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A Study on Smart Speed Breakers for Traffic Calming and Power Generation

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Abstract: In present day to day life increase in population due to ill-literates, old ideology results in increase of automobiles usage on pavements. This increase in automobile usage leads to traffic density on roads and causes to environmental effect (air, sound, noise pollution). This environmental effect increases the global warming. Due to global warming we are facing different problems such as temperature changes, climatic conditions etc. To reduce the environmental effect and control usage of conventional sources like coal, oil we are designing kinetic roads that harvest the kinetic energy by movement of vehicles is converts into electrical energy through speed breakers as power hump. Kinetic roads are a design used to generate electricity and overcome different drawbacks such as, increase in population leads to land occupation and reduces the agricultural land, as the automobiles usage is high on roads then the fuel consumption is high. Due to this fuel consumption the toxic released in to atmosphere are high which cause environmental effects. The fuel usage is done continuously the fuel get depleted because the fuel is a non-renewable source. While moving, vehicle possesses kinetic energy and that is being wasted. There is a possibility of lapping the wasted kinetic energy and generating power by making the speed breaker as power generating unit. The unit is capable of producing electricity using kinetic energy of vehicles passing over the speed breakers with the help of rack and pinion arrangement beneath it, the generated power is stored in a battery and transferred to inverter for use. The study of power generating is based on variation in speed & load of vehicle in different situations. Rack and pinion arrangement can be employed in speed breakers where traffic intensity is very high such as malls, multiplexes etc. The generation of power is based on traffic density. As the traffic density is very high the output power generate is high and the generated power is used mainly for street lights, on road battery charging units and many domestic applications like lighting, air conditioning etc**.**

Keywords: Population, automobiles, conventional, generation, rack and pinion etc.

I. INTRODUCTION

The present day's life style is changing day by day. This change in life pattern occurs by population, infrastructure, motor vehicles and income level in Indian road transportation system. The cities of this diverse country and its urban population play an major role in the growth of the country. As per the 2011 census, 31.2% of India's population (377 million) is living in urban areas for their needs. As the UN estimates, these numbers with population will grow to 40% (590 million) by 2030 and 58% (875 million) by 2050.

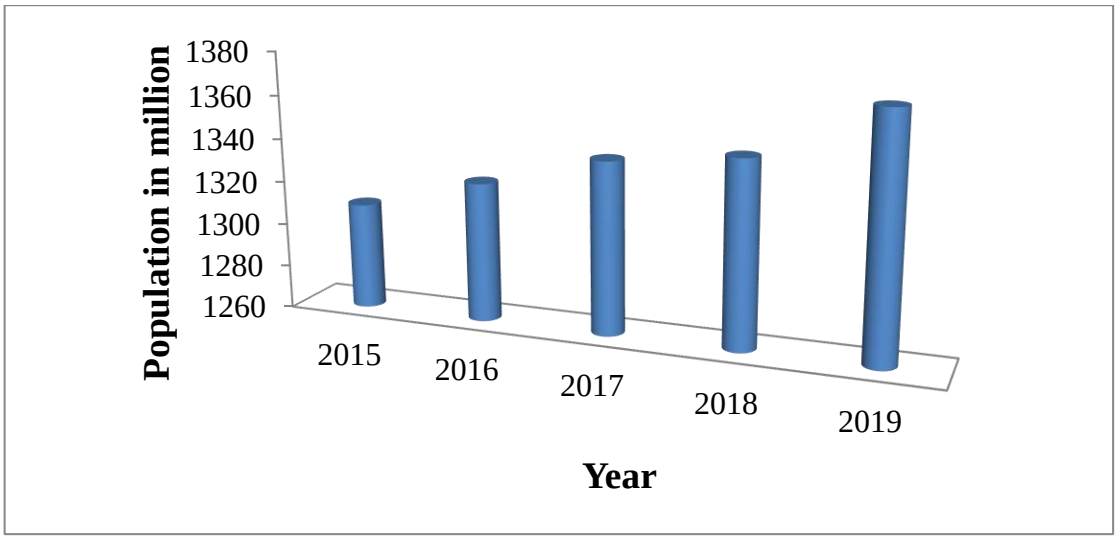

Figure 1: The Indian population growth from year 2015 – 2019.

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While only 30% of the total population lives in urban areas, approximately 63% of India's Gross Domestic Product (GDP) is contributed by those urban areas is high. A 'smart city' is an urban region that is highly advanced in terms of overall infrastructure and market viability. It is a city where information technology is the principle of infrastructure and the basis for providing essential services to residents.

Until now the federal government has shortlisted and establish'109 smart cities' in India. The key idea of smart cities is the association of public services with an integrated public transport system. Information Technology, therefore, will play a vital role in both integrating the public transport and automating these services.

India is world's 7th largest country by area and 2nd most populous country with more than 1.35 billion of resident are living by the year 2018. Indian population growth was slowly increasing from last few years. It is still growing faster than china and is expected to be surpassing china in population by 2028. Per a day there are 60 thousands new entries to the growing population in India. One person of every 6 people on the planet is lives in India. In India there are more than 50 urban areas with a population of more than one million people. While the number of Indians living in urban areas has increasing over the last two decades because of development in areas the people moving from rural areas to urban areas for their different purposes.

This is mostly due to the moderate life style of town people and technologies. Some people come to urban for higher studies and better knowledge acquiring.

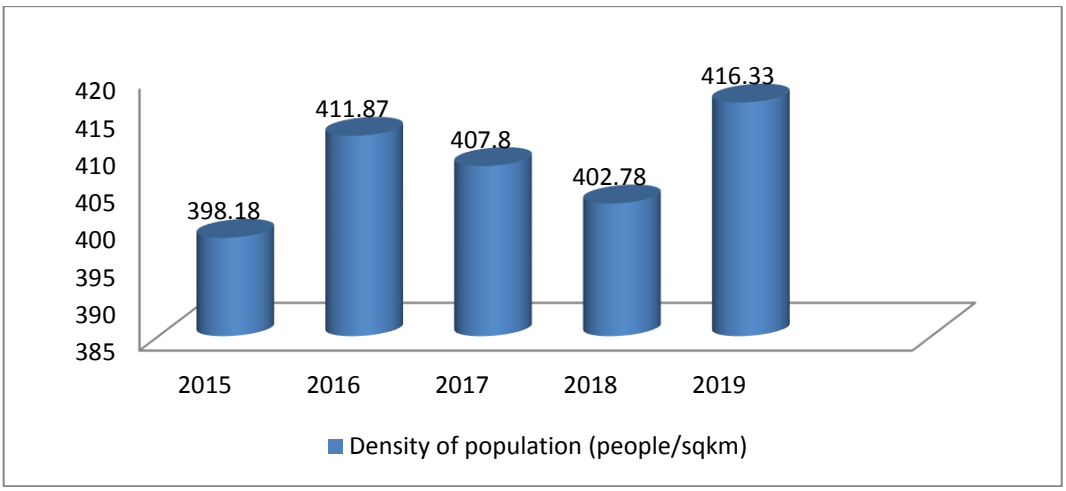

Figure 2: The Indian population density from year 2015 – 2019.

II.THE IDEA GENERATING ELECTRICITY FROM SPEED BREAKERS

Electricity will be generated with the assistance of speed breaker by creating gear arrangement and adopting of electronic gadgets, so a large quantity of electricity will be generated saving economically

SPEED BREAKERMECHANISM

Speed breakers are the devices which are adopted to measure traffic and use vertical deflection to cut down vehicle passing over pavement. Speed breakers also are called speed hump, speed bump, speed ramps, speed cushion or speed tables. Speed breakers measure as the common name for families of traffic calming devices that use vertical deflection to slow motorcar traffic so as to enhance safety condition variations embody the speed breakers, speed bumps, speed cushion, and speed tables. Speed breakers should be adopted only in urban areas for minor roads and residential areas. Speed breakers don't seem to be suggested on high speed roads or highways outside urban limits, the speed breakers are measure to cut down traffic close to colleges, hospitals in order that children will cross the roads a lot of simply or senior citizens will cross comfortably. They're conjointly placed close to toll booths and entry points of bridges or slim roads, to confirm that motorized scale back their speed.

III.WHY ONLY SPEED BREAKERS AS SOURCE POINT WHY NOT ROUGH OR PLANE ROADS

Currently the question arises on why the speed breaker is employed and not on the rough or plane roads, wherever the Kinetic Energy of the vehicle is over that obtained on the speed breaker. The solution to the particular question is obvious; think about for example: A automotive or any serious vehicle moving with a speed of a hundred mph on the road and spending over this roller that is fitted at the extent of the road then this roller can gain the speed of nearly ninety mph (due

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to losses). currently suppose a bicycle is moving with a speed of twenty mph and goes to pass this roller (which is moving at a speed of ninety mph), then thanks to this distinction within the speed there'll be a collision. that's the most reason for adopting this idea on the speed breaker. The rough or plane road won't give the torsion necessary for energy generation.

IV. FUEL CRISIS

On the idea of this day, the interest towards renewable energies has fully grown within the past few decades. We've got to develop another renewable supply of energy to tackle the issues of the energy crisis and scale back the dependency on non-renewable sources. As we all know Solar, wind, OTEC (Ocean Thermal Energy Conversion) is already living however not used properly for the assembly of electricity. The usage of renewable and non-renewable sources to supply electricity is mentioned as follows.

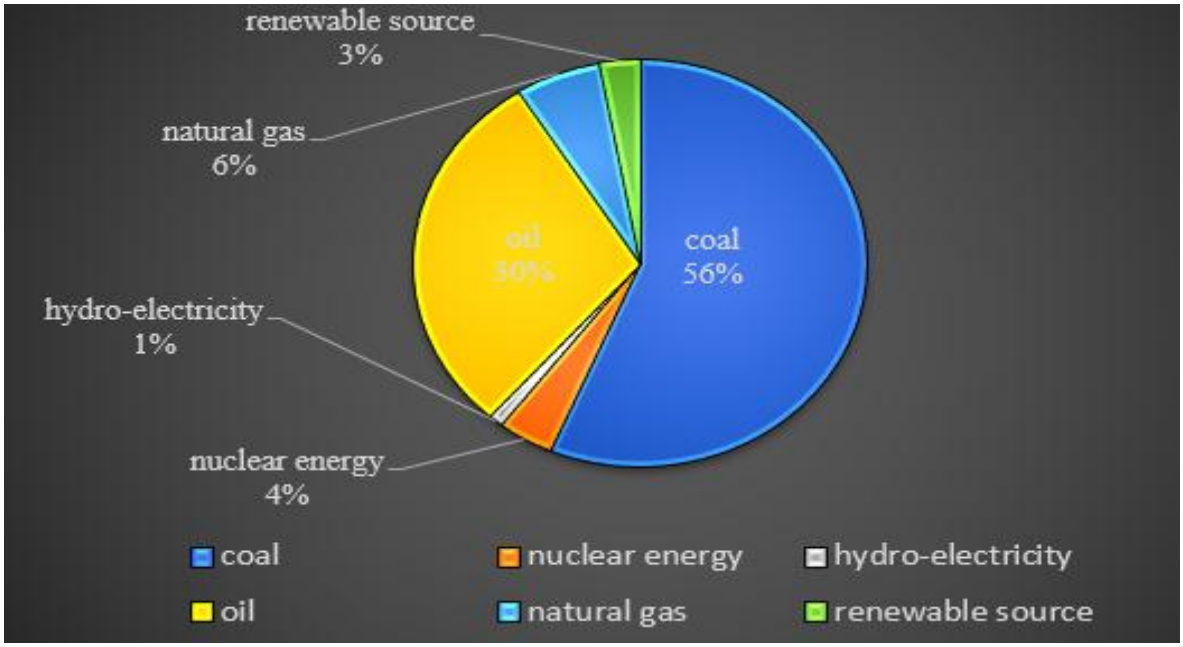

Figure: 3: Resources using to generate power per annual

V. NEED FOR THIS PROJECT

The need is to discover another approach to produce power in various manner without utilization of any sustainable sources in our task the population is developing step by step in view of created advancements and movement from different nations for various reasons, for example, for work, contemplates and so on. The individuals utilizing street transportation framework are high for various purposes, for transportation, to move from standard work places, for trips and so on. So, by this we can comprehend that individuals utilizing street transportation for the most part for their requirements. Presently we produce power trough street transportation framework by vehicle development. In street transportation the individuals and merchandise transport done by vehicle. The vehicle are of might be vehicle, truck, transport, engine bicycle, cycle. By any vehicle development the vehicle has some dynamic energy. By utilizing a few laws this kinetic Energy can be convert into electrical Energy. The created is with no use of characteristic assets. This create power can't be absolute lessen the force emergency however it may be help full for some degree. In street transportation framework at speed breakers the vehicle moves delayed for various reasons as we examined before. The force variety depends on weight of vehicles. The weight of vehicles is high the gaining of power is high. In this way, we need to pick a spot where the speed breaker moves gradually to get more proficiency.

VI. MECHANISMS AND MATERIALS

TYPES OF MECHANISMS

There are four different types of mechanisms are there to generate power from speed breakers.

- Crank shaft mechanism
- Roller mechanism
- Spring coil mechanism
- Rack and pinion & chain sprocket mechanism

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CRANK SHAFT MECHANISM

The driving rod is a component which changes rotational development into direct development, or the other way around. For instance, the movement of the cylinders in the motor of a vehicle is straight (they go all over). Be that as it may, the movement of the wheels must be rotating. In this way, engineers put a driving rod between the motor and the transmission to the wheels. The cylinders of the motor move the driving rod and the development gets revolving. At that point the rotational development goes past the clutch and the gear box right to the wheels.

In this system the driving rod is required to be mounted on bearing which adjusts the issues prompting mechanical vibrations which thus harms the heading and the bearings are of sliding sort, any variability may burden on the vehicles which additionally prompts adjusting issues due to non-uniform burdens we need have to put various sizes of shaft in order to be utilized. The driving rod has semi-round movement since it is fixed with a pin to pinion and driving rod pole. So, the revolutions are low at that point contrasted with different components.

Components of crank shaft mechanism:

- Crank shaft rod
- Springs
- Gears
- Special bearing arrangement
- Shaft rod
- Dynamo

Crank shaft rod, are used to convert shaft motion into rotator motion. Spring, takes the load directly without affecting other parts in housing. Gears are used to transfer the rotary motion. Special bearing arrangement is placed to increase the out. Shaft rods help to rotate pinions. Dynamo, used to generate power.

Draw backs for crank shaft mechanism are:

- Crank-shafts are required to be mounted on bearings which creates balancing problem.
- Mechanical vibrations which in turn damage the bearings.
- As bearings are of sliding type, any occurrence of variable load(which is bit obvious in case of vehicles) leads to balancing problem

ROLLER MECHANISM

In this Mechanism, a roller is fitted in the middle of a speed breaker and and grip is given on the speed breaker with the goal that when a vehicle ignores speed breaker it turns the roller. This development of roller is utilized to turn the pole of D.C. generator by which the assistance of chain drive which is there to give diverse speed proportions. As the role of D.C. generator pivots, it produces power. This power is put away in a battery. At that point the yield of the battery is utilized to help the road lights out and about. Presently during daytime we needn't bother with power for helping the road lights so we are utilizing a control switch which is physically worked. The control switch is associated by wire to the yield of the battery. The control switch has ON/OFF system which permits the current to stream when required.

SPRING COIL MECHANSIM

The wooden element with spring fixed at sides and on spring the top of speed breakers with connection of controlling rack and pinion with enormous apparatus connection in the club. The gambling club is of barrel shaped controlling appended to the base plate for the help. The pinion is associated with engine shaft little rigging, this apparatus are associated with dynamo to produce power. The produced power is less at that point contrasted with other instrument, the support cost is high and continuous checking is required.

At the point when vehicles moves toward the speed breaker the most extreme burden on the speed breaker is the point at which the vehicle is on the center of the speed breaker. Because of this power applied on the cylinder/spring instrument in the water tank and afterward water coming outside of the tank, presently one valve is there which estimated the weight and valve is keeping up of stream of water. This water is passing on the rotator cutting edge which revolves and one chain belt is there so generator is likewise turns with rotor. This created power which can be utilized for lighting of the lights on the streets or it might be put away in the battery can be changed over in AC current utilizing inverter and utilized for road lighting of the lights, signals sign board.

RACK AND PINION & CHAIN SPROCKET MECHANISM

Here the reciprocal movement of speed breaker is to changes over the stock movement of vehicles into rotating movement utilizing the rack and pinion method. The axis purpose of pinion is coupled to chain sprocket course of action. In that chain sprocket game plan the hub purpose of littler sprocket, fly wheel, huge gear, little gear are associated with shaft rod In separate order. The rod is turned by the development of huge sprocket associated with little sprocket further fly wheel,

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huge gear, little gear are pivoted at last the little apparatus is coupled to dynamo to deliver force and this force are put away in battery.

While moving, the vehicles have some Mechanical energy because of its weight and it is being wasted. This dynamic energy can be used to create power by utilizing an exceptional course of action called power bump. It is an Electro-Mechanical unit. It uses both mechanical innovations and electrical methods for the force age and its stockpiling. Power bump is a vault like gadget liable to be speed breaker.

At whatever point the vehicle is permitted to ignore the vault it gets squeezed downwards then the springs are connected to the arch and are packed and the rack which is appended to the base of the arch moves descending in responding movement. Since the rack has teeth associated with gears, there exists transformation of responding movement of rack into revolving movement of gears yet the two apparatuses pivot inverse way. So the poles will turn with certain R.P.M. these poles are associated through a lot of gears to the dynamos, which changes over the mechanical energy into electrical energy. The change will be relative to traffic volume. The electrical power can be improved by masterminding these force bumps in arrangement. This produced force can be enhanced and put away by utilizing distinctive electrical gadgets

COMPARISON BETWEEN DIFFERENT MECHANISMS

Table 1: Comparison between Different Mechanisms

Sr. No	Parameter	Roller Mechanism	Rack And Pinion Mechanism	Air Piston Mechanism	Spring Coil Mechanism
1	Cost	Cheap	Moderate	Costly	Costly
2	Mechanism	Very Easy	Difficult	Very Difficult	Very Difficult
3	Maintenance	Less Required	Weekly Basis	Daily Basis	Daily Basis
4	Efficiency	50%	70%	85%	65%
5	Design	Easy To Design	Depend Upon Weight Sustaining Capacity	Depend Upon Compressing Power Of Piston	Depends On Capacity

VII. WHY ONLY RACK AND PINION MECHANISM?

From over all examination and correlation between various instruments and mechanisms, we are utilizing rack and pinion course of action to create power with street transportation framework. Indeed, even there are four unique components to produce power from vehicle; we are thinking about rack and pinion to conquer the inconveniences by contrasting different techniques;

- Rack and pinion takes restricted dispersing on roads & pavements, it tends to be easy introduced and handily worked.
- The maintaining cost is low so it diminishes a little measure of conservative spending plan.
- In street transportation framework they are diverse burden will be gone through the speed breakers yet in rack and pinion doesn't have any adjusting issues

Table 2: Component & its material

Sr. NO	COMPONENT	MATERIAL
1	Rack	Plastic
2	Shaft	EN8
3	Spring	Spring Steel
4	Nut bolts	Plain carbon steel
5	Bearing	Plain carbon steel
6	Pinion gear	Plastic

VIII. METHODOLOGY

WORKING PRINCIPLE

A smart speed breaker is a framework configured to catch left Kinetic Energy from all vehicles proceeding onward roads. This gadget changes over the active Kinetic Energy of vehicles into electric energy by introducing moving plate out and about, it takes the stroke movement of the vehicles and changes over it to the turning movement by rack and pinion system and create the power.

This generated power is finished by the moving plate introduced out and about, this plate instated of speed breaker which is known as smart speed breaker. This plate catches little development from the vehicle on the roads. This plate take the

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stroke movement which the connection of the rack to the plate and the rack the associated with pinion. The rack and pinion is a sort of direct actuator that contains a couple of apparatus called pinion draws in teeth on a straight rigging bar called the rack to move comparative with the pinion, consequently interpretation direct movement into the rotational movement of the pinion.

ENERGY CONVERTION IN SMART SPEED BREAKER

Kinetic energy is produced by the movement vehicle on roads this energy is taken as stir movement and that feed movement is put away energy as mechanical energy and that mechanical energy in an item because of its situation of game plan taken by pinion course of action.

There is a framework that changes over mechanical energy into electrical energy. The mechanical energy produced by vehicles going up on SPEED BUMPS into dynamic energy. At the point when the vehicle moved over the speed breaker, it picks up height brings about increment the mechanical energy, which is wasted in a strip. At the point when the breaker descends, they the kind of component masterminded which thus rotates the equipped shaft stacked with springs. The yield of the pole coupled to a dynamo to change over motor energy into power.

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 mv^2. 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)

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 mechanical 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.

ELETRICAL 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.

IX. WORKING EXPLAINATION OF MECHANIS

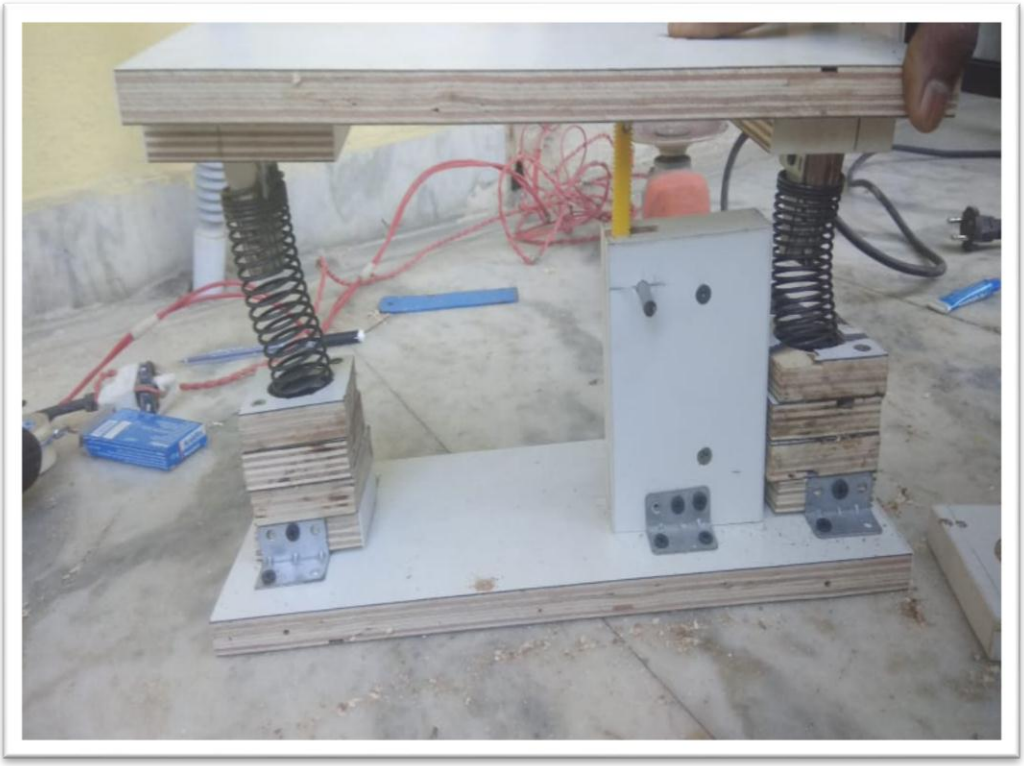

Figure 4: Load Applied On Speed Breaker

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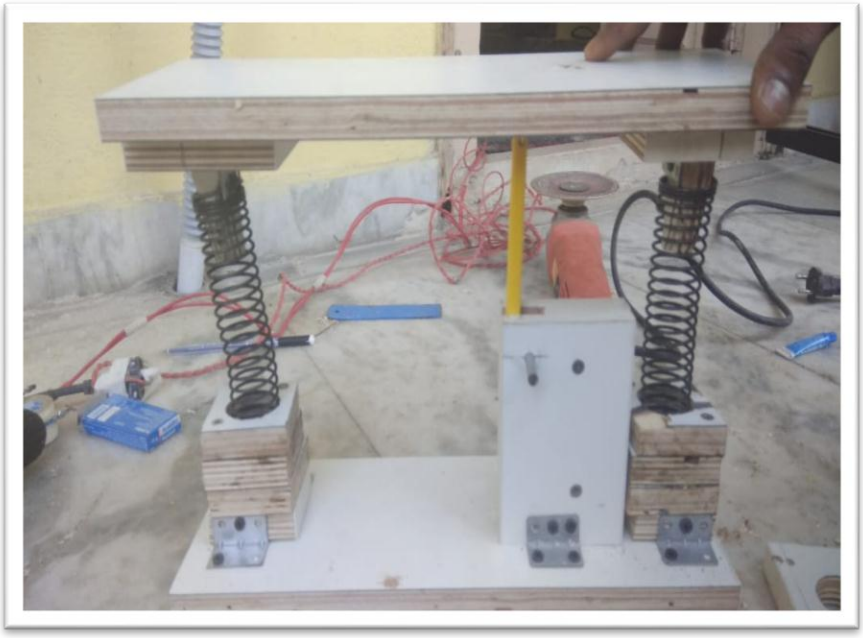
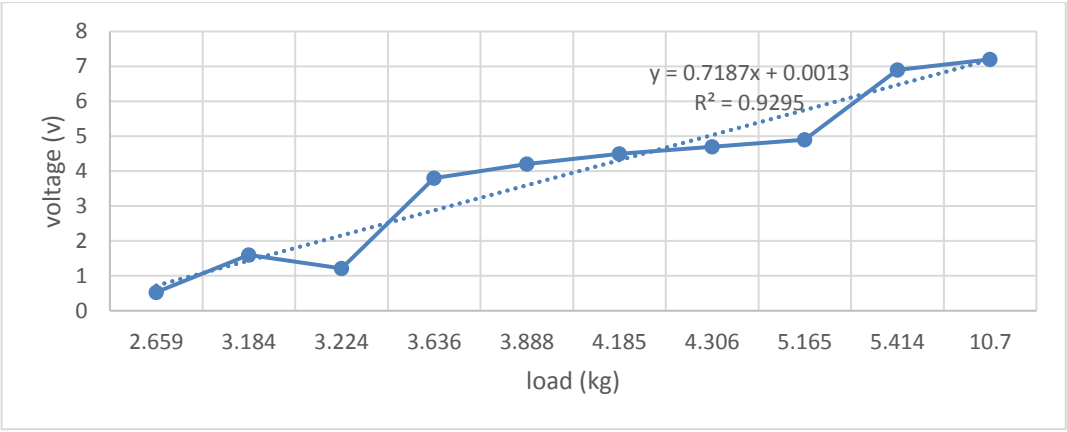


Figure 52: Due to the spring action the rack moves up and down and by the contact to the rack the pinion get rotates

X. RESULTS AND DISCUSSION

VOLTAGE VS. LOAD



Graph 1: voltage vs load

From the line representation of above chart, the voltage is fixed for a limit of 5v then only the voltage passes to the battery for the storage purpose. The intake of the load to generate voltage by keeping the fixed depth for the speed breakers. The generation of voltage is increasing gradually with increase in load. The generated voltage is also based on the movement of speed breaker depth by the load. The maximum voltage obtained is 7.2v

Sr. NO	Load (Kg)	Voltage (v)
1	10.7	7.2
2	5.414	6.9
3	5.162	4.9
4	4.36	4.7
5	4.185	4
6	3.88	4.2
7	3.636	3.8
8	3.224	1.12
9	2.659	0.53

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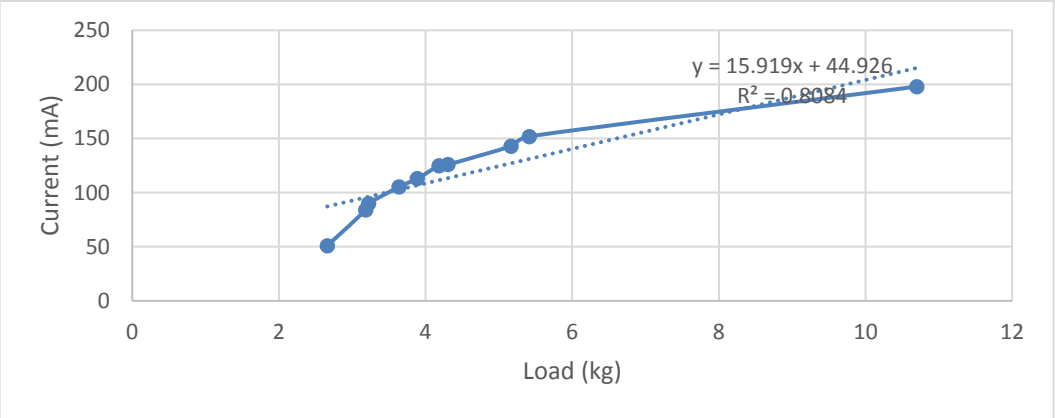
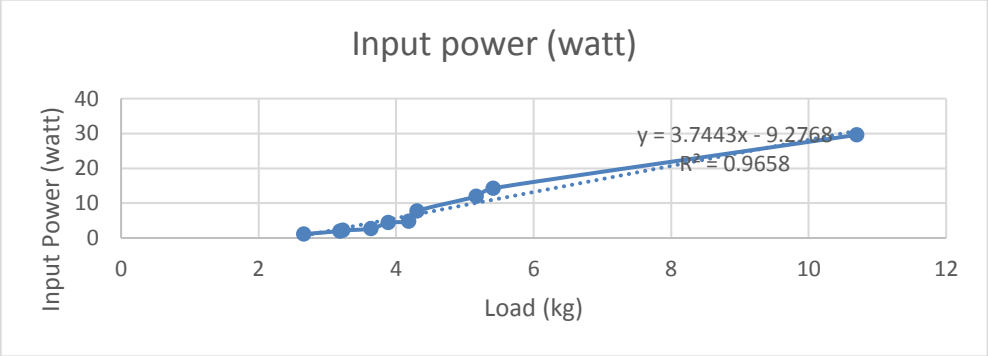
CURRENT VS LOAD



Graph 2: Current vs Load

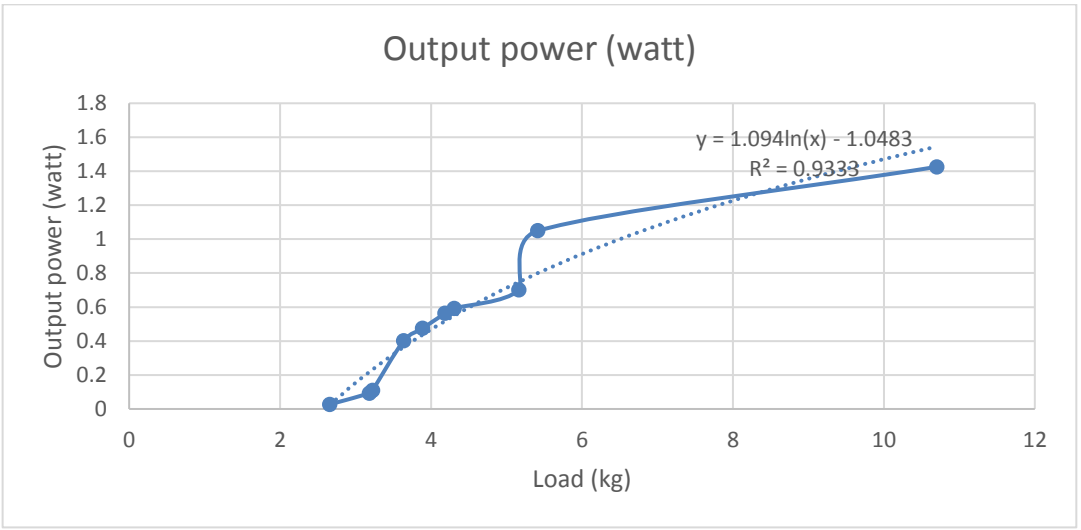
INPUT POWER VS. LOAD



Graph 3: Current vs Load

From the above pie chart, the current is fixed for a limit of 170 mA then only the current passes through battery the frequency data intakes to generate voltage by taking the time as constant (i.e., 1min). the current generated for 1 unit of load in 30 pushes is 196mA and for 36,48,60 pushes are 183,176,174 mA. Similarly, for unit 2 and unit 3, the current obtained for 30 pushes is 182,187 mA, for 36 pushes is 178,187 mA, for 48 pushes is 153,181 mA, for 60 pushes is 190,195 mA. Frequency study says that as frequency is decreasing and then at particular load it gets increase suddenly.

OUTPUT POWER VS. LOAD



Graph 4: Output power vs. load

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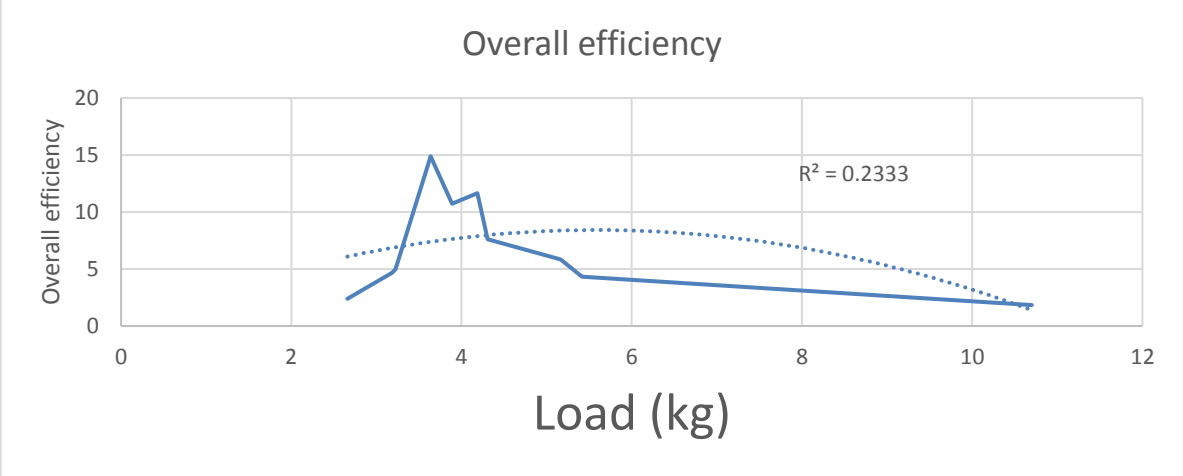
From above table, the maximum voltage is limited to 5 volts and the current is limited to 170 mA. If the produced voltage reaches to 5volts then only the produced voltage is stored in a battery and in the same way the current generated is get stored when the current reaches 170mA.



Graph 4: Overall efficiency vs. load

XI. IMPLEMENTATIONS

Street Lights: A Street light which is turned on or lit at a certain time every night. Modern lamps may also have light-sensitive photocells to turn them on at dusk, off at dawn, or activate automatically in dark weather.
Traffic Lights: Traffic lights are signaling devices positioned at road intersections, pedestrian crossings and other locations to control competing flows of traffic
Toll Plaza: At the toll plaza huge amount of electricity generated from speed breaker by vehicles. This electricity is used for the lighting purpose, signaling, and in various systems.
Housing Area: In housing area we can used for lighting, and low power application like door bell, mobile charger etc.
School Area: In school areas generated energy is used for the Lighting purpose and for various systems used in school like personal computers, ringing bell, bio metric machine etc.

XII. ADVANTAGES

- Power generation with low cost and using non-conventional energy sources which will help us to conserve the conventional energy sources to meet the future demand.
- By mistreatment this technique, electricity are going to be generated throughout the year while not looking on different factors.
- Easy for maintenance and no fuel transportation problem.
- Pollution free power generation.
- Less floor area required and no obstruction to traffic.
- No want of personnel throughout power generation

XIII. DRAWBACKS

- We have to check mechanism from time to time.
- It can get rusted in rainy season so frequent maintenance is required

XIV. CONCLUSION AND FUTURE SCOPE

"Electric Power incorporates an important role in our life". Thanks to population blast, the present force has gotten lacking to satisfy our wants. During this enterprise we discover innovation to provide power from speed breakers during which the framework utilized is solid and this technique can facilitate save our characteristic assets. In coming back days, this may demonstrate a unprecedented aid to the globe, since it'll spare a large amount of power of intensity plants that gets wasted in enlightening the road lights and different street use. Because the summary on the energy utilization in Asian

country had distributed a despicable report that just about 80000 of cities in Asian country do not in any case have current. The graciously of intensity within the overwhelming majority of the nations is poor, here additional innovative work of strategy area unit needed in field while not disconcerting non inexhaustible sources the energy have to be compelled to be utilized for power age. During this method, it's a customary type of creation of energy have to be compelled to be finished.

Taking a goose at the state of the ability emergency in Asian country, government aims around mistreatment the non-conventional energy hotspot for power age associate degreed decreasing the portion of an Earth-wide temperature boost. On these lines, the method. The framework is non-contamination. The present wellspring of energy, as an example, coal, oil and then forth might not be satisfactory to satisfy the frequently increasing energy requests. These regular wellsprings of energy area unit likewise debilitating and could be depleted. There are a unit some non-ordinary techniques for delivering energy this task is one very little advance to method of investigation the potential outcomes of energy from a couple of non-traditional energy supply. the strategy of intensity age procedure is spick, condition friendly value productive and safe. This enterprise is going to be facilitate full to illuminate some of the ability lack problems.

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