SONARGAON UNIVERSITY (SU)

Power Generation From Speed Breaker by Using Electromagnetic Suspension

A Project
By

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May 2023

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In partial fulfillment of the requirement for the award of the degree Of Bachelor of Science in Mechanical Engineering

May 2023

LETTER OF TRANSMITTAL

May 2023

To

Md. Misbah Uddin

Lecturer

Department of Mechanical Engineering.

Sonargaon University, Dhaka-1215

Subject: Submission of Project Report**.**

Dear Sir,

We are pleased to submit the project report on "**Power Generation From Speed Breaker by Using Electromagnetic Suspension".** It was a great pleasure to work on such an important topic. This project has been done per the instruction of your supervision and according to the requirements of Sonargaon University.

We expect that the concerned authority will accept the project. We are happy to explain anything further as you may feel necessary.

Thank You

Sincerely yours,

Md. Habibur Rahman	BME1903019168
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STUDENT'S DECLARATION

We do hereby solemnly declare that, the work presented here in this project report has been carried out by us and has not been previously submitted to any University/ Organization for the award of any degree or certificate.

We hereby ensure that the works that have been prevented here do not breach any existing copyright.

We further undertake to indemnify the university against any loss or damage arising from a breach of the foregoing obligation.

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SUPERVISOR'S DECLARATION

I hereby declare that I have checked this project. In my opinion, this project is satisfactory in terms of scope and quality for the award of the degree of Bachelor of Science in Mechanical Engineering.

Md. Misbah Uddin
Lecturer
Department of Mechanical Engineering
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ACKNOWLEDGEMENT

First, we started in the name of Almighty Allah. This thesis is accomplished under the supervision of Md. Misbah Uddin, Lecturer, Department of Mechanical Engineering, Sonargaon University. It is a great pleasure to acknowledge our profound gratitude and respect to our supervisor for this consistent guidance, encouragement, helpful suggestion, constructive criticism, and endless patience through the progress of this work. The successful completion of this thesis would not have been possible without his persistent motivation and continuous guidance.

The authors are also grateful to Md. Mostofa Hossain, Head of the Department of Mechanical Engineering, and all respectful teachers of the Mechanical Engineering Department for their cooperation and significant help in completing this project work successfully.

Abstract

The main objective of designed the controller for a Power Generation from speed breaker by using vehicle suspension system is to reduce the discomfort sensed by passengers which arises from road roughness and to increase the ride handling associated with the pitching and rolling movements. This necessitates a very fast and accurate controller to meet as much control objectives, as possible. The advantage of this controller is that it can handle the non linearities faster than other conventional controllers. The approach of the proposed controller is to minimize the vibrations on each corner of vehicle by supplying control forces to suspension system when travelling on rough road. Our project is to enlighten the streets utilizing the jerking pressure which is wasted during the vehicles passes over speed breaker in roadside. We can tap the energy generated by moving vehicles and produce power by using the speed breaker as power generating unit. The kinetic energy of the moving vehicles can be converted into mechanical energy through rack and pinion mechanism and this mechanical energy will be converted to electrical energy using generator which will be used for lighting the street lights. Therefore, by using this mechanism we can save lot of energy which can fulfill our future demands.

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Chapter 1
Introduction

1.1 Background

Now a day's power has become the major need for human life. Energy is an important input in all the sectors of any countries economy. The availability of regular conventional fossil fuels will be the main sources for power generation, but there is a fear that they will get exhausted eventually by the next few decades[1] . Therefore, we have to investigate other types of renewable sources. The day-to-day increasing population and decreasing conventional sources for power generation, provides a need to think on non-conventional energy resources [2]. Another major problem, which is becoming the exiting topic for today is the pollution. Power stations and automobiles are the major pollution producing places. So non-conventional power source is needed to reduce this problem. We proposed a non-conventional power generating system based on speed breaker mechanism which generate electricity without using any commercial fossil fuels, which is not producing any polluting products [3]. In this paper, our aim is to conserve the kinetic energy which convert into electricity that gone wasted, while vehicles move.

1.2 History

Electricity generation began somewhere around 100 years ago, and before this idea was known houses were lit with help of kerosene lamps, iceboxes were used to cool the food,and rooms were warmed by stoves using either coal or wood for burning. Direct current (DC) electricity was used in arc lights for outdoor lighting. Nikola Tesla pioneered the generation, transmission, and use of alternating current (AC) electricity, in the late-1800s, which could be transmitted over much greater distances compared to direct current. The first ever generation of electricity was done by using Faraday's dynamo in the 1800's. Almost 200 years later, it was found that we are still using the same basic principles to generate electricity, only on a much larger scale. The standard conventional fossil fuels are the key sources for power generation, but there is a fear of these conventional fossil fuels getting exhausted eventually by the next few decades. Hence it has become mandatory for us to search on some new alternative sources for power generation, which would last for a longer duration (N.V. Bhavsar, *et al*, 2015). Therefore, it is necessary & important that we depend on non-conventional energy sources for power generation. While moving, vehicles possess kinetic energy and some of the kinetic energy is wasted. This kinetic energy which is already being wasted can therefore be utilized to produce power by using a special arrangement called “elector-mechanical unit”. Electricity production from a speed breaker is a new concept that is undergoing research.

1.3 Motivation

An energy crisis is any significant bottleneck in the supply of energy resources to an economy. Industrial development and population growth have led to a surge in the global demand for energy in recent years. There is a current global need for clean and renewable energy sources. Fossil fuels are non-renewable and require finite resources, which are dwindling because of high cost and environmentally damaging retrieval techniques. So, the need for cheap and obtainable resources is greatly needed. [1]

1.4 Aims and Objectives

The main objective of our project is **Power Generation From Speed Breaker by Using Electromagnetic Suspension System** simple and accurate currently in our project. Our System main objectives are given below-

- The main objective of this project is To **Power Generation From Speed Breaker by Using Electromagnetic Suspension System**.
- This is the purpose of to generate power from electromagnetic speed breaker system.
- To take necessary notes from the project for future improvements.

1.5 Thesis Outline

- **Chapter 1: Introduction.** This chapter is all about background study, problem identification, motivation and aims and objectives.
- **Chapter 2: Literature Review-** Here briefly describe about Introduction, Related Work and Summery.
- **Chapter 3: Evaluation of the Developed System -** This chapter is discussed about instrument. Hardware details and its working procedure.

- **Chapter 4: The Design Method and Process –** Here briefly discuss about project methodology, Block Diagram, circuit diagram, required instrument cost analysis, working principle, work plan, output curve analysis etc.
- **Chapter 5: Conclusion** – This chapter is all about our project advantages, limitation, application and this project conclusion.

Chapter 2
Literature Review

2.1 Introduction

This chapter is dedicated to the literature that was used and studied within the preparation of this project. The study of literature shows the understanding of information processing solutions in deciding different findings on the literature.

2.2 Related Work

Recently several attempts and models have been suggested and tested for harnessing kinetic energy of vehicles via a speed breaker. Mechanisms which include springs by A.K. Singh, Deepak S., Madhawendra K. and V. Pandit [1], Rack and Pinion by Aswathaman. V and Priyadharshini.M in "*Every Speed Breaker Is Now A Source of Power*" [2]; by Shakun Srivastava , Ankit Asthana in "*Produce electricity by the use of speed Breakers*"[3] and by Ankit Gupta, Kuldeep Chaudhary & B.N Agrawal in "*An Experimental study of Generation of Electricity using Speed Breaker*"[4] and slider crank by Noor Fatima and Jiyaul Mustafa in *"Production of electricity by the method of road power generation"* [5] have been suggested for producing electricity. Electrodynamics based models by Ankita and Meenu Bala in *"Power generation from speed breaker"* [6] have also been suggested, but are not only expensive to fabricate but involve complicated calculations and can't be used a large scale very easily. Totaram [7] uses a platform plate which is kept inclined on a raised base level to allow vehicles to pass over the raised surface. This system will not work till a vehicle passes on road way.

The thought of generating electricity basically started from South Africa, where, a businessman felt the need for a generation of electricity without compromising on any resources. For this purpose, he thought of an idea and also brought into existence, the working model of this idea. His idea was to generate electricity using speed breakers. These speed breakers use the concepts of physics to convert the kinetic energy possessed by the vehicles running on the road into electrical energy, eventually generating electricity. This is where the plot for energy generating speed breakers was laid, later on, IIT Guwahati took over this project to overcome its limitations. The practical implementation of the electricity generating speed breaker has been very less and the result of the few places where it is implemented is still not known. Although, there have been many surveys to support the implementation of this idea.

One such survey was done by the Tamil Nadu electricity board. According to this survey, the electricity consumed by a remote village for 45 days is equal to the electricity consumed by all the street lights in one night in Chennai city. By this scenario, we can get an idea of the rate by which electricity is being consumed in India, also, this consumption rate is increasing day by day. Electricity and power can be called as the backbone for development and modernization of the country and therefore, the rapid speed of development has lead to a constant increase in the rate of electricity consumption.

Taking into consideration this situation, it is mandatory that either consumption of electricity must be reduced or the generation of electricity must be increased. The consumption of electricity can be reduced only to a certain limit, beyond this limit the development can be hampered. But, by conservation, the amount of electricity conserved will be in very small amount, hence, increasing the generation of electricity is the right option. Now, this increase in generation of electricity would result in more and more use of conventional resources, which are also on decrease, this creates a need to generate electricity without using conventional resources or at least using conventional resources in very small amount. Here the Electricity generating speed breaker would be perfect to apply as it can generate electricity without using any of the conventional resources.

2.3 Summary

From the literature discussed above, we gained a lot of knowledge and we inspired to do this project. We were able to do it with everyone tireless work.

Chapter 3
Component Description

3.1 Introduction

In this chapter we are going to describe our all components. How the components work and why we choose that.

3.2 Required Components and Software

Hardware

1. Inner Iron Spring
2. Magnet
3. Battery
4. Battery Charge Controller
5. LED Light
6. SS Steal Pipe
7. Copper Coil
8. Suspension System
9. Screw
10. Frame Base
11. LDR
12. LCD Display
13. Load Cell HX711

Software

1. EasyEDA

3.3 Suspension System

Electromagnetic suspension (**EMS**) is the magnetic levitation of an object achieved by constantly altering the strength of a magnetic field produced by electromagnets using a feedback loop. In most cases the levitation effect is mostly due to permanent magnets as they don't have any power dissipation, with electromagnets only used to stabilize the effect. According to Earnshaw's Theorem a paramagnetically magnetized body cannot rest in stable equilibrium when placed in any combination of gravitational and magnetostatic fields. In

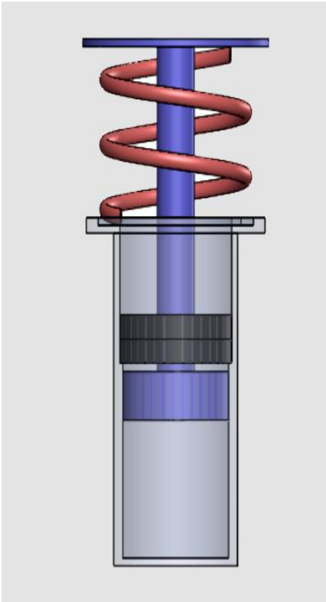

Figure 3.1: Suspension System

these kinds of fields an unstable equilibrium condition exists. Although static fields cannot give stability, EMS works by continually altering the current sent to electromagnets to change the strength of the magnetic field and allows a stable levitation to occur. In EMS a feedback loop which continuously adjusts one or more electromagnets to correct the object's motion is used to cancel the instability. Many systems use magnetic attraction pulling upwards against gravity for these kinds of systems as this gives some inherent lateral stability, but some use a combination of magnetic attraction and magnetic repulsion to push upwards. Magnetic levitation technology is important because it reduces energy consumption, largely reduces friction. It also avoids wear and has very low maintenance requirements. The application of magnetic levitation is most commonly known for its role in Maglev trains.

History

electrostatic field cannot levitate at stable equilibrium under the influence of electric forces alone”.[1] Likewise, due to limitations on permittivity, stable suspension or levitation cannot be achieved in a static magnetic field with a system of permanent magnets or fixed current electromagnets. Braunbeck’s extension (1939) states that a system of permanent magnets must also contain diamagnetic material or a superconductor in order to obtain stable, static magnetic levitation or suspension.[2] Emile Bachelet applied Earnshaw's theorem and the Braunbeck extension and stabilized magnetic force by controlling current intensity and turning on and off power to the electromagnets at desired frequencies.

He was awarded a patent in March 1912 for his “levitating transmitting apparatus” (patent no. 1,020,942).[3] His invention was first intended to be applied to smaller mail carrying systems but the potential application to larger train-like vehicles is certainly apparent.
In 1934 Hermann Kemper applied Bachelet’s concept to the large scale, calling it “monorail vehicle with no wheels attached.” He obtained Reich Patent number 643316 for his invention and is also considered by many to be the inventor of maglev. In 1979 the Transrapid electromagnetically suspended train carried passengers for a few months as a demonstration on a 908 m track in Hamburg for the first International Transportation Exhibition (IVA 79). The first commercial Maglev train for routine service was opened in Birmingham, England in 1984, using electromagnetic suspension, and a linear induction motor for propulsion.

Background:

Electromagnets

When a current passes through a wire, a magnetic field around that wire is generated. The strength of the generated magnetic field is proportional to the current through the wire. When a wire is coiled, this generated magnetic field is concentrated through the center of the coil. The strength of this field can be greatly increased by placing a ferromagnetic material in the center of the coil. This field is easily manipulated by passing a varying current in the wire. Therefore, a combination of permanent magnets with electromagnets is an optimal arrangement for levitation purposes.[1] To reduce average power requirements, often the electromagnetic suspension is used only to stabilise the levitation, and the static lift against gravity is provided by a secondary permanent magnet system, often pulled towards a relatively inexpensive soft ferromagnetic material such as iron or steel.

Feedback

The position of the suspended object can be detected optically or magnetically, other schemes may sometimes be used.The feedback circuit controls the electromagnet to try to keep the suspended object at the correct position.However, simply controlling the position usually leads to instability, due to the small time delays in the inductance of the coil and in sensing the position. In practice then, the feedback circuitry must use the change of position over time to determine and damp the speed.

Application

Maglev (magnetic levitation) is a transportation system in which a vehicle is suspended on a guiding rail by the principle of electromagnetic suspension. Maglev has the advantages of being quieter and smoother than wheeled transportations due to the elimination of much of the physical contact between wheels and track. Since maglev requires a guiding rail, it is mostly used in railed transport systems like trains.Since the first commercial maglev train was opened in Birmingham, England in 1984, other commercial EMS maglev train systems, such as the M-Bahn and the Transrapid have also been put into limited use. (Maglev trains based on electrodynamic suspension technology have also been developed and deployed.) With the possible exception of the 30.5 km Shanghai Maglev Train, no major long-distance EMS maglev routes have been built.

Active magnetic bearing

An active magnetic bearing (AMB) works on the principle of electromagnetic suspension and consists of an electromagnet assembly, a set of power amplifiers which supply current to the electromagnets, a controller, and gap sensors with associated electronics to provide the feedback required to control the position of the rotor within the gap. These elements are shown in the diagram. The power amplifiers supply equal bias current to two pairs of electromagnets on opposite sides of a rotor. This constant tug-of-war is mediated by the controller which offsets the bias current by equal but opposite perturbations of current as the rotor deviates by a small amount from its center position.

The gap sensors are usually inductive in nature and sense in a differential mode. The power amplifiers in a modern commercial application are solid state devices which operate in a pulse-width modulation (PWM) configuration. The controller is usually a microprocessor or DSP.

3.4 Inner Iron Spring

Any spring, whether it’s a leaf, torsion or coil spring, must compensate for irregularities in the road surface, maintain the suspension system at a predetermined height and support added weight without excessive sagging.

Figure 3.2: Inner Iron Spring

Each of those functions is extremely important in providing comfort, precise handling and load-bearing capability in the modern vehicle – three key areas that will raise customer concerns.Historically speaking, the steel multi-leaf spring is one of the oldest and most widely used spring designs in suspension systems. The advantages of the leaf spring are many, not only because it acts as a spring, but also because it attaches the axle directly to the chassis.In some applications, a single “mono-leaf” spring is employed. Although leaf springs are normally used in truck applications with solid drive axles,

a transverse leaf spring can be combined with an independently suspended rear axle to form a lightweight rear suspension system in performance road cars.The leaf spring can also be tuned to different load-bearing and ride control requirements by changing the numbers, widths, thicknesses and lengths of the spring leaves.In addition, a leaf spring tends to act as its own rebound dampener due to the friction of the leaves rubbing together. In some cases, a conventional steel spring can be replaced with a plastic unit that substantially reduces unsprung weight and resists corrosion from road salt and other elements.

Torsion Springs

Torsion-bar suspensions have been used for many years on vehicles equipped with short-long-arm (SLA) suspension systems. As the name implies, the torsion bar is simply a round bar, approximately four feet long, that's designed to twist as weight is applied to the suspension system. Because a torsion bar is generally preloaded by a clockwise or counterclockwise twist built into it, a torsion bar will fit only the side of the vehicle for which it was designed.The advantages of the torsion bar suspension system include compactness and light weight. Since the torsion bar tension is controlled by a threaded screw adjustment, torsion bars can be used to fine-tune suspension height. In addition, torsion bars can be attached to either the upper or lower control arms, increasing the versatility of the design.

Coil Spring

The function of a coil spring can be better understood if we visualize it as a long, thin, torsion bar wound into a coil shape. Because the coiled wire twists during the spring's compression/extension cycles, the coil spring actually operates on the same principle as a torsion bar.Since a coil spring occupies a relatively small space, it can be used in a variety of suspension designs including MacPherson strut, solid axle with trailing arms, independently sprung rear axle, or any SLA suspension system using a spring or coil-over shock absorber configuration.

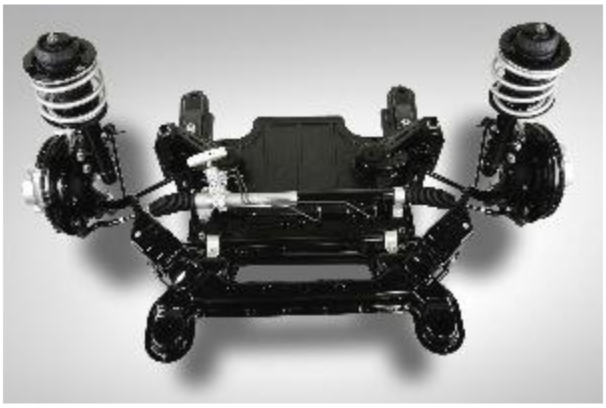

Figure 3.3: Coil Spring

Most modern imports use the coil spring in variations of the MacPherson strut design. In general, wire gauge, length, overall diameter and numbers of coils determine the characteristics of the coil spring.In some cases, a coil spring can be designed as a variable rate spring that increases load-bearing capability as it's compressed. Variable rate coil springs are often used in chassis configurations that occasionally carry heavy loads.

How Springs Work

Springs cushion the ride of a vehicle according to the principle of sprung-to-unsprung weight ratios. A farm wagon with no springs represents 100% unsprung weight. In this example, if springs are installed between the chassis and axles, the sprung-to-unsprung ratio might be 90% representing the chassis weight and 10% representing the axle and wheel weight.As a vehicle gains speed, the springs begin to absorb the impact of striking irregularities in the road surface. As vehicle speed increases, a stiffer spring rate is required to keep the axles and wheels in contact with the road surface. This is why high-performance vehicles tend to use stiffer suspension systems than regular passenger vehicles.Because a compressed spring will extend in a violent fashion, shock absorbers must be used to dampen the spring's compression and extension cycles. Without dampening, a spring's violent compression and extension would cause a vehicle to lose control on a rough road surface.
As rebound control deteriorates due to normal shock absorber wear, the vehicle will begin to experience poor ride, steering response and handling control.

In addition, tire wear will be accelerated due to tire scuff caused by the suspension geometry operating out of its normal range. This is why shock/strut manufacturers are adamant about the regular inspection and replacement of worn units.In general, the compression and extension characteristics of the shock absorber must match the compression and extension characteristics of the spring. Since stiffer springs don't normally experience extreme ranges of travel, less dampening or rebound control might be required for normal driving. Softer-rated springs, on the other hand, may require more dampening because they tend to experience more compression and extension and, thus, make the shock absorber work much harder. For performance applications, it's essential to remember that the sway bar must also be included as part of any spring or shock absorber package.

Figure 3.4: How Spring Work

Suspension Geometry

After numerous extension and compression cycles, the spring eventually experiences metal fatigue. In many cases, the spring's original height is reduced, causing the suspension system to sag. In extreme cases of metal fatigue, the spring breaks and causes a noticeable loss of suspension height.Sagging springs increase the camber angle of a typical SLA suspension system. In contrast, sagging springs decrease the camber angle on MacPherson strut-style suspension systems. Although most suspension systems can be adjusted to compensate for minor reductions in suspension height caused by spring sag, applications in which the camber angle isn't adjustable might require a spring replacement to restore the suspension geometry and camber angle.

Spring Replacement

Because any compressed spring stores an explosive amount of energy – making them highly dangerous – it's essential to use quality spring compression equipment and follow recommended safety and service procedures when replacing springs. Before removing any spring, it's important to choreograph the procedure to make sure all the necessary tools and equipment are at hand and adjusted for use to help ensure safe spring removal and replacement.Before replacing a spring, check for correct tire pressure and size, then record the vehicle's suspension height at all four wheels. Replace one spring at a time to ensure that critical parts like ABS wiring and brake hoses are correctly reinstalled.

Reassembly of MacPherson struts can be aided by scribing a crayon line along the length of the strut to indicate the relationship of the parts. Before reassembly, inspect the strut support bearing for smooth operation. To prevent noisy operation, at least 1/4-inch of clearance should exist between the end of the spring coil and the spring seat stamped into the control arm or strut assembly.When replacing torsion bars, ensure that the bars are installed in their correct positions. Correct suspension height is achieved only after a twist is worked through the bar by bouncing the suspension through 20-30 compression cycles. In some cases, the cycling process can be made easier by temporarily disconnecting the shock absorbers.

When replacing coil springs, ensure that the springs are indexed correctly from left to right and seated correctly in the spring seats located in the control arm and chassis. If the coil spring is incorrectly seated, an unwanted increase in suspension height will result. Also ensure that any rubber isolator pads or other hardware is in good condition and installed in their correct positions.All bolts should be installed in their original locations and positions. Bolts should also be lightly lubricated with a non-friction modified lubricant, such as common motor oil, and torqued to specification. Cotter pins, self-locking nuts and interference-fit bolts should be replaced with new ones. To achieve accurate suspension height, always torque the suspension bushing pivot nuts with the full weight of the vehicle on the suspension system and at normal suspension height.Generally speaking, the vehicle suspension height will change a small amount after driving a few thousand miles. To prevent unwanted tire wear or safety issues to arise from a new spring replacement, retorquing suspension bolts and rechecking alignment angles is a recommended operating procedure.

3.5 Battery

Lithium batteries are primary batteries that have metallic lithium as an anode. These types of batteries are also referred to as lithium-metal batteries. They stand apart from other batteries in their high charge density and high cost per unit. Depending on the design and chemical compounds used, lithium cells can produce voltages from 1.5 V (comparable to a zinc–carbon or alkaline battery) to about 3.7 V.

Disposable primary lithium batteries must be distinguished from secondary lithium-ion or a lithium-polymer, which are rechargeable batteries. Lithium is especially useful, because its ions can be arranged to move between the anode and the cathode, using an intercalated lithium compound as the cathode material but without using lithium metal as the anode material. Pure lithium will instantly react with water, or even moisture in the air; the lithium in lithium ion batteries is in a less reactive compound.

Figure 3.5: 3.7V Battery

Lithium batteries are widely used in portable consumer electronic devices. The term "lithium battery" refers to a family of different lithium-metal chemistries, comprising many types of cathodes and electrolytes but all with metallic lithium as the anode. The battery requires from 0.15 to 0.3 kg of lithium per kWh. As designed these primary systems use a charged cathode, that being an electro-active material with crystallographic vacancies that are filled gradually during discharge.

Product Specification

Voltage	3.7 V
Product Type	Lithium-Ion
Battery Capacity	2200mAh
Weight	45 g
Model Number	ICR 18650

3.6 LED Light

A **light-emitting diode** (**LED**) is a semiconductor device that emits light when current flows through it. Electrons in the semiconductor recombine with electron holes, releasing energy in the form of photons. The color of the light (corresponding to the energy of the photons) is determined by the energy required for electrons to cross the band gap of the semiconductor. White light is obtained by using multiple semiconductors or a layer of light-emitting phosphor on the semiconductor device.

Figure 3.6: LED Light

Appearing as practical electronic components in 1962, the earliest LEDs emitted low-intensity infrared (IR) light. Infrared LEDs are used in remote-control circuits, such as those used with a wide variety of consumer electronics. The first visible-light LEDs were of low intensity and limited to red. Early LEDs were often used as indicator lamps, replacing small incandescent bulbs, and in seven-segment displays.

3.7 Copper Coil

Copper coil is commonly used in general plumbing, heating, ventilation and air-conditioning (HVAC) industry. It is a durable, reliable and economical material with good electrical conductivity amongst other metals. The copper coil is produced under the material grade of C1220T and has a finishing of **phosphorus deoxidized**. Copper coil is deoxidized with phosphorus and so that the porosity can be cleared out and the copper oxide level can be decreased. As the copper tube has gone through the deoxidization process which is the removal of oxygen content, hence it can provide excellent flaring, bending and welding capability.

The **degree of strength** and **hardness** of the copper coil is determined by its temper. It can be categorized into 2 different types of temper in the piping trade. Annealed tempered which normally referred as soft tube and drawn tempered which often referred as hard tube.The copper coils carried in our product range are annealed tempered also known as soft type. Soft tempered type copper coil is frequently joined with flare type fittings and compression fittings during installation. It is also common for users to connect copper coils via soldering, brazing or welding by using capillary fittings too. By having the oxygen content removed will lead to a **better resistance** to corrosion for the copper coil as well. The chemical composition under alloy C1220T grade is as below:It is economical and easy to install the copper coil. Copper coil is usually joined with capillary fittings through soldering or brazing processes. Soldering method is used in water lines plumbing and for sanitary drainage. Whereas, when greater joint strength is needed or when **service temperatures** are as high as 350°F (176°C), brazed joints of the copper coil with capillary fittings will be preferred. In addition, the installation of **air-conditioning and refrigeration sector** will usually use the brazing method instead.

How to install copper coil?

Capillary fittings are fittings that have a socket-type end which could help to close the **tolerance gap** between copper coil and the connecting fittings. When both copper coil and capillary fittings are cleaned and fluxed, they can form a small even gap between them upon assembly. As a result, when the **solder is heated** until it melts, the forces of adhesion and cohesion will cause the melted solder to flow into the capillary gap and a strong and watertight joint can be formed.

The method of making capillary joints involves the following steps:

Step 1: Measure and **cut the copper coil** to the length needed and make sure it is cut neither too short nor too long so that a proper joint can be achieved.

Step 2: The coil and capillary fittings need to be cleaned by using sand paper or steel wool. Once cleaned, a **sufficient flux** will be applied resulting in a thin coat on the mating surfaces. This is to prevent dust and dirt from contaminating the capillary gap. Once the copper coil and capillary fittings are fluxed, the joint is ready for heating.

Step 3: Heat the joint and the solder should melt when it is brought into contact with the coil. Continue the heating process if the solder does not melt. The capillary gap should be filled with sufficient solder all around the coil.

Step 4: Be aware that any excessive solder will lead to a bead formed at the bottom of the joint or there is a chance that it will run inside the coil along the system. There is a **small hint on the length of solder** needed for soldering on small tube diameters. A length of solder which approximately equals to the diameter of the tube should be enough to fill the joint.

Step 5: After the soldering is done and the joint has been made, allow them to be **cooled down** so the solder can solidify without any disturbance.

Step 6: Lastly, **wipe the outer surface** of the tube with a cloth to remove any excess of flux on it.

3.8 Magnet

An object which is capable of producing magnetic field and attracting unlike poles and repelling like poles.A magnet is a material or object that produces a magnetic field. This magnetic field is invisible but is responsible for the most notable property of a magnet: a force that pulls on other ferromagnetic materials, such as iron, steel, nickel, cobalt, etc. and attracts or repels other magnets. A permanent magnet is an object made from a material that is magnetized and creates its own persistent magnetic field. An everyday example is a refrigerator magnet used to hold notes on a refrigerator door. Materials that can be magnetized, which are also the ones that are strongly attracted to a magnet, are called ferromagnetic (or ferrimagnetic). These include the elements iron, nickel and cobalt and their alloys, some alloys of rare-earth metals, and some naturally occurring minerals such as lodestone. Although ferromagnetic (and ferrimagnetic) materials are the only ones attracted to a magnet strongly enough to be commonly considered magnetic, all other substances respond weakly to a magnetic field, by one of several other types of magnetism.

Figure 3.7: Magnet

Properties of Magnet:

The following are the basic properties of a magnet:

- When a magnet is dipped in iron filings, we can observe that the iron filings cling to the end of the magnet as the attraction is maximum at the ends of the magnet. These ends are known as poles of the magnets.
- Magnetic poles always exist in pairs.
- Whenever a magnet is suspended freely in mid-air, it always points towards the north-south direction. Pole pointing towards geographic north is known as the North Pole, and the pole pointing towards geographic south is known as the South Pole.
- Like poles repel while unlike poles attract.
- The magnetic force between the two magnets is greater when the distance between these magnets is lesser.

Types of Magnets

There are three types of magnets, and they are as follows:

- Permanent magnet
- Temporary magnet
- Electromagnets

Permanent Magnet:

Permanent magnets are those magnets that are commonly used. They are known as permanent magnets because they do not lose their magnetic property once they are magnetized.

Following are the ways to demagnetize the permanent magnets:

- Exposing magnets to extreme temperatures.
- The magnetic attraction between the magnet's atoms gets loosened when they are hammered.
- Stroking one magnet with another will reduce the magnetic strength.

There are four types of permanent magnets:

- Ceramic or ferrite
- Alnico
- Samarium Cobalt (SmCo)
- Neodymium Iron Boron (NIB)

Temporary Magnet:

Temporary magnets can be magnetized in the presence of a magnetic field. When the magnetic field is removed, these materials lose their magnetic property. Iron nails and paper clips are examples of the temporary magnet.

Characteristics of Magnet

The following are the characteristics of a magnet:

- **Attractive property:** This property proves that the magnetic strength at the ends of the poles is strong.
- **Directive property:** This property helps to understand which pole of the magnet is north and south by suspending the magnet in mid-air.
- **Law of magnetic poles:** Like poles repel while unlike poles attract.
- **Pair property:** When a magnet is cut into two pieces, both the pieces will have the North Pole and the South Pole.
- **Sure test of magnetization:** This test is conducted to check if a given rod is magnetized or not by checking either the attraction or the repulsion of the iron rod and magnet.

Uses of Magnets

Following are the uses of magnets:

- Magnets are used for constructing magnetic needles and mariner's compasses.
- Permanent magnets find applications in generators, electric accelerators, and electric motors.
- Electromagnets find application in speakers, electric bells, and electric cranes.
- Magnets are used to separate iron filling from other solid mixtures

3.9 Resistor

Resistors are electronic components which have a specific, never-changing electrical resistance. The resistor's resistance limits the flow of electrons through a circuit. They are passive components, meaning they only consume power (and can't generate it). Resistors are usually added to circuits where they complement active components like op-amps, micro-controllers, and other integrated circuits. Commonly resistors are used to limit current, divide voltages, and pull-up I/O lines.

The electrical resistance of a resistor is measured in ohms. The symbol for an ohm is the greek capital-omega: Ω. The (somewhat roundabout) definition of 1Ω is the resistance between two points where 1 volt (1V) of applied potential energy will push 1 ampere (1A) of current. As SI units go, larger or smaller values of ohms can be matched with a prefix like kilo-, mega-, or giga-, to make large values easier to read. It's very common to see resistors in the kilohm (kΩ) and megaohm (MΩ) range (much less common to see miliohm (mΩ) resistors). For example, a 4,700Ω resistor is equivalent to a 4.7kΩ resistor, and a 5,600,000Ω resistor can be written as 5,600kΩ or (more commonly as) 5.6MΩ. All resistors have two terminals, one connection on each end of the resistor. When modeled on a schematic, a resistor will show up as one of these two symbols:

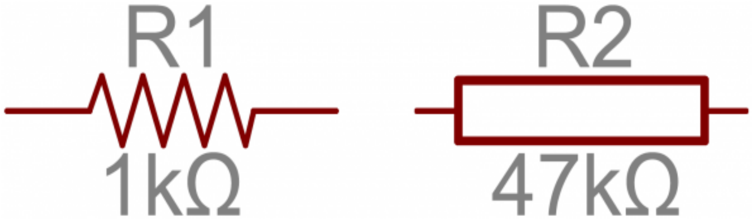

Figure 3.8: Two common resistor schematic symbols

3.10 Capacitor

When there is a potential difference across the conductors (e.g., when a capacitor is attached across a battery), an electric field develops across the dielectric, causing positive charge (+Q) to collect on one plate and negative charge (-Q) to collect on the other plate. If a battery has been attached to a capacitor for a sufficient amount of time, no current can flow through the capacitor. However, if an accelerating or alternating voltage is applied across the leads of the capacitor, a displacement current can flow.

Figure 3.9: Capacitor

An ideal capacitor is characterized by a single constant value for its capacitance. Capacitance is expressed as the ratio of the electric charge (Q) on each conductor to the potential difference (V). The SI unit of capacitance is the farad (F), which is equal to one coulomb per volt (1 C/V). Typical capacitance values range from about 1 pF (10−12 F) to about 1 mF (10−3 F).The capacitance is greater when there is a narrower separation between conductors and when the conductors have a larger surface area. In practice, the dielectric between the plates passes a small amount of leakage current and also has an electric field strength limit, known as the breakdown voltage. The conductors and leads introduce an undesired inductance and resistance. Capacitors are widely used in electronic circuits for blocking direct current while allowing alternating current to pass. In analog filter networks, they smooth the output of power supplies. In resonant circuits they tune radios to particular frequencies. In electric power transmission systems they stabilize voltage and power flow.

3.11 Multi Meter

A millimeter or multi center is a measuring instrument that can measure multiple electrical properties. A typical millimeter can measure voltage, resistance, and current, in which case it is also known as a volt-ohm-millimeter (VOM). Analog millimeters use a micrometer with a moving pointer to display readings. Digital millimeters (DMM, DVOM) have numeric displays and have made analog millimeters obsolete as they are cheaper, more precise, and more physically robust than analog millimeters.

Figure 3.10: Multi Meter

Operation:

A millimeter is the combination of a DC voltmeter, AC voltmeter, ammeter, and ohmmeter. An un-amplified analog millimeter combines a meter movement, range resistors and switches; VTVMs are amplified analog meters and contain active circuitry.

For an analog meter movement, DC voltage is measured with a series resistor connected between the meter movement and the circuit under test. A switch (usually rotary) allows greater resistance to be inserted in series with the meter movement to read higher voltages. The product of the basic full-scale deflection current of the movement, and the sum of the series resistance and the movement's own resistance, gives the full-scale voltage of the range. As an example, a meter movement that required 1 mA for full-scale deflection, with an internal resistance of 500 Ω, would, on a 10 V range of the multi meter, have 9,500 Ω of series resistance.[8]

For analog current ranges, matched low-resistance shunts are connected in parallel with the meter movement to divert most of the current around the coil. Again for the case of a hypothetical 1 mA, 500 Ω movement on a 1 A range, the shunt resistance would be just over 0.5 Ω.

Moving coil instruments can respond only to the average value of the current through them. To measure alternating current, which changes up and down repeatedly, a rectifier is inserted in the circuit so that each negative half cycle is inverted; the result is a varying and nonzero DC voltage whose maximum value will be half the AC peak to peak voltage, assuming a symmetrical waveform. Since the rectified average value and the root mean square (RMS) value of a waveform are only the same for a square wave, simple rectifier-type circuits can only be calibrated for sinusoidal waveforms. Other wave shapes require a different calibration factor to relate RMS and average value. This type of circuit usually has fairly limited frequency range. Since practical rectifiers have non-zero voltage drop, accuracy and sensitivity is poor at low AC voltage values.

To measure resistance, switches arrange for a small battery within the instrument to pass a current through the device under test and the meter coil. Since the current available depends on the state of charge of the battery which changes over time, a multi meter usually has an adjustment for the ohm scale to zero it. In the usual circuits found in analog multi meters, the meter deflection is inversely proportional to the resistance, so full-scale will be 0 Ω, and higher resistance will correspond to smaller deflections. The ohms scale is compressed, so resolution is better at lower resistance values.

3.12 Charge Controller

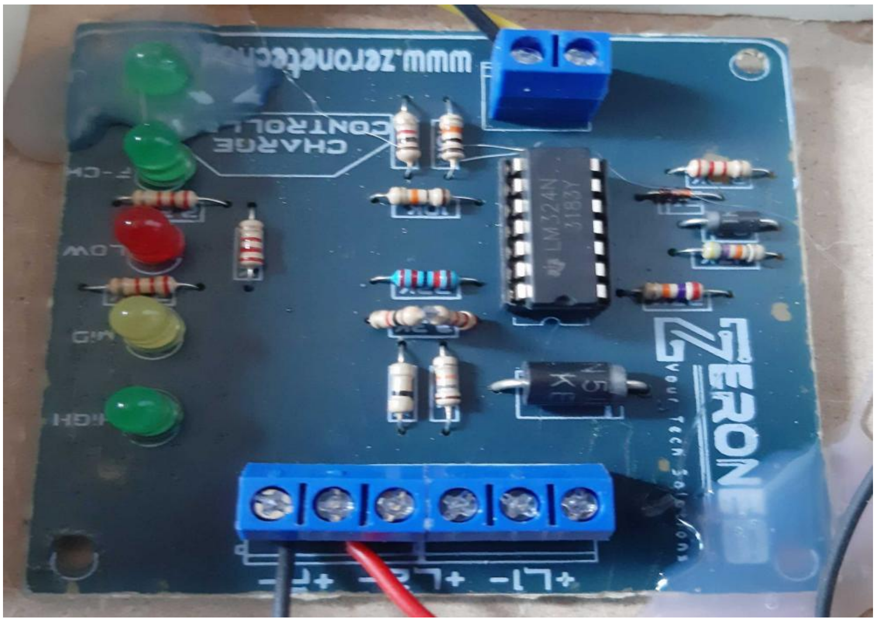

Figure 3.11: Battery Charge Controller Unit

Here is a battery charge controller circuit that is used to charge Lead Acid or Ni-Cd batteries using the suspension generating power. The circuit harvests suspension energy to charge a 6 volt 4.5 Ah rechargeable battery for various applications. The charger has voltage and current regulation and over voltage cut-off facilities.

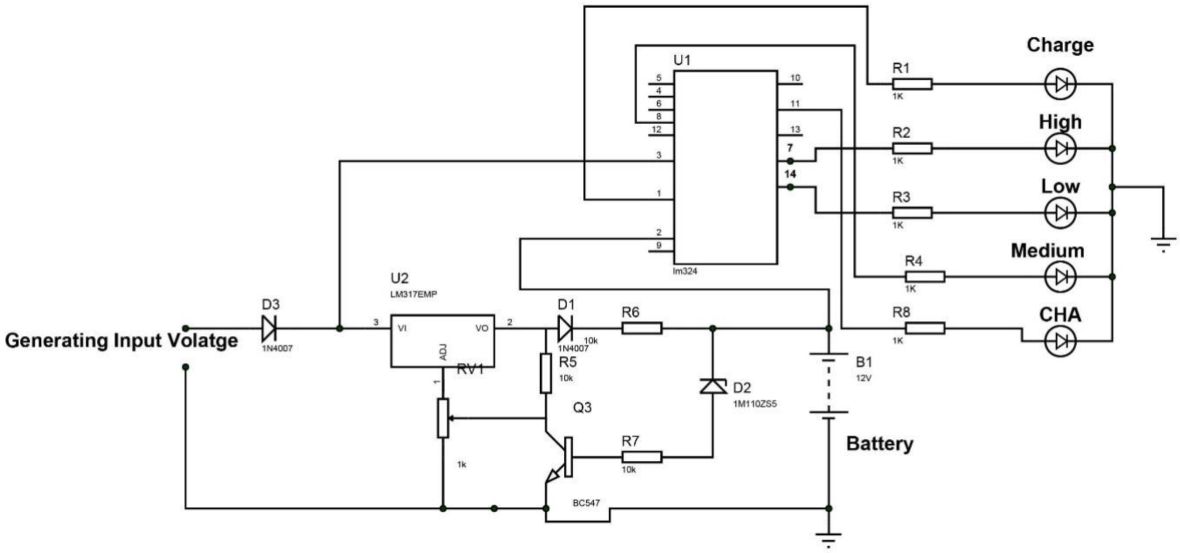

Figure 3.12: Battery Charger Controller Circuit

The circuit uses a electromagnetic suspension and a variable voltage regulator IC LM 324. Charging current passes through D1 to the voltage regulator IC LM 324. By adjusting its Adjust pin, output voltage and current can be regulated. VR is placed between the adjust pin and ground to provide an output voltage of 6 volts to the battery. Resistor R3 Restrict the charging current and diode D2 prevents discharge of current from the battery.

3.13 LDR

The LDR sensor module is used to detect the presence of light / measure the intensity of light. The output of the module is higher in the presence of light and it is lower in the absence of light. LDR sensor module is a low-cost **digital sensor** as well as **analog sensor** module, which is capable to measure and detect light intensity. This sensor also is known as the Photo-resist **or sensor**. This sensor has an onboard LDR(Light Dependent Resistor), that helps it to detect light. This sensor module comes with 4 terminals. Where the “DO” pin is a digital output pin and the “AO” pin is an analog output pin. The output of the module goes high in the absence of light and it becomes low in the presence of light. The sensitivity of the sensor can be adjusted using the onboard potentiometer.

Features:

- Operating voltage = 3.3V-5V
- Output Type = Analog voltage output -A0
- Digital switching outputs = (0 and 1) -D0

- With fixed bolt hole for easy installation
- Small board PCB size = 3cm * 1.6cm
- Power indicator (red) and the digital switch output indicator (green)
- Using LM393 comparator chip, stable

Pin outs:

- External = 3.3V-5V VCC
- External GND GND
- DO digital output interface, a small plate (0 and 1)
- AO small board analog output interface
- Can detect ambient brightness and light intensity

Fig 3.13 : LDR

3.14 LCD Display

The LCD (liquid crystal display) screen is an electronic display module and looks for various applications. A 16x2 LCD display is a very basic module and it is very commonly used in various devices and circuits. These modules are preferred over seven sections and many other segments.

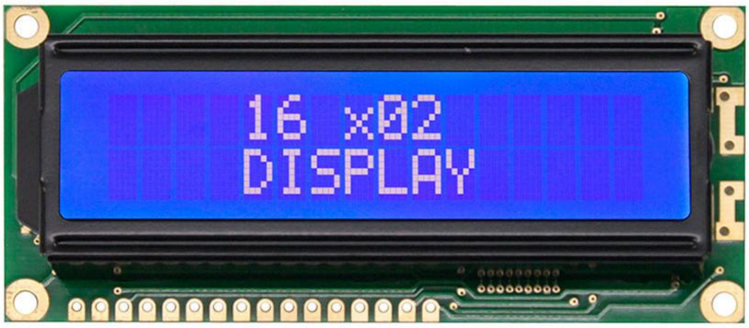

Figure 3.14: 16*2 LCD Display

The reasons for having LCD are economic; Easily programmable, special and even custom characters (different in seven sections), there are no restrictions on displaying animations. A 16x2 LCD means it can display 16 characters per line and contains 2 lines. Each character on this LCD is displayed in a 5x7 pixel matrix.

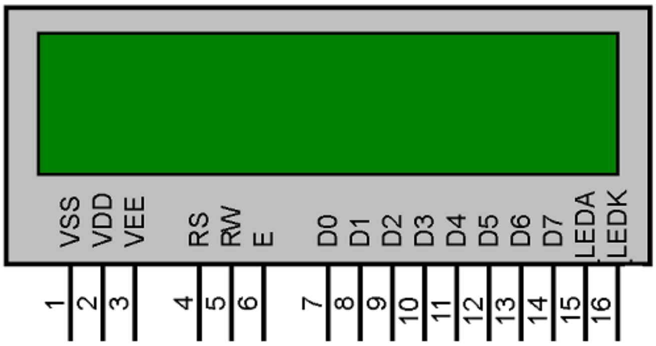

Figure 3.15: Pin out of 16*2 LCD Display

This LCD contains two articles called Command and Data. The command register stores the command instructions on the LCD. The command is a command given to the LCD to perform a predefined task such as starting it, clearing its screen, locating the cursor, controlling the display, etc.

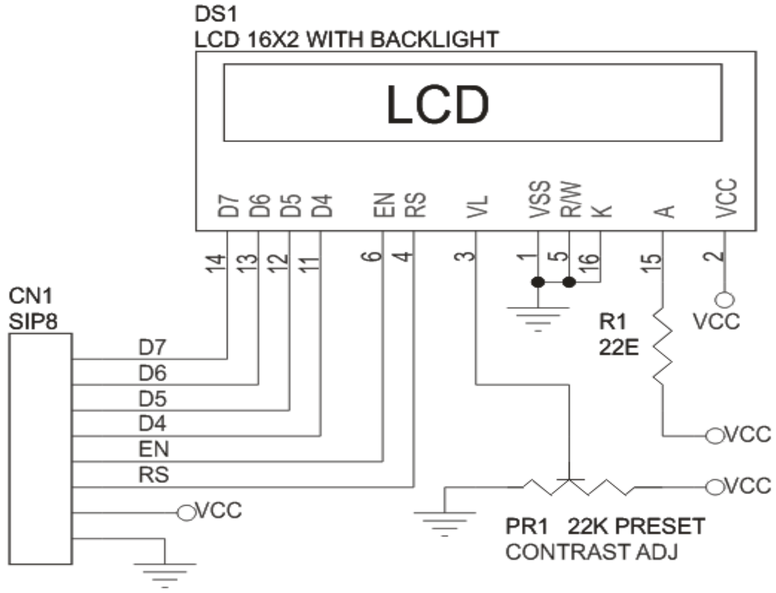

Figure 3.16 : 16*2 LCD Display interfacing with Arduino

Feature

The features of this LCD mainly include the following.

- The operating voltage of this LCD is 4.7V-5.3V
- It includes two rows where each row can produce 16-characters.
- The utilization of current is 1mA with no backlight
- Every character can be built with a 5×8 pixel box
- The alphanumeric LCDs alphabets & numbers
- Is display can work on two modes like 4-bit & 8-bit
- These are obtainable in Blue & Green Backlight
- It displays a few custom generated character

3.15 Load Cell HX711

A **load cell** converts a force such as tension, compression, pressure, or torque into an electrical signal that can be measured and standardized. It is a force transducer. As the force applied to the load cell increases, the electrical signal changes proportionally. The most common types of load cell are pneumatic, hydraulic, and strain gauges

Figure 3.17: Load Cell HX711

Common types of load cell

There are several types of strain gauge load cells:

- Single Point load cells; used in small to medium platform scales with platform sizes of 200x200mm up to 1200x1200 mm.
- Planar Beam load cells; used in low profile solutions where space is limited, like medical scales and retail scales.
- Bending Beam load cells; used in pallet, platform and small hopper scales.
- Shear Beam load cells; used in low profile scale and process applications, available in capacities from 100kg up to 50t.
- Dual Shear Beam load cells; used in truck scales, tank and hopper applications.
- S-type load cells; used in tension applications where you will find static and dynamic loads.
- Compression load cells; used in truck scales, large platform scales, weighbridges and hopper scales.
- Ring Torsion load cells; used in high accuracy hoppers, silo's, platforms and pallet scales.
- Spoke Type load cells; used in low profile, high precision application. High forces varying from 1t-500t.
- Onboard load cells; used for onboard weighing systems on trucks, tractors and other vehicles.

- Loadpins; used in applications for measuring dynamic, static or hoisting forces.
- Weighpads; portable weighpads for the weighing of cars and the measure the center of gravity of planes.
- Specials; all kind of special sensors.

Load cells are commonly used to measure weight in an industrial environment. They can be installed on hoppers, reactors, etc., to control their weight capacity, which is often of critical importance for an industrial process. Some performance characteristics of the load cells must be defined and specified to make sure they will cope with the expected service. Among those design characteristics are:

- Combined error
- Minimum verification interval
- Resolution

Load Cell Specification:

The electrical, physical, and environmental specifications of a load cell help to determine which applications it is appropriate for. Common specifications include:

- Full Scale Output (FSO): Electronic output expressed in mV/V. Measured at full scale.
- Combined Error: percent of the full scale output that represents the maximum deviation from the straight line drawn between no load and load at rated capacity. Often measured during decreasing and increasing loads.
- Non-Linearity: The maximum deviation of the calibration curve from a straight line drawn between the rated capacity and zero load. Measured on increasing load and expressed as percent of full scale output.
- Hysteresis: Maximum difference between load cell output signals for the same applied load. The first measurement can be obtained by decreasing the load from rated output and the second by increasing the load from zero.
- Repeatability: Maximum difference between output measurements for repeated loads under identical conditions. Measured in percent of rated output.

- Zero Balance (Offset): Output reading of the load cell with rated excitation under no load. The deviation in output between a true zero measurement and a real load cell under zero load expressed as a percentage of full scale output.
- Compensated Temperate Range: The temperature range over which a load cell is compensated so that it can ensure zero balance & rated output within specified limits. Expressed as °F or °C.
- Operating Temperature Range: Temperature range extremes in which a load cell can operate without permanent, adverse effects on any of its performance characteristics. Expressed as °F or °C.
- Temperature Effect on Output: Modification of output readings caused by load cell temperature. Expressed as percent of full scale output per degree of °F or °C.
- Temperature Effect on Zero: Change in zero balance caused by ambient temperature changes. Expressed as percent of full scale output per degree of °F or °C.
- Input Resistance: Input resistance of the load cell's bridge circuit. Measured at the positive & negative excitation leads with no load applied. Measured in Ohms.
- Output Resistance: Output resistance of the load cell's bridge circuit. Measured at the positive & negative excitation leads with no load applied. Measured in Ohms.
- Insulation Resistance: The resistance measured along pathways between the: bridge circuit and transducer element, bridge circuit and the cable shield, and the transducer element and the cable shield. Typically measured at fifty volts under standard test conditions.
- Recommended Excitation: Maximum recommended excitation voltage of the transducer for it to operate within its specifications. Expressed in VDC.
- Cable Length: Length of the standard cable for which the load cell is calibrated. Cable length affects how the load cell is calibrated.
- Safe Overload: The maximum load that can be applied to a load cell without causing permanent effects to its performance specifications. Measured as a percent of full scale output.
- Ultimate Overload: Maximum load that can be withstood without causing structural failure.
- Material: Substance that comprises the spring element of the load cell.

Load cell Calibration:

Load cells are an integral part of most weighing systems in industrial, aerospace and automotive industries, enduring rigorous daily use. Over time, load cells will drift, age and misalign; therefore, they will need to be calibrated regularly to ensure accurate results are maintained.[14] ISO9000 and most other standards specify a maximum period of around 18 months to 2 years between re-calibration procedures, dependent on the level of load cell deterioration. Annual re-calibration is considered best practice by many load cell users for ensuring the most accurate measurements.

Standard calibration tests will use linearity and repeatability as a calibration guideline as these are both used to determine accuracy. Calibration is conducted incrementally starting working in ascending or descending order. For example, in the case of a 60 tonne load cell, then specific test weights that measure in 5, 10, 20, 40 and 60 tonne increments may be used; a five step calibration process is usually sufficient for ensuring a device is accurately calibrated. Repeating this five-step calibration procedure 2-3 times is recommended for consistent results.

3.16 EasyEDA Software

EasyEDA is a web-based EDA tool suite that enables hardware engineers to design, simulate, share - publicly and privately - and discuss schematics, simulations and printed circuit boards. Other features include the creation of a bill of materials, Gerber files and pick and place files and documentary outputs in PDF, PNG and SVG formats.EasyEDA allows the creation and editing of schematic diagrams, SPICE simulation of mixed analogue and digital circuits and the creation and editing of printed circuit board layouts and, optionally, the manufacture of printed circuit boards.

Subscription-free membership is offered for public plus a limited number of private projects. The number of private projects can be increased by contributing high quality public projects, schematic symbols, and PCB footprints and/or by paying a monthly subscription.Registered users can download Gerber files from the tool free of charge; but for a fee, EasyEDA offers a PCB fabrication service. This service is also able to accept Gerber file inputs from third party tools.

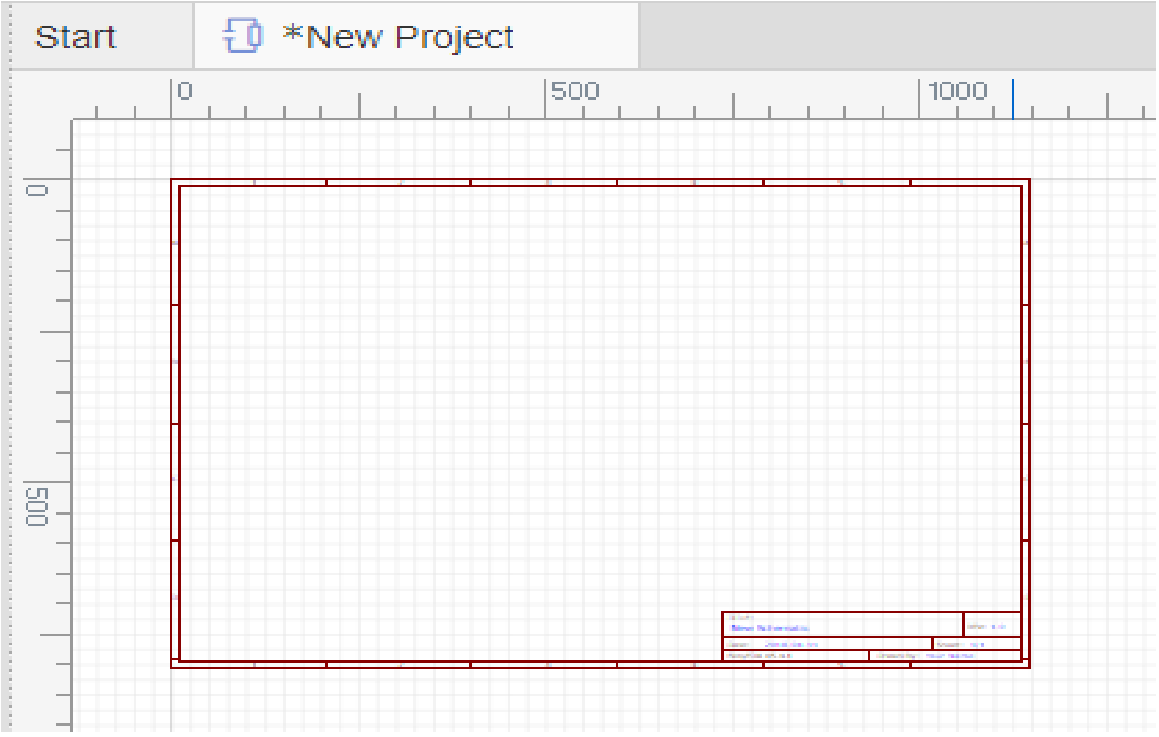

Figure 3.18: EasyEDA Software Interface

Chapter 4
The Design Methods and Procedures

4.1 Introduction

In this chapter we will discuss about our system methodology, block diagram, circuit diagram, working principle, instrument cost analysis, working timeline and solar graph.

4.2 Methodology

The working principle of this power generation program is to convert the kinetic energy to electric energy via mechanical energy. This can be done when the brakes are applied upon the vehicle kinetic energy is produced. After this the kinetic energy is converted to mechanical energy using a rack and pinion gear and the by connecting the pinion gear to a generator shaft the energy is converted into electrical energy.

1. Speed Breaker:- This is a normally used thing in everyday life. This element can be made from the composite of carbon fibre and rubber so that the speed breaker can sustain the heavy load of vehicles such as a container filled with some material in it. The speed breakers can be made such that the starting and ending slopes would be made up of concrete and cement mixture and the central part would be made up of the composite mentioned before.

4. Electricity Storage: - It is very difficult to store electricity for a long time into any kind of storage. To deal with this issue a battery pack will be introduced which will help us store the electric energy in to the battery pack. Also battery packs can be useful to transfer electric energy from one place to another.

4.3 Energies Involved in this Method

Three types of energies are taking part in this conversion in order to generate electricity.

4.3.1 Kinetic Energy: Energy possessed by a body due to virtue of its motion is called as Kinetic energy. The kinetic energy of an object of mass m traveling at a speed v is

½ mv2 . The kinetic energy of an object is directly proportional to the square of its speed. The kinetic energy of an object is completely described by magnitude alone (scalar quantity).

4.3.2 Mechanical Energy: Mechanical energy is the energy associated with both the motion and position of an object. Objects possess mechanical energy when they are in motion or if they are at a zero potential energy position. An object gains energy, when some work has been done on it. The energy gained by the objects on which, work is done, is known as mechanical energy.

4.3.3 Electrical Energy: When energy is stored in charged particles which are in an electric field, that energy is known to be electrical energy. The regions or areas which form an envelope around these charged particles are called as electric fields. The electric fields are a result of charged particles, and they exert force on other charged particles causing them to move in the electric field.

The basic energy conversion taking place is first from kinetic energy to mechanical energy and then from mechanical energy to electrical energy. The kinetic energy of the vehicle which is wasted at the speed breaker is converted to mechanical energy of the unit below speed breaker by the rack and pinion mechanism. This mechanical energy is later converted to electrical energy by a generator.

4.4 Block Diagram

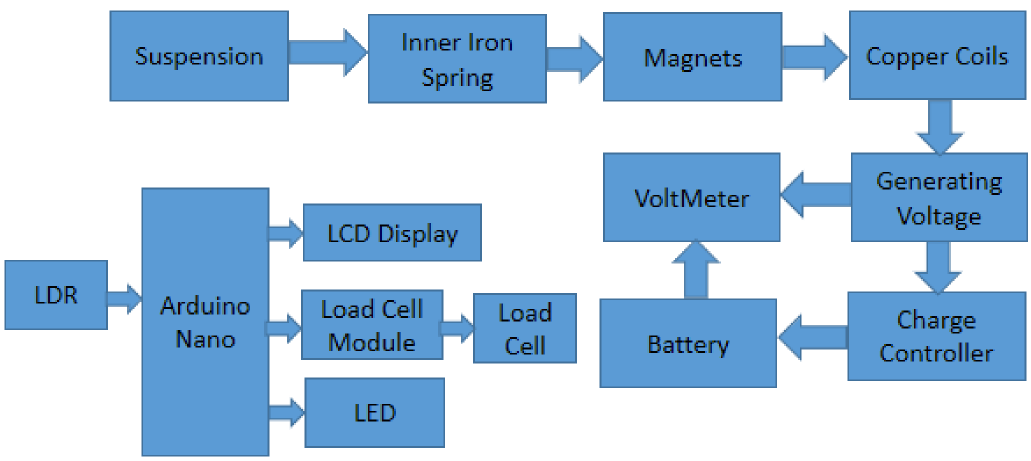

Figure 4.1: Block Diagram of our Project

4.5 Schematic Diagram

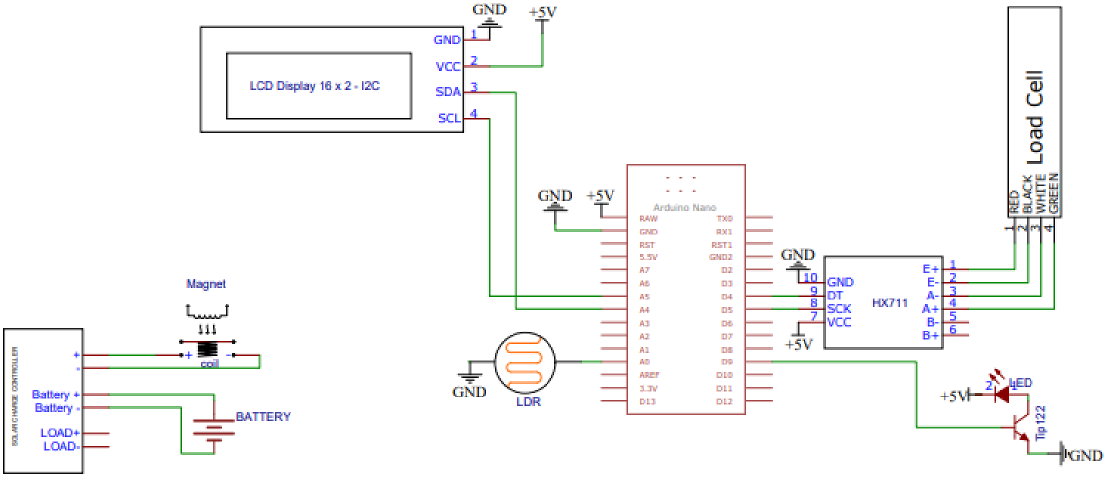

Figure 4.2: Circuit Diagram of Our System

4.6 Structural Overview

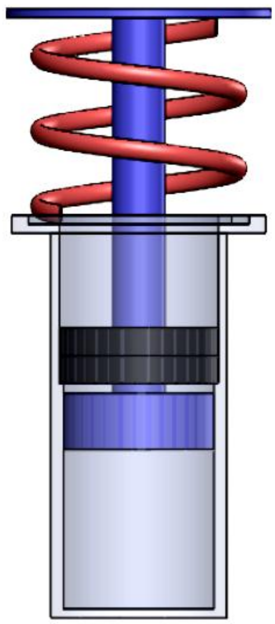

Figure 4.3: Project Structural Image

4.7 Working Principle

To achieve this we here use the principles of electromagnetism in order to generate electricity from this motion. Our suspension is made up of a metal shaft, spring, magnet, coils, base with screws and joints. It uses a coil wound around in particular turning arrangement over the inner beam of the part. We use cylindrical supports in order to minimize friction and ensure smooth generation. The head of the absorbed/ Suspension consists of magnets attached to outer core which are aligned with inner core to ensure smooth motion while ensuring efficient generation. This arrangement is fitted with springs in a precise manner so as to achieve the desired motion and magnet coil overlapping which allows for generation of electricity through electromagnetism principle. A battery voltage can be measured with a multi meter and Street light control with LDR Sensor. The pressure sensor will measure the weight of the vehicle. Thus our system puts forward a Power Generation From Speed Breaker by Using Electromagnetic Suspension system. This is the working procedure of our system.

4.8 Project Prototype Image

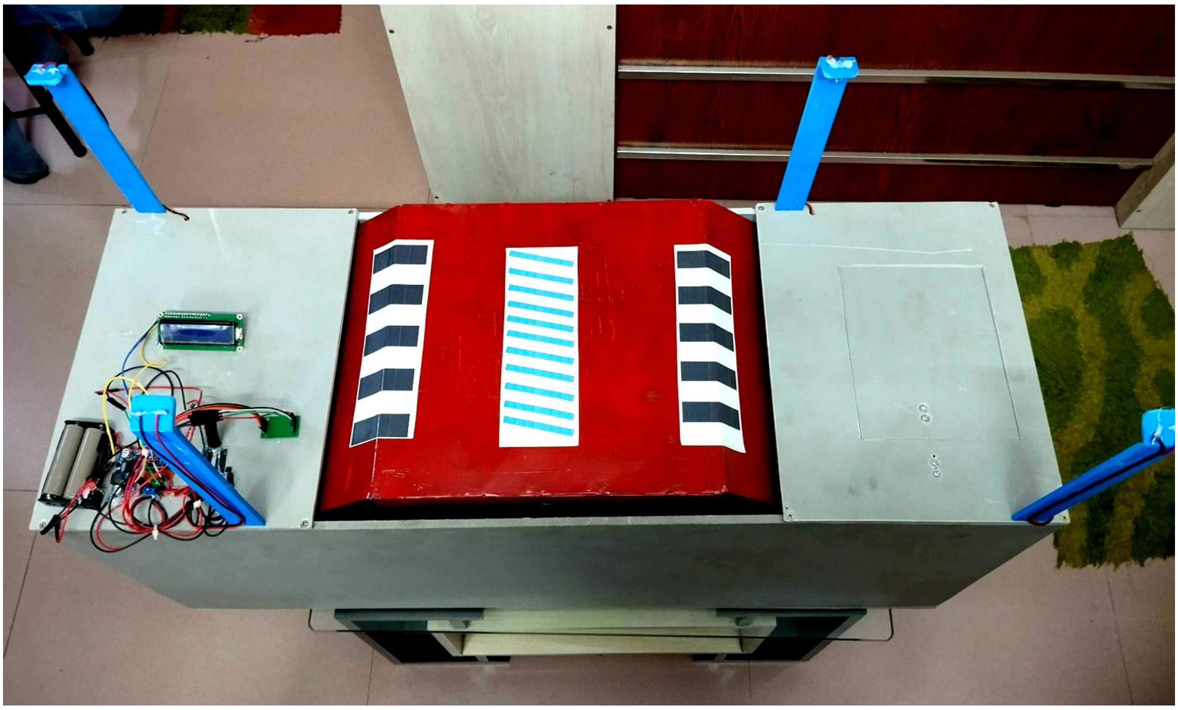

Figure 4.4: Our Final Project Prototype

4.9 Project Cost Analysis

Table 02: Required Instrument Cost Analysis

Sl. No	Particulars	Specification	Qty.	Unit Price (Taka)	Total Price (Taka)
01	Inner Iron Spring		2	150	300
02	Magnet		2	250	500
03	LED Light		1	10	10
04	Battery	3.7V	2	350	700
05	Frame Base		1	2000	2000
06	Copper Coil		1	400	400
07	LCD Display		1	280	280
08	LDR		1		15
09	Arduino Nano		1	650	650
10	Others				1500
				Total	6355/=

4.10 Power Calculation

Calculation of spring

Were k = spring stiffness

D=diameter of spring=40mm

d=diameter of spring wire=3mm

N= number of turns= 9G= shear modulus of elasticity

For carbon steel SAE 1050From design data book T V111-9

G=79Gpa

Maximum deflection of spring= 3 inches=76.2 mm

K=Gd4/8D3N

= 1388.6718Maximum force= spring stiffness × maximum deflection=1388.6718×0.0762=1058.16~1000 N

Weight=force/acceleration due to gravity

Let acceleration due to gravity =10 m/s2

Therefore maximum weight =1000/10=100 Kg

Minimum deflection for which voltage is produced

X min =0.003mF min =13123×0.003810=49.9986~50 N

Therefore minimum weight to obtain deflection

W min =50/10=5 kg

Spring Index (C) =D/d=13.33mmShear stress factor (K s) =1+1/2C=1.0375Wahl's Correction Factor (K w)= (4C-1/4C-4)+(0.615/C)= 1.10Pitch = free length/(n-1)=17.5 mm

Energy Calculation

For 1 stroke

Current= 24 mA

Voltage = 2.1 V

For a Led

Current required = 20 mA

Voltage required = 1.8 V

Considering 180 foot steps on a unit

For 180 stroke, current = 180×20Current = 4320 mA

Considering, 2 units = 2×4320Current produce by 2 units = 8640 mA

For 180 stroke, voltage= 180×1.8Voltage = 324 V

Considering, 2 units = 2×324Voltage produce by 2 units = 648 V

The power generated is enough to enlighten any of the following and many more.Syska Smart light 7W = 220 V acPanasonic RGB Round Base B22 7 Watt = 220 V acWipro garnet 9 w led bulb = 240 V ac

4.11 Increase the Power by Increase the Size of Component

The power generation from a speed breaker using electromagnetic suspension depends on various factors, including the size of the components involved. Electromagnetic suspension systems use the principle of electromagnetic induction to generate electricity as a vehicle passes over a speed breaker, converting the kinetic energy of the vehicle into electrical energy. Increasing the size of the components, such as the coils and magnets used in the electromagnetic suspension system, can potentially increase the power generated. Larger components may be able to capture more kinetic energy from the vehicle passing over the speed breaker, resulting in higher power generation.

However, simply increasing the size of the components may not always result in a proportionate increase in power generation. There are other factors to consider, such as the efficiency of the electromagnetic suspension system, the speed of the vehicle, the frequency and strength of the magnetic field, and the design of the speed breaker itself. Additionally, there may be practical limitations to the size of the components based on available space, cost, and safety considerations. To accurately determine the potential increase in power generation by increasing the size of the components in an electromagnetic suspension system for power generation from a speed breaker, detailed simulations and experiments would need to be conducted, taking into account all the relevant factors mentioned above. Consulting with experts in electromagnetism and power generation, and conducting thorough testing and analysis, would be necessary for an accurate assessment. It's important to ensure that any modifications or changes comply with relevant regulations and safety standards. So, it is recommended to work with qualified engineers or researchers in this field for a comprehensive evaluation. Safety should always be a priority in any engineering project.

4.12 Diagram with Comparison to Reduce the use of Fossil Fuel

1.Use LED light bulbs, which are more efficient (and so decrease energy consumption) and last a long time. The US Department of Energy says that LEDs use 75% less energy than traditional incandescent bulbs and can last for years.

2. Turn off the lights when you leave a room for more than 15 minutes. The power saved reduces the demand on electric utilities, which in turn require less output from power plants that burn fossil fuels.

3. Turn off your television, computer, or any other electrical device when you’re not using it; this is a good way to conserve energy and help these investments last longer, so you don’t have to buy new ones as soon.

4. Use appliances with the ENERGY STAR label, which is only placed on products that meet high-efficiency standards. To inform consumers, the label usually displays a calculation of annual savings as a percentage or monetary value. It can be found on air conditioners, heaters, refrigerators, and just about any home appliance.

5. Reuse products that require fossil fuel resources to produce. By avoiding paper or plastic shopping bags, you can reduce the demand on the production process, which is fossil-fuel intensive. Instead, use fabric bags for groceries. You can limit how much plastic and Styrofoam you use by purchasing glass plates and cups, which can be reused over and over again instead of just once.

6. Purchase goods manufactured with recycled materials. This helps reduce the demand for fossil fuels, too. Check for product labels that indicate such materials are included. Reusing anything that you can, such as printer ink cartridges, helps too.

7. Recycle. By recycling waste, you send less of it to landfills. Many cities have recycling programs and require residents to put plastics, paper, and aluminum into separate bins. You can also donate clothing, lights, and appliances you don't plan to use anymore instead of throwing them out, so they continue to serve a purpose. According to GreenAmerica.org, just over 34% of US waste is recycled or composted, but the Environmental Protection Agency estimates that 75% of all waste can be recycled.

8. Avoid using petroleum-based printer inks. Soy ink, derived from soybeans, is an eco-friendlier choice for printer cartridges. Newspapers and other printed publications use it as well, some since the late 1980s.

9. Take public transportation. Fossil fuels are a major part of the oil-refining process, which is how gasoline is made. Public transportation reduces the number of cars on the road and therefore the number of cars releasing emissions. You could also carpool, ride a bicycle, or walk.

10. Telecommute. Telecommuting eliminates the need to travel altogether, avoiding the use of fossil fuels and the costs of fuel and travel. All you need is a computer, Internet connection, and smart phone.

11. Avoid using nylon, which is petroleum-based. It can be found in luggage, life vests, and umbrellas. Even nylon clothing or clothing made of polyester relies on fossil fuels, but clothes made of natural fibers are a more economically and environmentally friendly choice.

12. Invest in reusable containers. Plastics are environmentally costly to produce and dispose of and do not decompose. Bottled waters require a lot of plastic, so reusable containers filled with filtered tap water are better instead. Biodegradable plastics will break down over time and are a somewhat better option if you would rather stick to plastic.

13. Drink more water for your headache. Dehydration is a big cause of headaches, and over-the-counter products such as Aspirin are made with oil products.

14. Wax your floors with beeswax. Waxing the floors will keep them looking shiny and new, but commercial waxes are often made from petroleum derivatives. Beeswax is a natural alternative and can do the job just as well.

15. Use natural essential oils for your scent fix. Essential oils are popular, and not only for their attractive and pleasant scents. Traditional scent products and even perfumes are often made with petrochemicals, in turn feeding the demand for fossil fuels and increasing their effects on the environment.

16. Use natural wood for your deck. Wood decks may increase the demand for tree-based products, but plastic materials like those made to resemble wood are made from oil.

17. Embrace your glasses. Soft contact lens wearers often don't know their products are made using petroleum products. Although eyeglass frames require some oil to make, they typically last much longer and can be donated once you have a new pair.

18. Use metal or clay roof tiles. Instead of replacing your roof with tar, which is a byproduct of coal production, use metal or clay tiles that are not so heavily fossil fuel dependent.

19. Power your home with solar energy so you don't have to buy power from coal plants. Plus, energy from the sun is free.

20. Use more environmentally friendly gardening practices. These include using pushable mowers and planting gardens that limit the amount of space that you have to mow.

Reducing your reliance on fossil fuels can lead to more attractive landscaping on your property, not to mention be better for the environment, your wallet, and health.

Diagram:

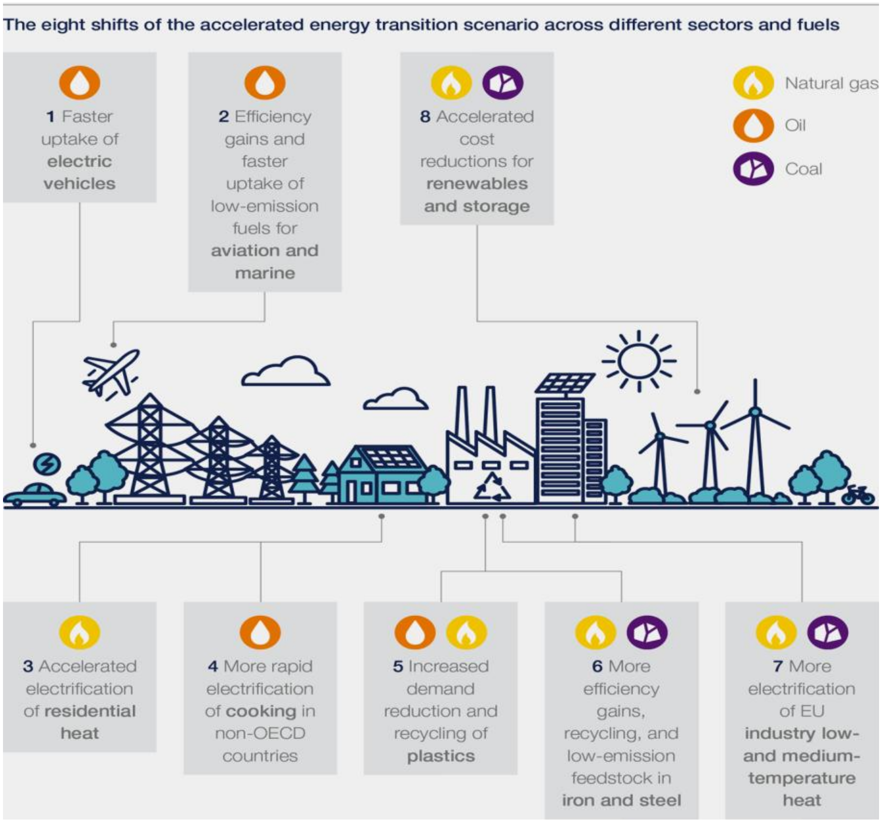

Figure 4.5: reduce the use of Fossil fuel Diagram

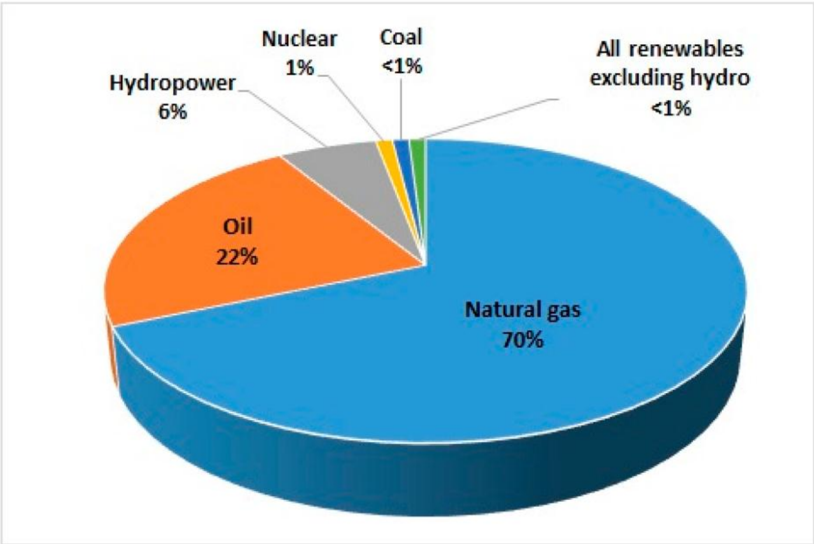

Figure 4.6: Reduce Reliance of fossil Fuels Diagram

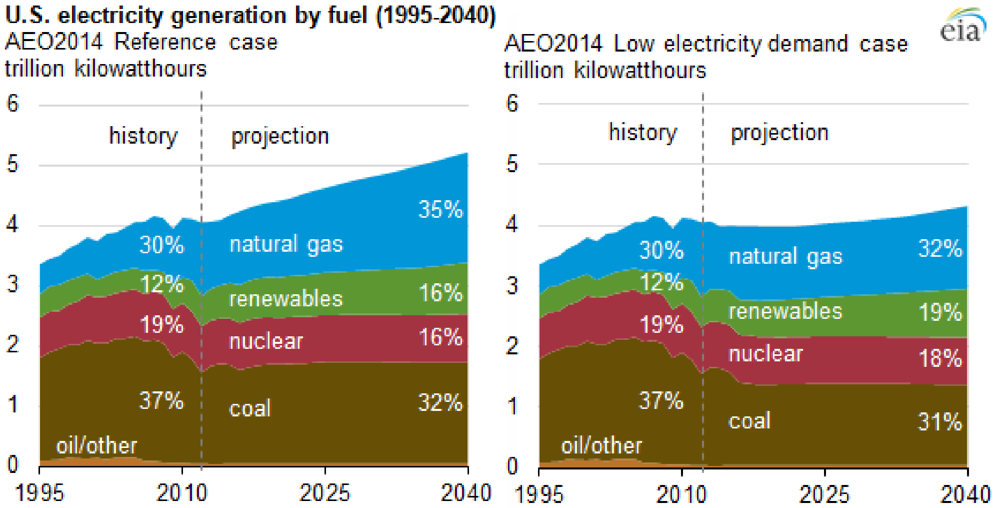

Figure 4.7: Electricity generation of fossil Fuels Diagram

Chapter 5
Conclusion

5.1 Conclusion

Energy is important part to retain the industrial production rate and also the progress of any Country. The conventional sources are reducing day by day and by the turn of century, we have to depend upon the non-conventional sources of energy. (Non-conventional sources such as solar energy, wind energy, biogas etc.) We can also increase the growth of country by installing Power Generation from speed breaker by using electromagnetic suspension in heavy traffic roads and toll plaza. We can generate electricity almost continuously by using the weight of the vehicles to produce mechanical power in the shafts by using the rack and pinion mechanism. As this method does not require any external power source and the traffic never reduces, these Power Generation from speed breaker by using electromagnetic suspension are more reliable and have a greater life span.

5.2 Advantages

Here are some of the advantages of using this type of Power Generation program :-

- Free Energy Generation
- Low Maintenance Part
- Energy Saving
- We can store energy in battery.
- Very effectively work for generate power generation.
- Reduce energy waste.
- No Oil consumption.
- Less skill technicians is sufficient to operate.
- Simple construction
- Ease of operation.

5.3 Limitation of the Research

Although our project has many applications and advantages but there are some limitations of the project as well and the good thing is that these limitations are minor and doesn't affect the efficiency of the system. Limitations are given below:

- The system needs to be more efficient to produce more energy.
- It will work on a minimum weight in this project

5.4 Application

Our project has many application areas and actually we need to use it in many places to verified the exact person which have the proper access. Some of the application areas of the project has been pointed out below:

- ➢ Street lights.
- ➢ Road signals.
- ➢ Sign boards on roads.
- ➢ Digital advertising boards on roads.
- ➢ Lighting of the check post on the highways.

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Appendix

```
#include <LiquidCrystal_I2C.h>   // scl=d1& sda=d2
LiquidCrystal_I2C lcd(0x27, 16, 2);  // I2C address 0x3F, 16 column and 2 rows
#include <HX711_ADC.h> // need to install
#include <Wire.h>
HX711_ADC LoadCell(6, 7); // parameters: dt pin 6, sck pin 7;
 int solar;
float input_voltage = 0.0;
float input_voltage1 = 0.0;



// Your WiFi credentials.
// Set password to "" for open networks.

void setup()
{
  // Debug console
  Serial.begin(115200);
  pinMode(A0,INPUT);
   pinMode(A1,INPUT);
 LoadCell.begin(); // start connection to HX711
  LoadCell.start(2000); // load cells gets 2000ms of time to stabilize
  LoadCell.setCalFactor(1000.0); // calibration factor for load cell => dependent on your
individual setup
  lcd.init();
  lcd.backlight();

  lcd.begin(16,2);
  lcd.init();      // initialize the lcd
  lcd.backlight(); // open the backlight
}
```

```
void loop()
{
   int analog_value = analogRead(A0);
    input_voltage = (analog_value * 5.0) / 1024.0;
      Serial.print("piezo:");
      Serial.println(input_voltage   );
    /*lcd.setCursor(0, 0);
    lcd.print("piezo");
    lcd.println(input_voltage   );*/

if(input_voltage>0.60){
   lcd.setCursor(0, 0);
    lcd.print("EMV:");
    lcd.println(input_voltage   );
  }
if(input_voltage<0.60){
   lcd.setCursor(0, 0);
    lcd.print("EMV:");
    lcd.println("0.00"   );
  }
     int analog_value1 = analogRead(A1);
    input_voltage1 = (analog_value1 * 13.00) / 1024.0;
      Serial.print("Bv:");
      Serial.println(input_voltage1   );
    lcd.setCursor(10, 0);
    lcd.print("Bv");
    lcd.println(input_voltage1   );
    delay(500);



     LoadCell.update(); // retrieves data from the load cell
  float i = LoadCell.getData(); // get output value
  float weight=((i/1000)*3)/2.16;
  lcd.setCursor(0, 1); // set cursor to first row
```

```
  lcd.print("Weight: "); // print out to LCD
  lcd.print(weight); // print out the retrieved value to the second row
}
```