regions prone to landslides, navigating vehicle curves presents a significant challenge for drivers due to the increased risk of encountering hazardous conditions. To address this issue, a sophisticated Landslide Update And Conflict Avoidance System has been developed, aimed at enhancing vehicle safety and preventing accidents in such terrain.

It integrates advanced sensing technologies, real-time data analysis algorithms, and communication systems to detect and respond to landslide risks proactively. By providing vehicles with timely updates and reroute guidance, particularly in curves where visibility is limited, aims to mitigate the dangers posed by landslides and ensure safe passage for drivers and passengers alike.

This introduction sets the stage for exploring the multifaceted approach of it in addressing the complex challenges posed by landslides in vehicle curves, highlighting its potential to revolutionize road safety and transportation resilience in landslide-prone regions.

This is designed to proactively detect, assess, and mitigate the risks associated with landslides, particularly in areas where curves in the road compound these hazards. Unlike conventional navigation systems that rely solely on pre-existing maps and static data, it leverages dynamic real-time information to anticipate and respond to evolving landslide conditions. By integrating a suite of advanced sensors, communication technologies, and predictive modelling capabilities, it empowers vehicles to navigate safely through curves while avoiding potential landslide conflict zones.

Navigating through curves in terrain prone to landslides poses significant challenges for drivers and passengers alike. The unpredictable nature of landslides, coupled with limited visibility in curves, increases the risk of accidents and road closures, jeopardizing both safety and transportation efficiency. In response to these challenges, the development of a sophisticated Landslide Update And Conflict Avoidance System has emerged as a crucial innovation in the realm of landslides and road safety technology.

CHAPTER 02

LITERATURE SURVEY

The most crucial stage of the software development process is a literature review. It's important to assess the company's strength, the economics, and the time element before building the tool. The next steps are to decide which operating systems and programming languages are required for the project's development once these requirements have been met. The folks require outside assistance before they can build the initiative. You can find this outside assistance in books or online. The aforementioned factors are taken into account before building the proposal for the proposed system.

K.P. Sreevishakh, Prof.S.P. Dhanure presented “Automotive Crash Insight using AMR Sensor System”, The Unit was created to avoid a collision based accident.

The Arduino microcontroller, which handles all of the system's essential functions, is the "heart" of the unit. Additionally, it will be covered in the sections that follow. This system will gather data from the Ultrasonic transceiver and send it to the controller via the Wi-Fi router as a result.

S. Rakul, S. Ravia and K.N. Thirukkuralkani presented "Implementation of Vehicle Mishap Averting System Using Arduino Microcontroller."

By avoiding collisions, the device is intended to prevent accidents. An Arduino microcontroller, which handles all of the crucial functions of the system, serves as its "heart." Additionally, it will be covered in the parts that follow. This system will gather data from the ultrasonic transceiver and send it to the controller over the Wi-Fi router in response. The vehicle information will be displayed to users via the buzzer signal, light-emitting display, and liquid crystal display. The system's main objective is to avoid collisions when two or more vehicles turn at the same time on a U-bend.

A study by R. C. Jing et al. (2019) proposed an IoT-based driver assistance system. that unes sensors to detect the distance between the vehicle and as a result of excessive waiting and blind corners is attributed as one of the most important factors for all road accidents. An estimated 1.2. million people lose their lives in road traffic crashes every year, and another 20 to so million are injured

Title	Advanced Road Safety for Ghat Roads at Hairpin Bend
Author	Harshada Targe, Anushka Mahajan, Mohit Patil, Yogesh Lilake, VijaySonawane
Year	January 2018
Methodology	The use of CCTV and LCD screens rather than Mirror.
Limitations	During night, driver can only be able to view headlight of the vehicle in the big LCD screen than the type and size of the vehicle.

Table2.1: Literature Survey 1

Title	Sensor Based Accident Prevention System in Curving
Author	Anand M G, A Dhanyakumar, Bhaskar N, Mahaling S B
Year	December 2019
Methodology	Use of Ultrasonic sensors to trigger signal of approaching vehicle.
Limitations	Waiting time is more in case of small vehicle approaching. Signal is Triggered even for object.

Table 2.2: Literature Survey 2

Title	Implementation of Critical Intimation System for Avoiding Accidents in Hairpin Curves & Foggy Areas
Author	Anuradha A Kasangottuwar, TrupthiTagare, Vibha T G, Priyanka N, Chaithra A
Year	November 2018
Methodology	Use of IR sensors to calculate the speed of the approaching vehicle and given priority to high speed vehicle
Limitations	Fails in case of both vehicles approaching with same speed.

Table 2.3: Literature Survey

2.1 OBJECTIVES

- Develop a real-time conflict avoidance system using Arduino Uno and IR sensors to identify obstacles and potential conflicts on the road, especially in deep curves.

- Implement an ADXL sensor to monitor Land slides and provide drivers with information on vehicle tilt and lateral acceleration in real-time.

- Detection of vehicles in curves and automating the vehicle operations

- Utilize an LCD display to present visual warnings and updates to the driver regarding road conditions and potential conflicts.

- Establish a Zigbee communication network between vehicles to exchange critical information about road conditions, obstacles, and potential landslide risks.

- Ensure compatibility with existing vehicle systems and navigation devices, making it easy to retrofit vehicles with this system.

CHAPTER 03

PROBLEM STATEMENT

In India more than 12% of the territory is landslide prone area killing approximately hundreds of people every year and has one of the highest rate of traffic accidents in the world. During landslides the fatality and injuries are mainly due to lack of proper guidance, quick communication and emergency alerts. The majority of road accidents are caused at high speeds or when the driver is unaware of other vehicles coming opposite to it, especially in deep curves (hairpin curve). Due to a lack of communication and zero visibility over the hairpin curves, vehicles travelling around hairpin bends are extremely vulnerable to accidents. As a result, there must be proper guidance and communication in emergency situations and vehicles must take extreme caution when driving through hairpin curves.

Landslides pose a significant threat to human lives and infrastructure in hilly and mountainous regions. Rapid detection and early warning systems are crucial for mitigating the impact of landslides. The aim of this project is to develop a landslide detection system using Arduino and MEMS (Micro-Electro- Mechanical Systems) sensors to provide real-time monitoring and alerting in landslide-prone areas.

3.1 Purpose

The purpose of the Integrated Landslide Alert And Curve Collision Prevention System For Vehicles is to enhance updating of the landslides in prone areas, road safety and mitigate the risks associated with landslides in challenging terrain by integrating advanced technologies and real-time data analysis

The purpose of this system is to prevent accidents and collisions caused by landslides, especially in curves where visibility may be limited. By providing early warnings and rerouting guidance, it helps drivers avoid hazardous areas and navigate safely through challenging terrain.

It prioritizes the safety of vehicle occupants by alerting drivers to potential landslide risks and providing alternative routes to avoid dangerous conditions. This helps minimize the likelihood of injuries and fatalities resulting from landslide-related accidents.

Optimize Transportation Efficiency by offering real-time updates and route recommendations, it helps optimize transportation efficiency by minimizing delays and disruptions caused by landslides. Vehicles equipped with it can navigate around affected areas more effectively, reducing travel times and improving overall road network performance

3.2 Scope of the project

The scope of a Integrated Landslide Alert And Curve Collision Prevention System For Vehicles would likely include real-time monitoring of geological conditions to detect potential landslide risks, integrating sensors and algorithms to detect vehicles approaching deep curves, and implementing pre-emptive measures such as warning alerts to drivers or even automated braking systems to avoid collisions or accidents. Additionally, it may involve data analysis to continuously improve the system's effectiveness and adaptability to different road and weather conditions.

It contributes to the resilience of transportation infrastructure by proactively managing landslide risks and mitigating their impact on roadways. By integrating predictive modelling and monitoring capabilities, it supports proactive decision-making and risk mitigation strategies, ultimately enhancing the resilience of transportation systems in landslide-prone regions.

Overall, the scope is to leverage technology and data-driven approaches to enhance road safety, ensure passenger well-being, optimize transportation efficiency, and strengthen the resilience of transportation infrastructure in areas vulnerable to landslides.

The scope of a Integrated Landslide Alert And Curve Collision Prevention System For Vehicles would likely include real-time monitoring of geological conditions to detect potential landslide risks, integrating sensors and algorithms to detect vehicles approaching deep curves, and implementing pre-emptive measures such as warning alerts to drivers or even automated braking systems to avoid collisions or accidents. Additionally, it may involve data analysis to continuously improve the system's effectiveness and adaptability to different road and weather conditions.

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CHAPTER 04

EXISTING SYSTEM

- **Sensor- based Collision Avoidance**: Two Ultrasonic sensors are place data known distance on both side of the curve. Ultrasonic sensors are used to determine the vehicle position. Sensor placed at two distinct point, outputs high pulse when the vehicle passes near to them. The vehicle speed is calculated by knowing the distance between those two points and time required by vehicle to cover those points. When two vehicles approach the curve simultaneously, speed of both vehicles are calculated and vehicle with higher speed is made to pass through the curve.

- **Convex Mirrors**: Convex mirror is a mirror whose reflective surface is bulged so that the incident light rays gets reflected back at a different angle. This set up is widely used in hilly regions which reflects the image of opposite vehicle approaching the hairpin curve.

- **Headlights and Horns**: Both Headlights and Horns are extensively used while driving in hairpin curves. Headlights can be used only during night time by flashing on high beams.

4.1 Limitations of Existing Systems

- **Sensor based Collision Avoidance**: This method offers high disadvantages to the vehicles, climbing uphill. Priority is always given to high speeding vehicles which will not only results in traffic congestion but, also lacks in Effective traffic management.

- **Convex Mirrors**: The major drawback of this system is reflective surface gets faded as time passes and also it is seasonal. hence, it is not compatible during night time, foggy environment and rainy season.

- **Headlights**: Headlights may not be efficient method during day time.

CHAPTER 05

SYSTEM REQUIREMENTS

5.1 Hardware Requirements

- Arduino UNO
- IR Sensor
- ADXL Sensor
- Rain Sensor
- LCD Display
- Zigbee Communicator
- Buzzer
- Motor Gates

5.2 Software Requirements

- Arduino IDE
- Embedded C
- Python

5.1 Hardware Requirements

5.1.1 Arduino Uno

Arduino/GenuinoUno is a microcontroller board based on theATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. You can tinker with your UNO without worrying too much about doing something wrong, worst case scenario you can replace the chip for a few dollars and start over again. "Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0. The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino , now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform; for an extensive list of current, past or outdated boards see the Arduino index of boards.[1]

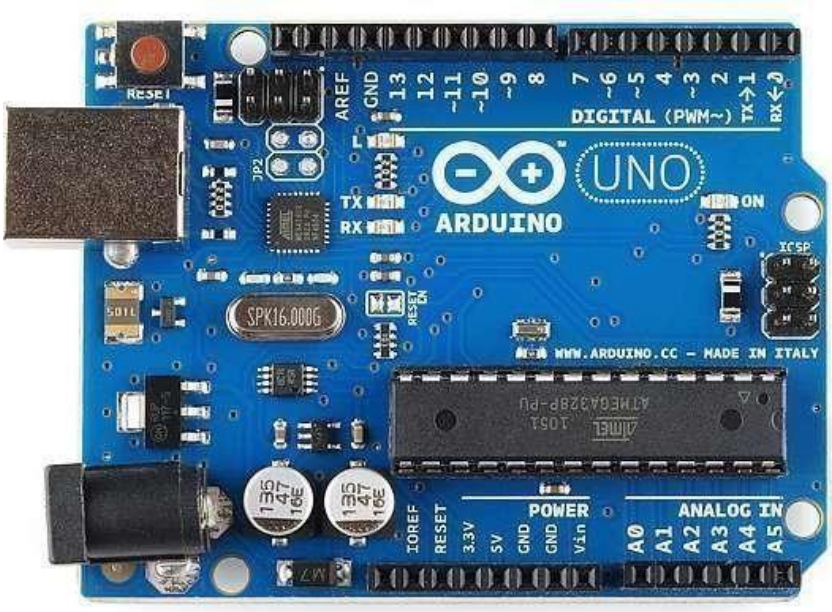

Fig 5.1.1 Arduino Uno

Arduino specification

Microcontroller	ATmega328P
Operating Voltage	5v
Input voltage	7-12v
Input voltage limit	6-20v
Digital I/O Pins	6
Analogue input Pins	6
DC current perI/O pins	20 Ma
DC current for 3.3v Pin	50 Ma
Flash Memory	Of which o.5KB is used
SRAM	2 KB
EEPROM	1KB
Clock Speed	16MHz
Length	68.6mm
Width	53.4nm
Weight	25g

Arduino programming

The Arduino /GenuinoUno can be programmed with the (Arduino Software (IDE)).Select

"Arduino/GenuinoUno from the Tools>Board menu (according to the microcontroller on your board). The ATmega328 on the Arduino/GenuinoUno comes preprogrammed with a boot loader that allows us to upload new code to it without the use of an external hardware programmer. It communicates using the original STK500 protocol (reference ,C header files). We can also bypass the boot loader and program the microcontroller through the ICSP (In-Circuit Serial Programming) header using Arduino ISP or similar. 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 reusing the8U2.
- 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.

Warnings

The Arduino/GenuinoUno has a resettable poly fuse that protects your computer's USB ports from shorts and over current. Although most computers provide their own internal protection, the fuse provides an extra layer of protection. If more than500 mA is applied to the USB port, the fuse will automatically break the connection until the short or overload is removed.

Differences with other boards

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 version R2) programmed as a USB-to-serial converter.

Power

The Arduino/GenuinoUno board can be powered via the USB connection or with an external power supply. The power source is selected automatically.

The board can operate on an external supply from 6 to 20 volts. If supplied with less than7V, however, the 5V pin may supply less than five volts and the board may become unstable. If using more than 12V, the voltage regulator may over heat and damage the board. The recommended range is 7 to 12volts.

The power pins are as follows:

- VIN. The input voltage to the Arduino/ Genuino board when it's using an external power source(as opposed to 5 volts from the USB connection or other regulated power source). One can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.
- This pin outputs a regulated 5Vfrom 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.
- 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/GenuiUno board provides the voltage reference with which the microcontroller operates.

Memory

- The ATmega328 has 32 KB (with 0.5 KB occupied by the boot loader). It also has2 KB of SRAM and 1KB of EEPROM (which can be read and written with the EEPROM library).

Input & Output

Each of the 14 digital pins on the Uno can be used as an input or output, using pin Mode(), digital write (), and digital read () functions. They operate at 5 volts. Each pin can provide or receive 20 mA as recommended operating condition and has an internal pull- up resistor (disconnected by default) of 20-50k ohm. A maximum of 40mAis the value that must not be exceeded on any I/O pin to avoid permanent damage to the microcontroller.
In addition, some pins have specialized functions:

Serial: 0 (RX) and 1 (TX). Used to receive (RX) and transmit (TX) TTL serial data. These pin share connected to the corresponding pins of the ATmega8U2 USB-to-TTL Serial chip.

- **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.
- **SPI**: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI communication using the SPI library.
- **LED**: 13. There is a built-in LED driven by digital pin 13. When the pin is HIGH value, the LEDis on, when the pin is LOW, it's off.

  TWI: A4 or SDA pin and A5 or SCL pin. Support TWI communication using the Wire library. The Uno has 6 analog inputs, labelled A0 through A5, each of which provide 10 bits of resolution (i.e. 1024 different values).

By default they measure from ground to5 volts, though is it possible to change the upper end of their range using the AREF pin and the analog reference ()function. There are a couple of other pins on the board:

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

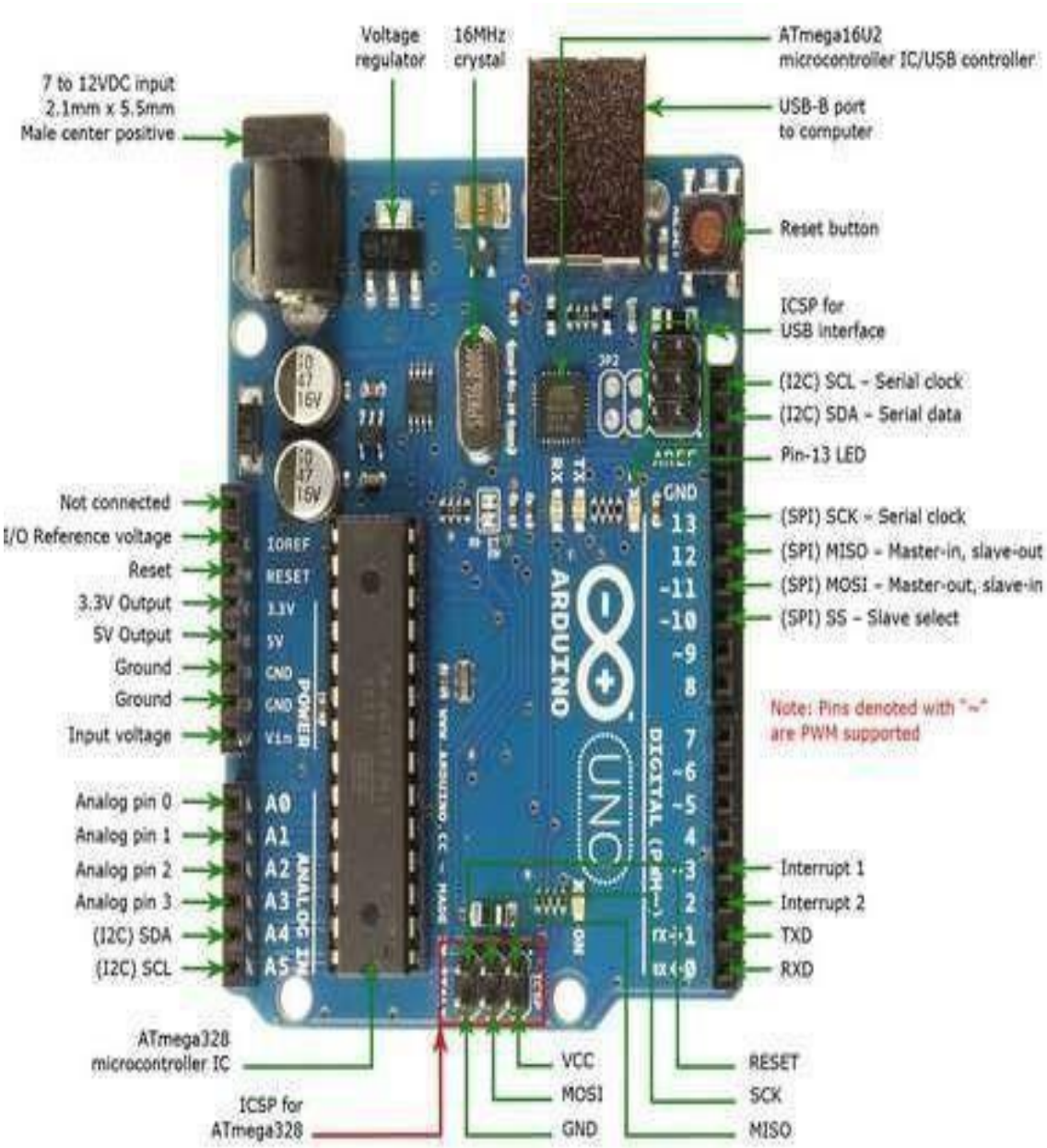

Fig 5.1.2 : Pin Specification

Communication

Arduino/Genuino Uno has a number of facilities for communicating with a computer, another Arduino/Genuino board, or other microcontrollers. The ATmega328provides UART TTL (5V) serial communication, which is available on digital pins 0 (RX) and 1 (TX). An ATmega16U2 on the board channels this serial communication over USB and appears as a virtual com port to software on the computer. The 16U2 firmware uses the standard USB COM drivers, and no external driver is needed. However, on Windows, an inf file is required. The Arduino Software (IDE) includes a serial monitor which allows simple textual data to be sent to and from the board. The RX and TX LEDs on the board will flash when data is being transmitted via the USB-to-serial chip and USB connection to the computer (but not for serial communication on pins 0 and1).

A Software serial library allows serial communication on any of the Uno's digital pins. The ATmega328alsosupports I2C(TWI) and SPI communication. The Arduino Software (IDE) includes a Wire library to simplify use of the I2C bus; seethe documentation for details. For SPI communication, use the SPI library.

Automatic (Software)Reset

Rather than requiring a physical press of the reset button before an upload, the Arduino/Genuino Uno board is designed in a way that allows it to be reset by software running on a connected computer. One of the hardware flow control lines (DTR) of the ATmega8U2/16U2 is connected to the reset line of the ATmega328 via a 100nano farad capacitor. When this line is asserted (taken low), the reset line drops long enough to reset the chip. The Arduino Software (IDE) uses this capability to allow you to upload code by simply pressing the upload button in the interface toolbar. This means that the boot loader can have a shorter timeout, as the lowering of DTR can be well-coordinated with the start of the upload. When the Uno is connected to either a computer running Mac OS X or Linux, it resets each time a connection is made to it from software (via USB). For the following half-second or so, the boot loader is running on the Uno. While it is programmed to ignore malformed data (i.e. anything besides an upload of new code), it will intercept the first few bytes of data sent to the board after a connection is opened. If a sketch running on the board receives one-time configuration or other data when it first starts, make sure

that the software with which it communicates waits a second after opening the connection and before sending this data. The Uno board contains a trace that can be cut to disable the auto-reset. The pads on either side of the trace can be soldered together to re-enable it. It's labeled "RESET-EN". You may also be able to disable the auto-reset by connecting a 110 ohm resistor from 5V to the reset line.

Regulated power supply

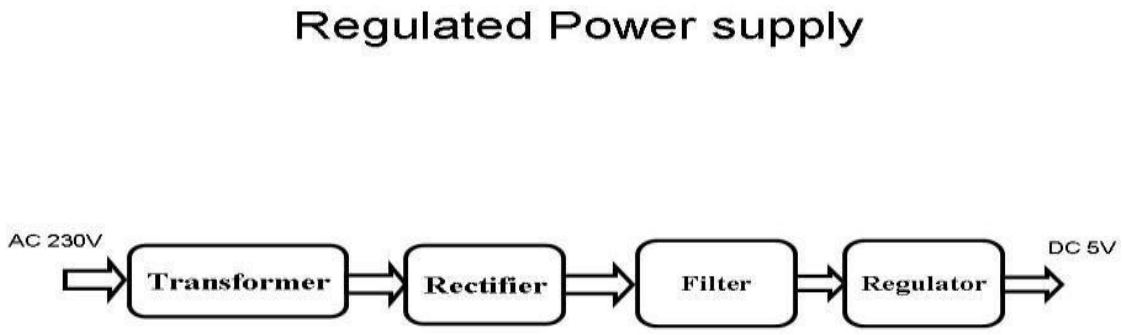

Fig 5.1.3 : Regulated power supply

Transformer

A transformer is a device that transfers electrical energy from one circuit to another through inductively coupled conductors without changing its frequency. A varying current in the first or primary winding creates a varying magnetic flux in the transformer's core, and thus a varying magnetic field through the secondary winding. This varying magnetic field induces a varying electromotive force (EMF) or "voltage" in the secondary winding. This effect is called mutual induction. If a load is connected to the secondary, an electric current will flow in the secondary winding and electrical energy will be transferred from the primary circuit through the transformer to the load. This field is made up from lines of force and has the same shape as a bar magnet. If the current is increased, the lines of force move outwards from the coil. If the current is reduced, the lines of force move inwards. If another coil is placed adjacent to the first coil then, as the field moves out or in, the moving lines of force will "cut" the turns of the second coil. As it does this, a voltage is induced in the second coil. With the 50 Hz AC mains supply,

this will happen 50 times a second. This is called MUTUAL INDUCTION and forms the basis of the transformer.

Filter

The process of converting a pulsating direct current to a pure direct current using filters is called as filtration. Electronic filters are electronic circuits, which perform signal-processing functions, specifically to remove unwanted frequency components from the signal, to enhance wanted ones.

Rectifier

A rectifier is an electrical device that converts alternating current (AC) to direct current (DC), a process known as rectification. Rectifiers have many uses including as components of power supplies and as detectors of radio signals. Rectifiers may be made of solid-state diodes, vacuum tube diodes, mercury arc valves, and other components. A device that it can perform the opposite function (converting DC to AC) is known as an inverter. When only one diode is used to rectify AC (by blocking the negative or positive portion of the waveform), the difference between the term diode and the term rectifier is merely one of usage, i.e., the term rectifier describes a diode that is being used to convert AC to DC. Almost all rectifiers comprise a number of diodes in a specific arrangement for more efficiently converting AC to DC than is possible with only one diode. Before the development of silicon semiconductor rectifiers, vacuum tube diodes and copper (I) oxide or selenium rectifier stacks were used.

Regulator

A voltage regulator (also called a _regulator‘) with only three terminals appears to be a simple device, but it is in fact a very complex integrated circuit. It converts a varying input voltage into a constant regulated ‘output voltage. Voltage Regulators are available in a variety of outputs like 5V, 6V, 9V, 12V and 15V. The LM78XX series of voltage regulators are designed for positive input. For applications requiring negative input, the LM79XX series is used. Using a pair of _voltage-divider resistors can increase the output voltage of a regulator circuit. It is not possible to obtain a voltage lower than the stated rating. You cannot use a 12V regulator to make a 5V power supply. Voltage regulators are very robust. These can withstand over-current draw due to short circuits and also over- heating. In both cases, the regulator will cut off before any damage occurs. The only way to destroy a regulator is to apply reverse voltage to its input. Reverse polarity destroys the regulator almost instantly. Fig shows voltage regulator.

5.1.2 IR SENSOR

Fig 5.1.4 IR Sensor

An infrared sensor is an electronic device that emits in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. These types of sensors measure only infrared radiation, rather than emitting it that is called a passive IR sensor. Usually, in the infrared spectrum, all the objects radiate some form of thermal radiation. These types of radiations are invisible to our eyes, that can be detected by an infrared sensor. The emitter is simply an IR LED (Light Emitting Diode) and the detector is simply an IR photodiode that is sensitive to IR light of the same wavelength as that emitted by the IR LED. When IR light falls on the photodiode, the resistances and the output voltages will change in proportion to the magnitude of the IR light received.

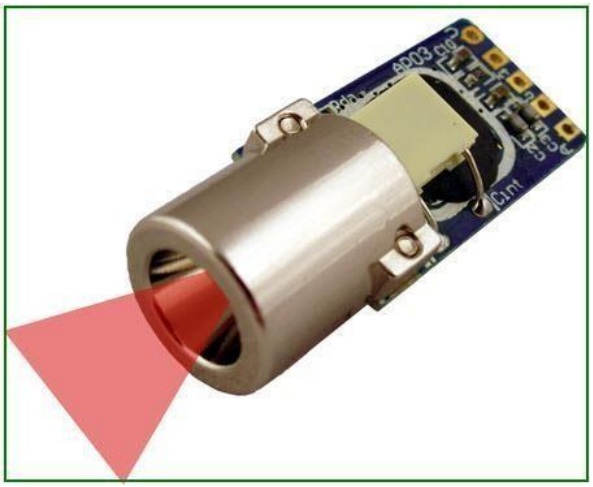

Fig 5.1.5 IR Sensor LED

IR Sensor Circuit Diagram and Working Principle

An infrared sensor circuit is one of the basic and popular sensor module in an electronic device. This sensor is analogous to human's visionary senses, which can be used to detect obstacles and it is one of the common applications in real-time. This circuit comprises of the following components

- LM358 IC 2 IR transmitter and receiver pair
- Resistors of the range of kilo-ohms.
- Variable resistors.
- LED (Light Emitting Diode)

5.1.3 ZIGBEE:

A Zigbee transceiver is a device used to enable communication in Zigbee wireless networks. Zigbee is a wireless communication protocol commonly used in IoT (Internet of Things) applications due to its low power consumption, low data rate, and short-range communication capabilities. A Zigbee transceiver facilitates the transmission and reception of data packets between devices in a Zigbee network. Here's an overview of a Zigbee transceiver:

Zigbee transceiver is a key component in Zigbee wireless networks, enabling reliable, low-power communication between devices in IoT and embedded systems applications. It provides the essential functions for transmitting and receiving data packets according to the Zigbee protocol, facilitating the creation of efficient and scalable wireless networks.

5.1.4 ADXL335 Three Axis Low-g Micro machined Accelerometer

The ADXL335 is a small, thin, low power, complete 3-axis accelerometer with signal conditioned voltage outputs. The product measures acceleration with a minimum full-scale range of ±3 g. It can measure the static acceleration of gravity in tilt sensing applications, as well as dynamic acceleration resulting from motion, shock, or vibration. The user selects the bandwidth of the Accelerometer using the C_X, C_Y, and C_Z capacitors at the X_{OUT},

Y_{OUT}, and Z_{OUT} pins. Bandwidths can be selected to suit the application, with a range of 0.5 Hz to 1600 Hz for X and Y axes, and a range of 0.5 Hz to 550 Hz for the Z axis.

The ADXL335 is available in a small, low profile, 4 mm × 4 mm × 1.45 mm, 16-lead, plastic lead frame chip scale package (LFCSP_LQ).

Functional Block diagram

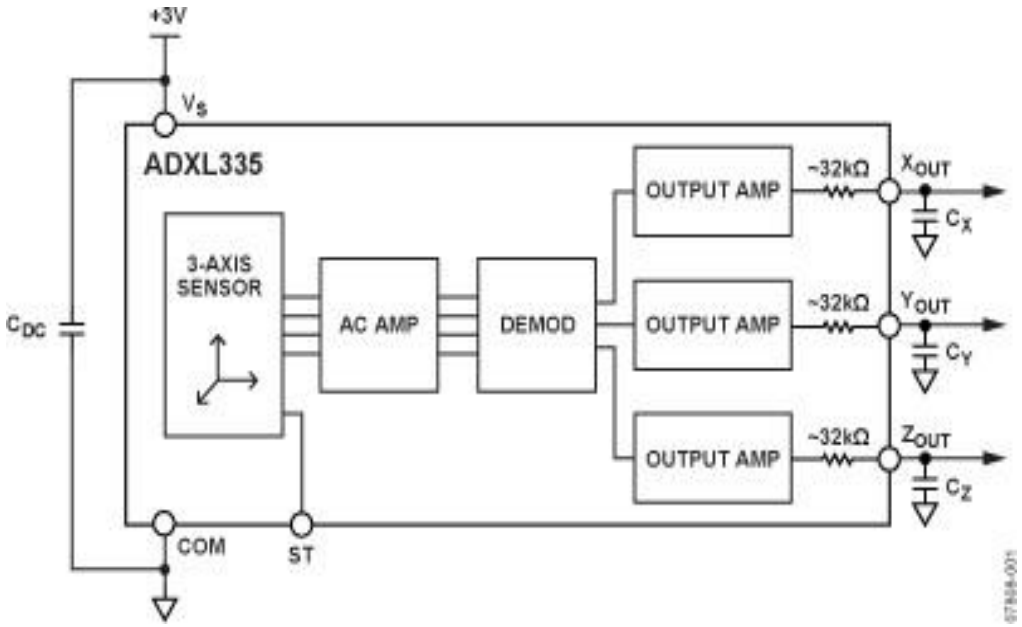

Fig 5.1.6 ADXL Sensor

Features

- 3-axis sensing
- Small4 mm × 4 mm × 1.45 mm LFCSP
- Low power - 350 µA (typical)
- Single-supply operation1.8 V to 3.6 V
- 10,000 g shock survival
- Excellent temperature stability
- BW adjustment with a single capacitor per axis
- ROHS/WEEE lead-free

Compliant Theory of Operation

The ADXL335 is a complete 3-axis acceleration measurement system. The ADXL335 has a measurement range of ±3 g mini-mum. It contains a polysilicon surface-micro machined sensor and signal conditioning circuitry to implement open-loop acceleration measurement architecture. The output signals are analog voltages that are proportional to acceleration. The accelerometer can measure the static acceleration of gravity in tilt-sensing applications as well as dynamic acceleration resulting from motion, shock, or vibration.

The sensor is a polysilicon surface-micro machined structure built on top of a silicon wafer. Polysilicon springs suspend the structure over the surface of the wafer and provide a resistance against acceleration forces. Deflection of the structure is measured using a differential capacitor that consists of independent fixed plates and plates attached to the moving mass. Acceleration deflects the moving mass and unbalances the differential capacitor resulting in a sensor output whose amplitude is proportional to acceleration. Phase-sensitive demodulation techniques are then used to determine the magnitude and direction of the acceleration.

Applications:

- Motion- and tilt-sensing applications
- Mobile devices
- Gaming systems
- Image stabilization
- Sports and Health Devices

Pin Diagram:

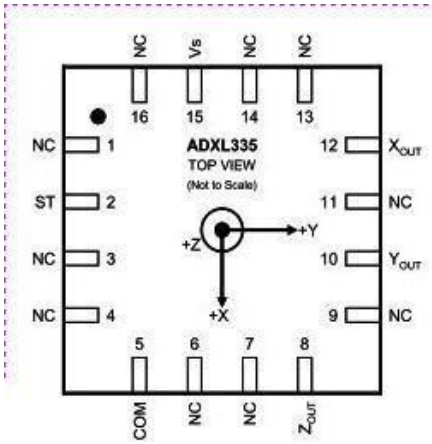

Figure 3. Pin Configuration

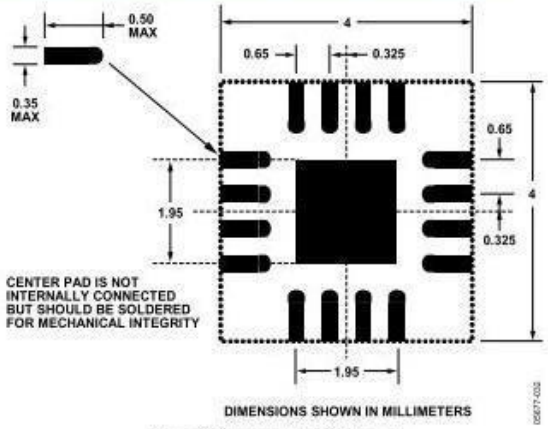

Figure 4. Recommended PCB Layout

5.1.5 Jumper Wires

Fig 5.1.7Jumper wires

A **jump wire** (also known as jumper, jumper wire, jumper cable, DuPont wire, or DuPont cable) is an electrical wire or group of them in a cable with a connector or pin at each end (or sometimes without them – simply "tinned"), which is normally used to interconnect the components of a breadboard or other prototype or test circuit, internally or with other equipment or components, without soldering. Individual jump wires are fitted by inserting their "end connectors" into the slots provided in a breadboard, the header connector of a circuit board, or a piece of test equipment.

5.1.6 DC Motor

DC motors convert electrical into mechanical energy and they consist of permanent magnets and loops of wire inside, When current is applied, the wire loops generate a magnetic field, which reacts against the outside field of the static magnets. The interaction of the fields produces the movement of the shaft/armature. Thus, electro magnetic energy becomes motion.

Fig 5.1.8 DC Motor

H-Bridge: L293D

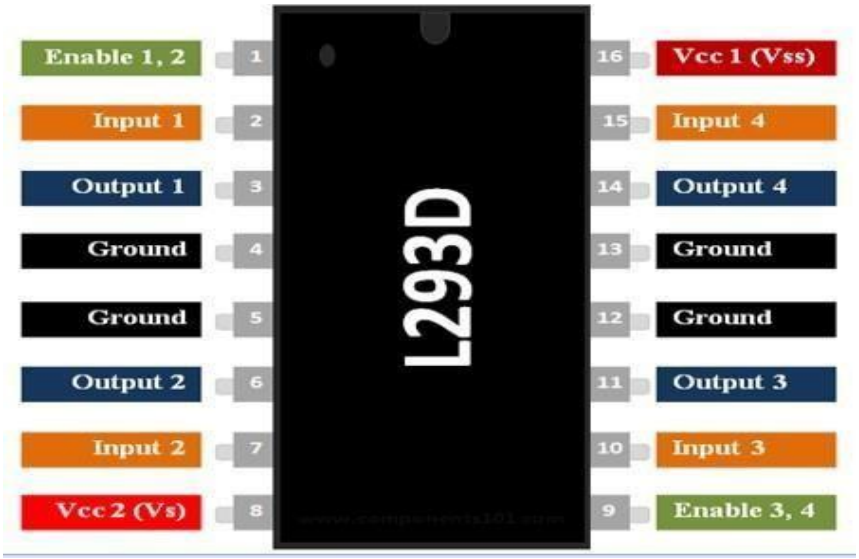

Fig 5.1.9 H-Bridge: L293

Features :

- Can be used to run Two DC motors with the same IC.
- Speed and Direction control is possible
- Motor voltage Vcc2 (Vs): 4.5V to 36V
- Maximum Peak motor current: 1.2A
- Maximum Continuous Motor Current: 600mA
- Supply Voltage to Vcc1(vss): 4.5V to 7V
- Transition time: 300ns (at 5Vand 24V)
- Automatic Thermal shutdown is available
- Available in 16-pin DIP, TSSOP, SOIC packages

	Pin Name	**Description**
1	Enable 1,2	This pin enables the input pin Input 1(2) and Input 2(7)
2	Input 1	Directly controls the Output 1 pin. Controlled by digital circuits
3	Output 1	Connected to one end of Motor 1
4	Ground	Ground pins are connected to ground of circuit (0V)
5	Ground	Ground pins are connected to ground of circuit (0V)
6	Output 2	Connected to another end of Motor 1
7	Input 2	Directly controls the Output 2 pin. Controlled by digital circuits
8	Vcc2 (Vs)	Connected to Voltage pin for running motors (4.5V to 36V)

9	Enable 3,4	This pin enables the input pin Input 3(10) and Input 4(15)
10	Input 3	Directly controls the Output 3 pin. Controlled by digital circuits
11	Output 3	Connected to one end of Motor 2
12	Ground	Ground pins are connected to ground of circuit (0V)
13	Ground	Ground pins are connected to ground of circuit (0V)
14	Output 4	Connected to another end of Motor 2
15	Input 4	Directly controls the Output 4 pin. Controlled by digital circuits
16	Vcc2 (Vss)	Connected to +5V to enable IC function

Rain Sensor

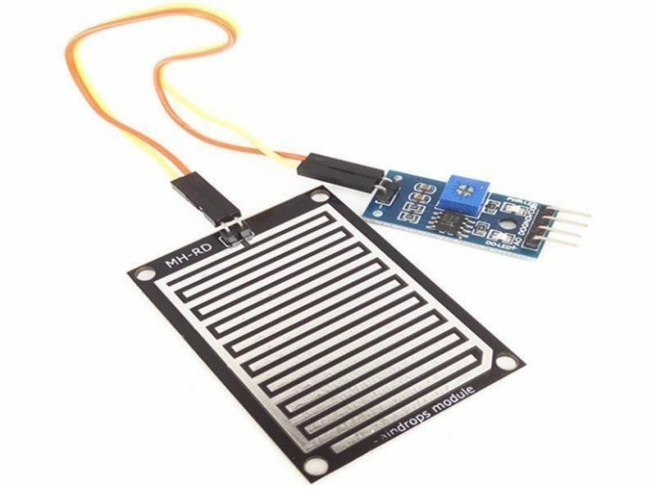

Fig5.1.10 Rain Sensor

A rain sensor or rain switch is a switching device activated by rainfall. The raindrop sensor measures the moisture via analog output pins and it provides a digital output when a threshold of moisture exceeds.

It typically consists of one or more sensing elements that respond to changes in moisture levels. When rain or moisture is detected, the sensor sends a signal to a connected system, such as an automatic irrigation system or windshield wipers in a car, triggering them to activate or adjust accordingly. Rain sensors can use various detection methods, including conductivity, capacitance, or optical properties, to sense the presence of water droplets. They are commonly used in applications where automatic response to changing weather conditions is desired. Rain sensors automate tasks that would otherwise require manual intervention, enhancing convenience for users. In vehicles, rain sensors activate windshield wipers automatically when rain is detected, enhancing driving safety and convenience.

5.1.8 BUZZER

Fig5.1.11 Buzzer

A buzzer or beeper is an audio signalling device, which may be mechanical, electromechanical, or piezoelectric (piezo for short). a sounding device that can convert audio signals into sound signals. It is usually powered by DC voltage. It is widely used in alarms, computers, printers and other electronic products as sound devices. A buzzer is an electronic signaling device that produces a buzzing or beeping sound when activated. It consists of a vibrating element, such as a piezoelectric crystal or an electromagnetic coil, and a resonating chamber to amplify the sound.

Buzzer applications vary widely, including in alarms, timers, notifications, and electronic games, where audible alerts are needed to grab attention or convey information. When an electrical current is applied to the buzzer, the vibrating element oscillates, producing sound waves.

Buzzer applications range from simple alarms and timers to more complex systems like those found in electronic games and industrial equipment. They are commonly used to provide audible alerts, notifications, or warnings in various electronic devices and systems.

5.1.9 LCD display

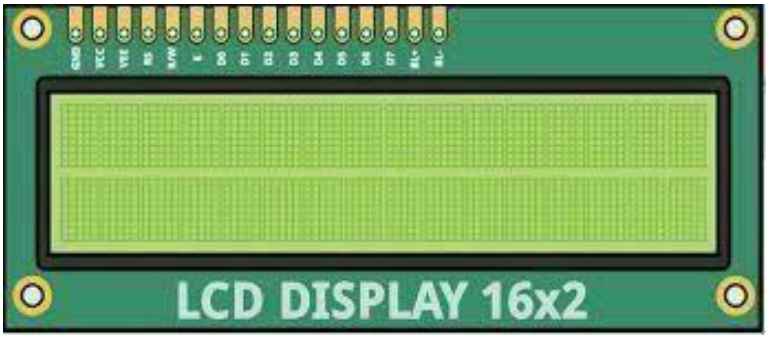

Fig 5.1.12 16*2 LCD display

A **liquid-crystal display** (**LCD**) is a flat-panel display or other electronically modulated optical device that uses the light-modulating properties of liquid crystals. Liquid crystals do not emit light directly, instead using a backlight or reflector to produce images in colour or monochrome. LCDs are available to display arbitrary images (as in a general-purpose computer display) or fixed images with low information content, which can be displayed or hidden, such as preset words, digits, and 7-segment displays, as in a digital clock. They use the same basic technology, except that arbitrary images are made up of a large number of small pixels, while other displays have larger elements.

LCD is used in wide range application including computer monitors, televisions, instrument panels, aircraft cockpit displays, and indoor and outdoor signage. Small LCD screens are common in portable consumer devices such as digital cameras, watches, calculators, and mobile telephones, including smartphones. LCD screens are also used on consumer electronics products such as DVD players, videogame devices and clocks. LCD screens have replaced heavy, bulky cathode ray tube (CRT) displays in nearly all applications. LCD screens are available in a wider range of screen sizes than CRT and plasma displays, with LCD screens available in sizes ranging from tiny digital watches to huge, big-screen television sets. Since LCD screens do not use

phosphors, they do not suffer image burn-in when a static image is displayed on a screen for a long time (e.g., the table frame for an aircraft schedule on an indoor sign). LCDs are, however, susceptible to image persistence.

Interfacing an LCD with an Arduino

The 16x2 LCD has a total of 16 pins. As shown in the table below, eight of the pins are data lines (pins7-14), two are for power and ground (pins 1 and 16), three are used to control the operation of LCD (pins 4-6), and one is used to adjust the LCD screen brightness (pin 3). The remaining two pins (15 and 16) power the backlight.

The details of the LCD terminals are as follows:

Terminal 1	GND
Terminal 2	+5V
Terminal 3	Mid terminal of potentiometer (for brightness control)
Terminal 4	Register Select (RS)
Terminal 5	Read/Write (RW)
Terminal 6	Enable (EN)
Terminal 7	DB0
Terminal 8	DB1
Terminal 9	DB2
Terminal 10	DB3
Terminal 11	DB4
Terminal 12	DB5
Terminal 13	DB6
Terminal 14	DB7
Terminal 15	+4.2-5V
Terminal 16	GND

Table : LCD terminals

LCD MODULE

Fig 5.1.13 Output of LCD

The name and functions of each pin of the 16×2 LCD module is given below.

Pin1 (Vss): Ground pin of the LCD module.

Pin2 (Vcc): Power to LCD module (+5V supply is given to this pin)

Pin3 (VEE): Contrast adjustment pin. This is done by connecting the ends of a 10K potentiometer to +5Vand ground and then connecting the slider pin to the VEE pin. The voltage at the VEE pin defines the contrast. The normal setting is between 0.4 and 0.9v

Pin4(RS): Register select pin. Logic HIGH at RS pin selects data register and logic LOW at RS pin selects command register. If we make the RS pin HIGH and feed an input to the data lines (DB0 to DB7), this input will be treated as data to display on LCD screen. If we make the RS pin LOW and feed an input to the data lines, then this will be treated as a command (a command to be written to LCD controller – like positioning cursor or clear screen or scroll).

Pin5 (R/W): Read/Write modes. This pin is used for selecting between read and write modes. Logic HIGH at this pin activates read mode and logic LOW at this pin activates write mode.
Pin6 (E): This pin is meant for enabling the LCD module. A HIGH to LOW signal at this pin will enable the module.

Pin7 (DB0) to Pin14(DB7): These are data pins. The commands and data are fed to the LCD module though these pins.

Pin15 (LED+): Anode of the back light LED. When operated on 5V, a 560 ohm resistor should be connected in series to this pin. In Arduino based projects the back light LED can be powered from the 3.3V source on the Arduino board.

Pin16 (LED-): Cathode of the back light LED.
RS pin of the LCD module is connected to digital pin 12 of the Arduino. R/W pin of the LCD is grounded. Enable pin of the LCD module is connected to digital pin 11 of the Arduino. This method is very simple, requires less connections and we can almost utilize the full potential of the LCD module. Digital lines DB4, DB5, DB6 and DB7 are interfaced to digital pins 5, 4, 3 and 2 of the Arduino. The 10K potentiometer is used for adjusting the contrast of the display. The Arduino can be powered through the external power jack provided on the board. +5V required in some other parts of the circuit can be tapped from the 5V source on the Arduino board. The Arduino can be also powered from the PC through the USB port.

5.2 Software Requirements:

5.2.1 Arduino IDE

A program for Arduino may be written in any programming language for a compiler that produces binary machine code for the target processor. Atmel provides a development environment for their microcontrollers, AVR Studio and the newer Atmel Studio.

The Arduino project provides the Arduino integrated development environment (IDE), which is a cross- platform application written in the programming language Java. It originated from the IDE for the languages Processing and Wiring. It includes a code editor with features such as text cutting and pasting, searching and replacing text, automatic indenting, brace matching, and syntax highlighting, and provides simple one-click mechanisms to compile and upload programs to an Arduino board. A program written with the IDE for Arduino is called a sketch. Sketches are saved on the development computer as text files with the file extension. ino. Arduino Software (IDE) pre-1.0 saved sketches with the extension. pde.

The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. User-written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub main() into an executable cyclic executive program with the GNU toolchain, also included with the IDE distribution.

A minimal Arduino C/C++ sketch, as seen by the Arduino IDE programmer, consist of only two functions:

- **setup**(): This function is called once when a sketch starts after power-up or reset. It is used to initialize variables, input and output pin modes, and other libraries needed in the sketch.□
- **loop():** After setup() has been called, function loop() is executed repeatedly in the main program. It controls the board until the board is powered off or is reset.

Fig 5.2.1

5.2.2 Embedded C:

When designing software for a smaller embedded system with the 8051, it is very common place to develop the entire product using assembly code. With many projects, this is a feasible approach since the amount of code that must be generated is typically less than 8 kilobytes and is relatively simple in nature. If a hardware engineer is tasked with designing both the hardware and the software, he or she will frequently be tempted to write the software in assembly language.

The trouble with projects done with assembly code can is that they can be difficult to read and maintain, especially if they are not well commented. Additionally, the amount of code reusable from a typical assembly language project is usually very low. Use of a higher-level language like C can directly address these issues. A program written in C is easier to read than an assembly program.

- Since a C program possesses greater structure, it is easier to understand and maintain. Because of its modularity, a C program can better lend itself to reuse of code from project to project. The division of code into functions will force better structure of the software and lead to functions that can be taken from one project and used in another, thus reducing overall development time. A high order language such as C allows a developer to write code, which resembles a human's thought process more closely than does the equivalent assembly code. [25]The developer can focus more time on designing the algorithms of the system rather than having to concentrate on their individual implementation. This will greatly reduce development time and lower debugging time since the code is more understandable.

- By using a language like C, the programmer does not have to be intimately familiar with the architecture of the processor. This means that someone new to a given processor can get a project up and running quicker, since the internals and organization of the target processor do not have to be learned. Additionally, code developed in C will be more portable to other systems than code developed in assembly. Many target processors have C compilers available, which support ANSI C.
- All of this is not to say that assembly language does not have its place. In fact, many embedded systems (particularly real time systems) have a combination of C and assembly code. Assembly code is frequently the only way to go. One of the great things about the C language is that it allows you to perform low-level manipulations of the hardware if need be, yet provides you the functionality and abstraction of a higher order language.

5.2.3 Python:

Python is a high-level, interpreted, interactive and object-oriented scripting language. Python is designed to be highly readable. It uses English keywords frequently where as other languages use punctuation, and it has fewer syntactical constructions than other languages.

- **Python is interpreted:** Python is processed at runtime by the interpreter. You do not need to compile your program before executing it. This is similar to PERL and PHP.
- **Python is Interactive:** You can actually sit at a Python prompt and interact with the interpreter directly to write your programs.
- **Python is Object-Oriented:** Python supports Object-Oriented style or technique of programming that encapsulates code within objects.
- **Python is a Beginner's Language:** Python is a great language for the beginner-level programmers and supports the development of a wide range of applications from simple text processing to WWW browsers to games.

Python Features

- **Easy-to-learn:** Python has few keywords, simple structure, and a clearly defined syntax. This allows the student to pick up the language quickly.
- **Easy-to-read:** Python code is more clearly defined and visible to the eyes.
- **Easy-to-maintain:** Python's source code is fairly easy-to-maintain.

- **A broad standard library:** Python's bulk of the library is very portable and cross- platform compatible on UNIX, Windows, and Macintosh.
- **Interactive Mode:** Python has support for an interactive mode which allows interactive testing and debugging of snippets of code.
- **Portable:** Python can run on a wide variety of hardware platforms and has the same interface on all platforms.
- **Extendable:** You can add low-level modules to the Python interpreter. These modules enable programmers to add to or customize their tools to be more efficient.
- **Databases:** Python provides interfaces to all major commercial databases.
- **GUI Programming:** Python supports GUI applications that can be created and ported to many system calls, libraries, and windows systems, such as Windows MFC, Macintosh, and the X Window system of Unix.
- **Scalable:** Python provides a better structure and support for large programs than shell scripting

Python's standard library

- Pandas
- Numpy
- Sklearn
- Seaborn
- Matplotlib
- Importing Datasets
- OpenCV

IMAGE PROCESSING USING OPENCV IN PYTHON

Image processing is the process of manipulating pixel data in order to make it suitable for computer vision applications or to make it suitable to present it to humans. For example, changing brightness or contrast is an image processing task which make the image visually pleasing for humans or suitable for further processing for a certain computer vision application.

PYTHON

It is an object-oriented programming language. The processing happens during the runtime, and this is performed by the interpreter. Python's simple to learn and easy to use is an advantage and thus makes it developer friendly. It is easier to read and understand as the syntax is conventional. The code can be executed line by line using the interpreter. Python can support multiple platforms like Linux, UNIX, windows, Macintosh, and so on. The paradigms of Object-oriented programming are supported by python. The functions such as polymorphism, operator overloading and multiple inheritance is supported python.

CHAPTER 06

DESIGN AND METHODOLOGY

6.1 BLOCK DIAGRAM:

HUB MODEL

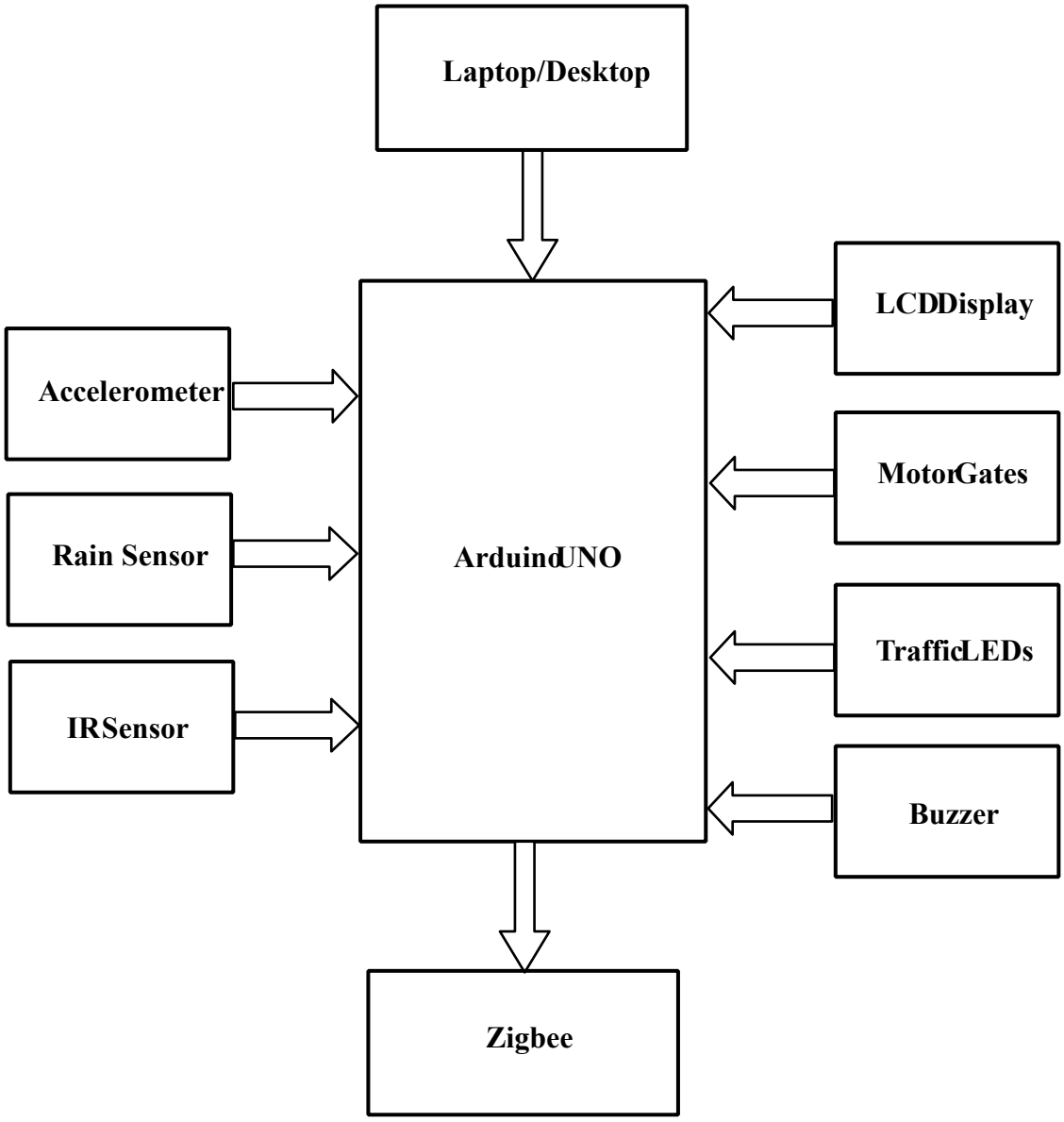

Fig6.1

6.2 VEHICLE MODEL:

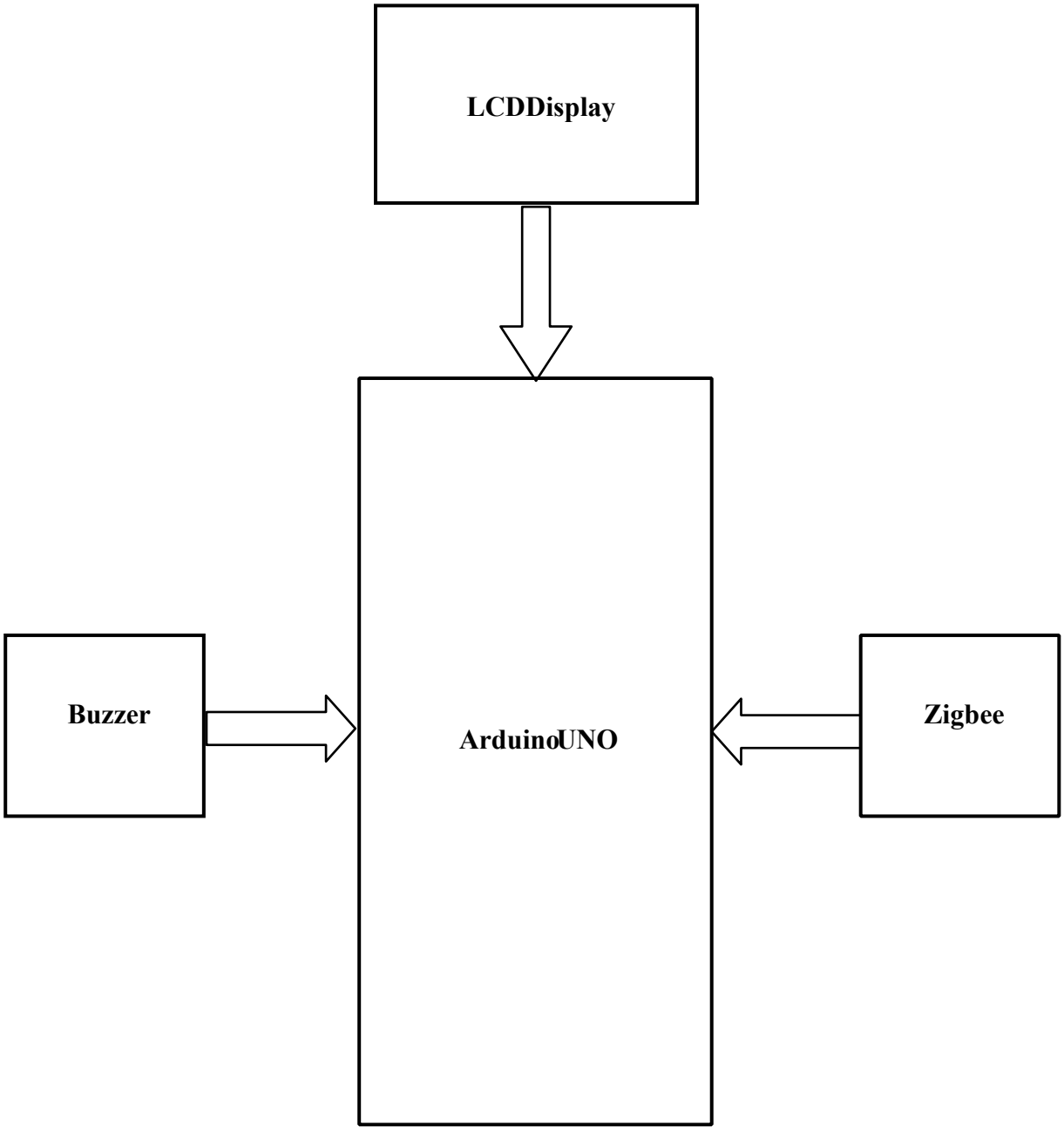

Fig 6.2

6.3 METHODOLOGY

- **IR Sensor Integration**: Install IR sensors on the vehicle to detect obstacles and other vehicles in the proximity, especially in deep curves.

- **ADXL Sensor Implementation**: Use ADXL sensors to measure land tilt and ground vibrations and possible land slides, providing real-time data to assess the vehicle's stability.

- **Arduino Uno Control Unit**: Employ Arduino Uno as the central control unit to process data from IR and ADXL sensors and communicate with other components.

- **LCD Display Interface**: Design a user-friendly interface on an LCD display to show warnings and updates to the driver.

- **Rain Sensor Integration**: Updates about rainfall across the ghat or roads that are passing across mountains and update to driver.

- **Zigbee Communication Network**: Establish a Zigbee network for vehicles to communicate with each other, sharing information about road conditions and obstacles.

6.4 ACTIVITY DIAGRAM:

The activity diagram is an UML diagram that describes the system's dynamic aspects. In fact, it is a flowchart that regulates the flow every event. The event can be described as the operation of the system. The control flow shall be taken between operations.

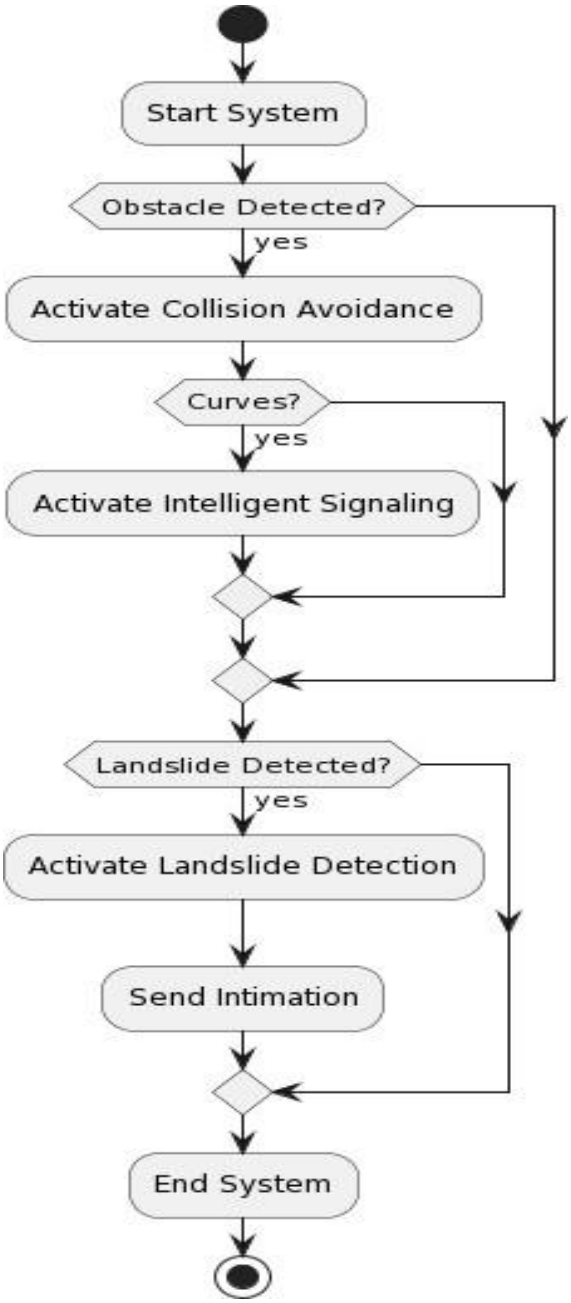

Fig 6.3

CHAPTER 7

SNAPSHOTS

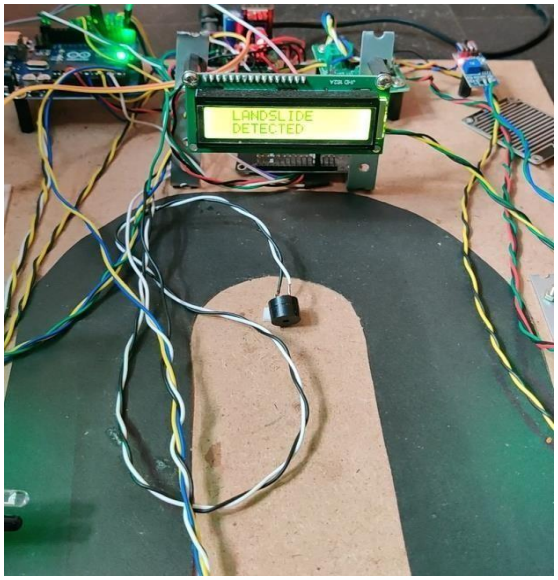

Fig 7.1: Landslide Detected

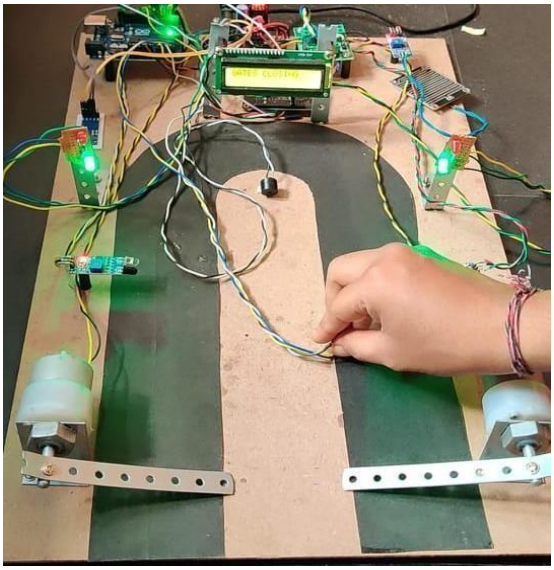

Fig 7.2: Gates closing

LANDSLIDE DETECTION: is the process of identifying and monitoring potential or ongoing landslides to prevent disaster protect lives and reduce damage to property fig (7.1).

GATE CLOSING: to manage the flow of water debris and sediment and to avoid accidents fig(7.2).

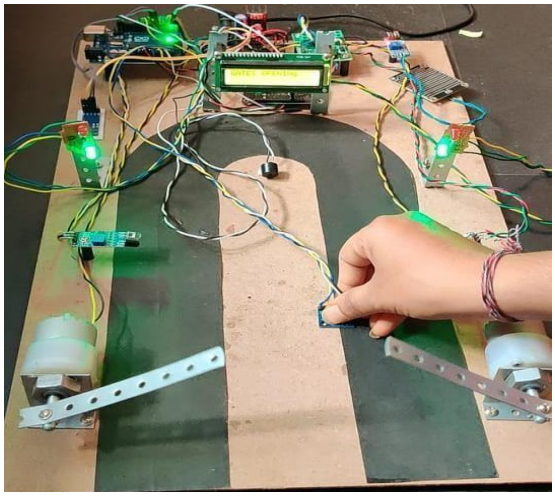

Fig 7.3: Gates opening

GATE OPENING: can be implemented after the weather condition is clear like landslide ,etc fig (7.3)

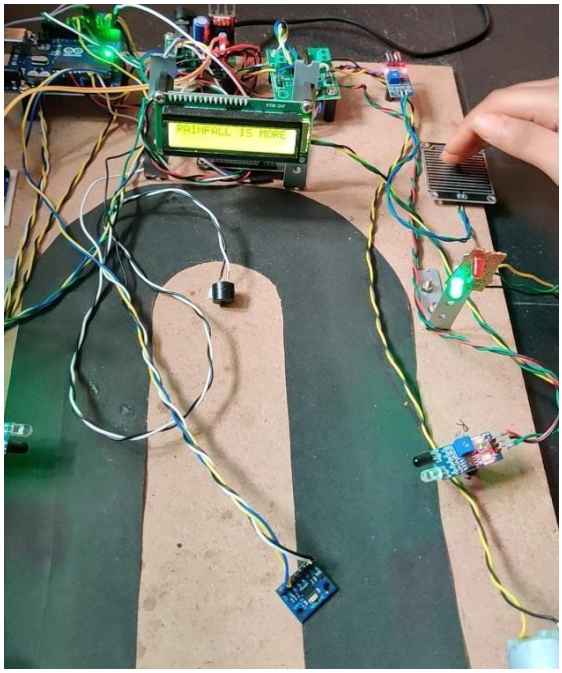

Fig 7.4: Rainfall detected

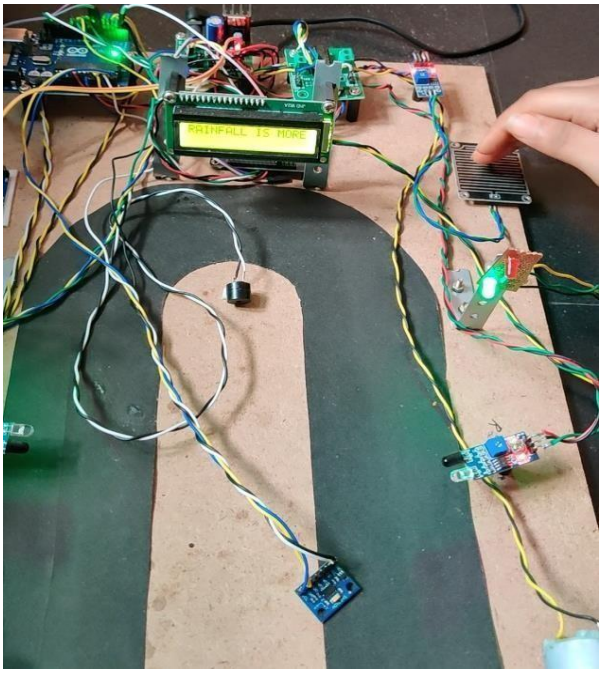

Fig 7.5: Rainfall is more

RAINFALL DETECTION : It is crucial for weather forcasting and disaster management and it can be detected by using the rain sensor fig (7.4).

RAIN FALL IS MORE: It leads to a range consequences and requires immediate attention to mitiate its impact fig(7.5).

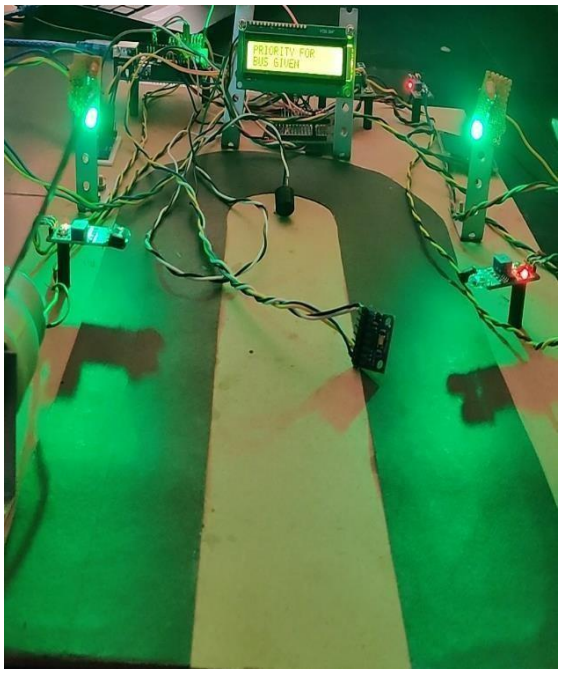

Fig 7.6: Priority for bus given

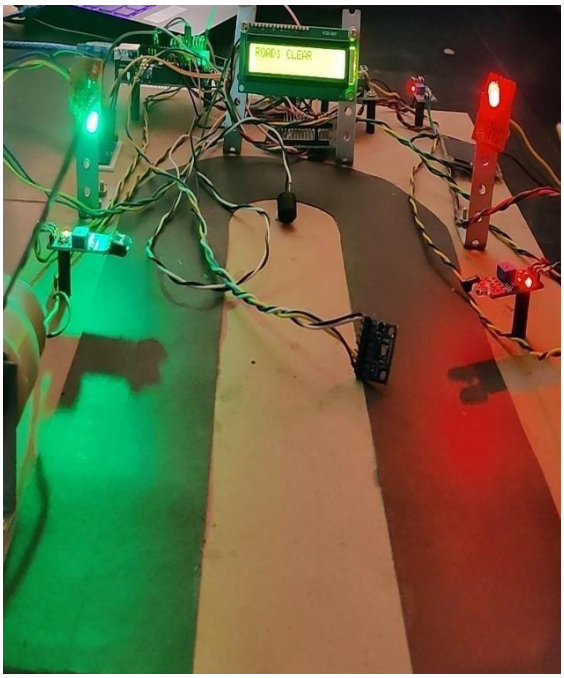

Fig 7.7: Road 1 clear

PRIORITIZING BUSES especially in urban areas is essential for improving public transportation efficiency reducing traffic congestion fig(7.6)

ROAD 1 CLEAR :it means the road is open for traffic providing an opportunity to manage traffic flow efficiently fig (7.7)

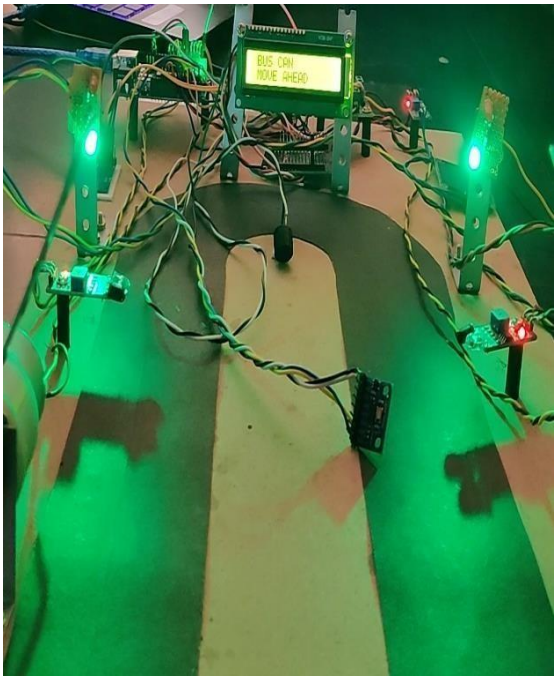

Fig 7.8: Bus can move ahead

BUS CAN MOVE A HEAD :Indicates that the road is clear and the bus can proceed without any delay fig(7.8)

VEHICLE MODEL

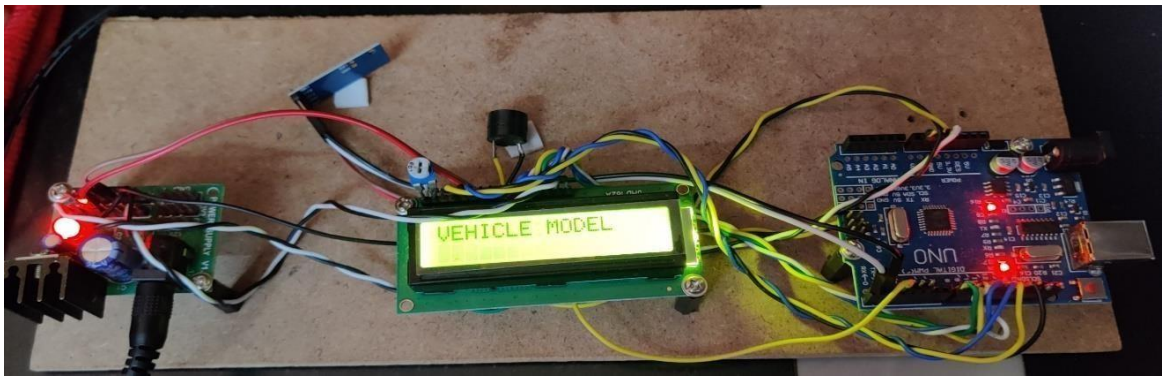

Fig 7.9: Vehicle Model

This vehicle model represent the vehicle design , structure or functionality ,typically for simulations manufacturing or conceptualization (7.9).

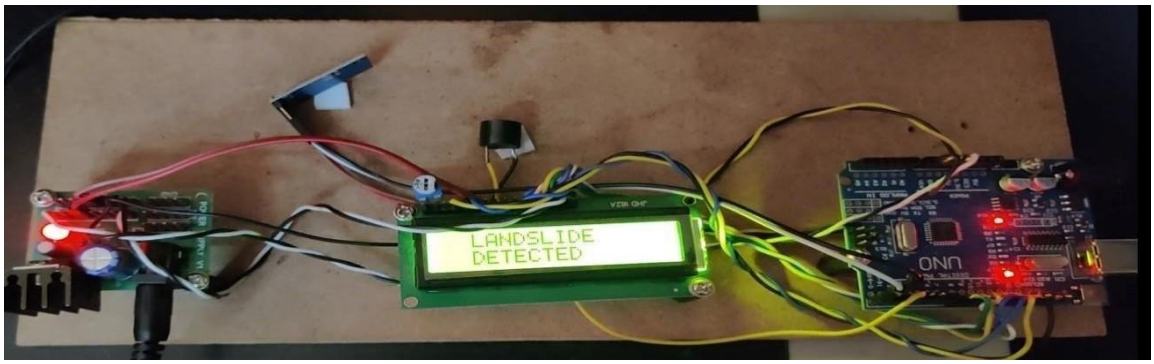

Fig 7.10: Landslide Detected

It is the process of identification and potential or ongoing landslides to prevent disaster protect lives and reduce damage property fig (7.10)

Fig 7.11: More Rainfall

It can leads toa range of consequences and requires immediate attention to mitigate its impact (7.11).

CHAPTER 08

APPLICATIONS

- **Real-time Monitoring:**Use sensors such as accelerometers, inclinometers, and moisture sensors installed on slopes and in soil to monitor movements and conditions indicative of landslides.Integrate data from satellite imaging and radar to track large-scale changes in terrain.
- **Data Analysis:**Analyze sensor data to detect early warning signs of potential landslides.Combine sensor data with weather data and geological surveys for more comprehensive analysis.
- **Alert Systems:** Send automated alerts to authorities and local communities when a landslide is detected or imminent.Provide information to drivers about road closures or reroutes due to landslides.
- **Mapping and Visualization:** Create interactive maps displaying landslide-prone areas and the latest updates on detected landslides.Provide visual alerts on maps in GPS and navigation apps for drivers.
- **Curvature Recognition:** Utilize LiDAR or radar to assess the curvature of roads ahead and identify potentially hazardous curves.Combine GPS data with high-resolution maps to accurately gauge road geometry.
- **Vehicle-to-Infrastructure (V2I) Communication:** Enable vehicles to communicate with roadside units or traffic signals to receive information on upcoming curves and potential hazards.Use V2I communication to adjust speed limits dynamically based on traffic and road conditions.
- **Driver Assistance Systems:** Provide visual, auditory, or haptic warnings to drivers approaching deep curves, especially when there's oncoming traffic or other hazards.Implement adaptive cruise control that adjusts speed based on curve sharpness and traffic conditions.