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SIMULATION OF POWER GENERATION FROM SPEED BREAKERS USING ROLLER MECHANISM

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ABSTRACT

Nowadays, power is the primary need for the survival of human life. Researches shows that large amount of power is generated from non-renewable energy resources compared to that of renewable energy resources. The extensive usage of available resources in recent years created a demand for the future generation. To overcome this problem we need to utilize renewable energy sources for power generation and conservation. Beneath speed breaker, setting up an electro-mechanical unit known to be power hump, could help in conserving wasted kinetic energy and use it for power generation. This generated power can be stored, by using different electrical devices and supply this energy to street lights, traffic lights, and nearby areas. In this project it is mainly focused to provide the detailed survey of power generation mechanism from renewable energy resources by making an analysis on the Roller mechanisms. By using the softwares like Solidworks 2015 for modeling of the mechanism,ANSYS for Analysis and MATLAB Application for Convertor circuits and outputs are done. This gives a details view of the mechanism generated more power output by using less weight and low cost material for its manufacturing in an efficient way with more efficiency and less maintenance. After analysis of the mechanism through software, for the proposal of implementation of the project in the society which will be very useful in the future

KEYWORDS: Power generation, Speed breaker, Roller mechanism,Boost convertor.

INTRODUCTION

In today's world, almost every equipment requires electricity for its working and the demand for the electricity is increasing in many folds. In this project, studies available conventional methods for the generation of electricity from the wasted energy. The number of vehicles passing over the speed breaker in roads is increasing .Due to this a large amount of energy is wasted daily on the speed breaker through the friction between the speed breakers and the vechicle tires during vehicle passes. There is possibility of storing this energy by making power generating system under speedbreaker.The power thus generated is stored in a rechargeable device such as battery (conservation) for future use (conversion). Generating electricity by speed breakers is an innovative and useful concept. It is an attractive technology for optimal use of available sources This project aims to compare all the existing power generation mechanism to make the best mechanisms which can give the better power with more efficiency. And providing further information to improve the output of the other mechanism

SCOPE

The usage of the energy is an indication of the development of the nation. A recent survey on the energy consumption in India had published a pathetic report that 55,000 villages in India do not still have electricity. The main problem is the population the demand is not equal to the supply. The 300 million people in india is using power but the power produced is not always less than the power used. Many generating stations were idle due to the fuel and political problem and other crisis. India as 46 lakhs kilometer road in it.And it is second largest road network in the world. In these road we normally have speed breakers as already said we can store the energy that produced in the battery and we can use the power for street lights, signals

RELATED WORK

Many research works are done on the speed breaker .Some of the works as follow Pankaj D.Jagtap et al. investigated experimentally on the three methods of power generation from the kinetic energy of the moving vehicle. Mohammad Ramadan et al. (2015) analysed a Speed Bump Power Generator (SBPG) system that produces electrical power by utilizing the movements of commuting vehicles on highways, boulevards, and streets. Ghuge N.N et al. (2014) proposed a system in that ,when the vehicle come on the speed breaker, electricity produced by motor which acts as a generator. Aravind Reddy.B et al. (2015) designed a Free wheel and recoil spring in the rack and pinion mechanism. Piyush Bhagdikar et al. (2014) proposed Roller mechanism. Rollers are fixed on a wooden ramp on which vehicle passes. Ravivarma.B.K et al. proposed the energy generation methods using air piston mechanism. The renewable source of energy from vehicle bumpers can be utilized. Antonin Stribrsky et al. experimentally states that linear motor was fitted in the suspension system for power generation. During the sprung and unspring of the shock absorber linear motor was actuated thus it convert vehicle vibration caused by road disturbances in to electrical energy. Rajat Gupta et al. (2013) proposed the Hydraulic press mechanism was used to transmit force from one point to another with the help of an incompressible working fluid and further the work will transmitted by the crank and lever mechanism (beam engine).

COMPONENTS AND MATERIAL

Roller

The Roller is made up off Aluminum 7075 T6.This material is highly Strength material only used for High stressed structures. And it has high stress- corrosion Cracking Resistance. Though the Aluminum was light weighted it will give high efficiency.

Spur Gear

Spur gears are mainly used for increasing the speed and for reducing the speed of the system. Here we are using Four Spur gear with two spur gear having 76 Teeth and other two having 18 teeth. Material used in the spur gear is AISI 1018 Mild/Low Carbon Steel

Bearing

Bearing is the part which allow relative motion between two parts. The two types of motion that bearing allows are Rotatory and linear. Here we are using rotary type bearing which is used in world wide which as relatively high in friction. The type of bearing rotatory so we are using ball bearing. The material used in the ball bearing is Stainless steel. Totally we are using 12 ball bearings, six in the Roller mechanism setup and Six in the Gear box setup.

Timing Belt And Pulley

Timing Belt drives give a positive power transmission than the other drives like chain, gears and belt. The Timing pulley with diameter of 40MM are made up of Aluminium and the bigger one is made up of steel. The belt material Fibre glass tensile cord with Neoprene body and nylon tooth

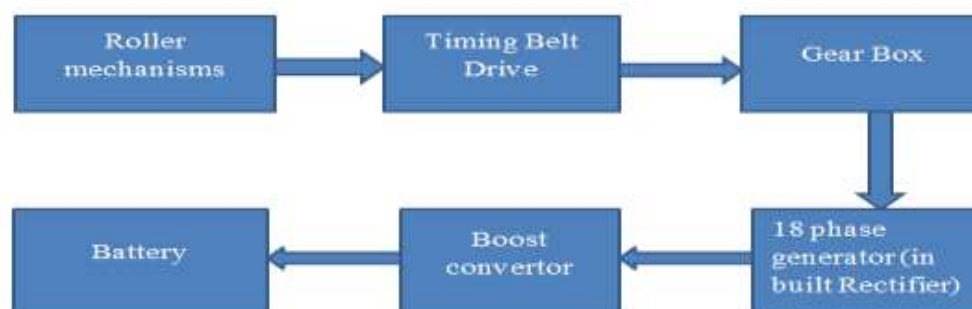## EXPERIMENTAL SETUP

Block Diagram

Figure 1. Block Diagram

Roller Mechanism

The experimental setup of the roller mechanism contains the following items which are already mentioned in the materials and component section. The setup of the project as follows ,the basement of the setup consist of two set of wooden ramp which tends to hold the roller mechanism. One set of roller mechanism contain three ball bearing on each ramp with distance of 111.5mm gap. The ball bearing is made of chrome steel to avoid rust. And three Rollers R1,R2,R3 is attached to the ball bearing in both ends. Surface of the roller is attached plain rubber to increase the friction between the the roller and the vehicles tyre.The rollers are connected with Timing belt to avoid loss .One end of the roller R1 and Roller R2 have one timing pulley each T3,T4 and Roller R2 have another timing pulley in other end T5 .At the same side roller R3 have timing pulley T6.T3 and T4 is connected with Timing Belt and Other timing Pulley T5 is connected to T6 pulley .This connection will give same speed in all the Roller.In R1 another pulley T1 is placed which is 156mm diameter is connected to T2 of 40mm placed in the gear box setup

Gear Box

The experimental setup of gear box contain box setup which has two set of ramp. In one set of ramp three Ball bearing is connected with distance of 94mm and three shafts S1,S2,S3 are connected with the ball bearing as shown in the figure.First shaft S1 consist of one spur gear G1 with 76 teeth which is meshed with second spur gear G2 with 18 teeth which is placed in the parallel shaft S2.In the same shaft S2 another Spur gear G3 with 76 teeth is placed. The Gear G3 is meshed with spur gear G4 with 18 teeth is placed in the shaft S3 parallel to S2.The shaft S3 is the output shaft R3 it is directly connected with generater shaft.The shaft S1 as timing pulley T2 in one end of the shaft.
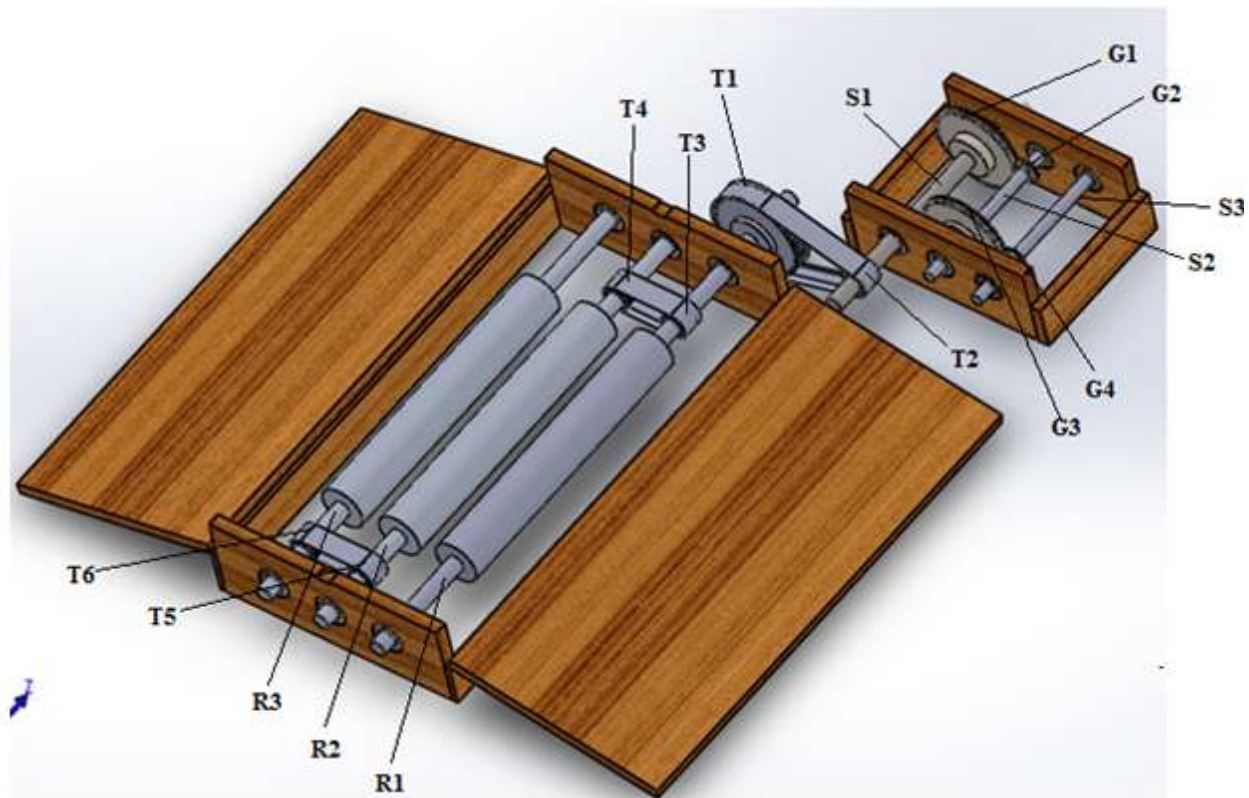
Figure 2. Roller Mechanism with gear box

The simulation of the this model is done in the ansys is shown below in the figure.It is taken as the weight or mass of the vehicle as 250 kg with driver passing over the roller. At the same time one of the Roller carries a weight of 100 kg for a given instant and there will be some rotation on the roller, so we shall take on safer side that the roller rotated at 100 rad/s .
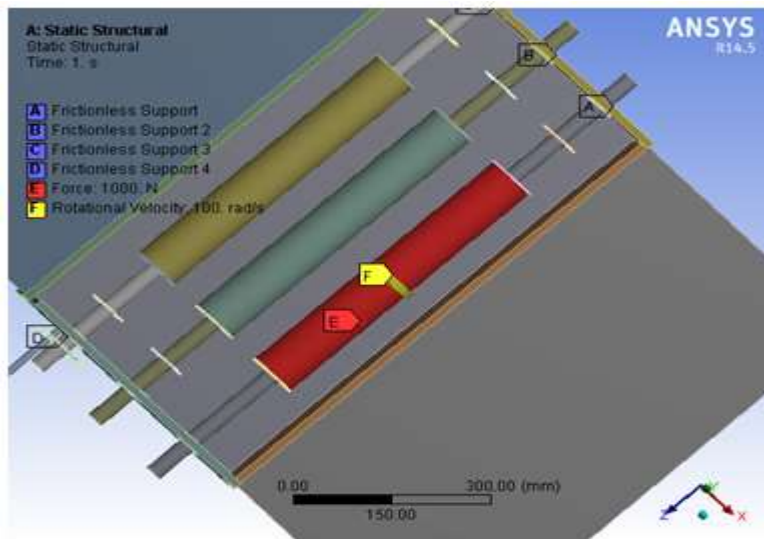
Figure 3. Roller Mechanism which applying load

Below figure shows the results of the simulation on the Roller. The maximum stress on the bearings is 0.62MPa which is within limit of the Stainless steel yield point.
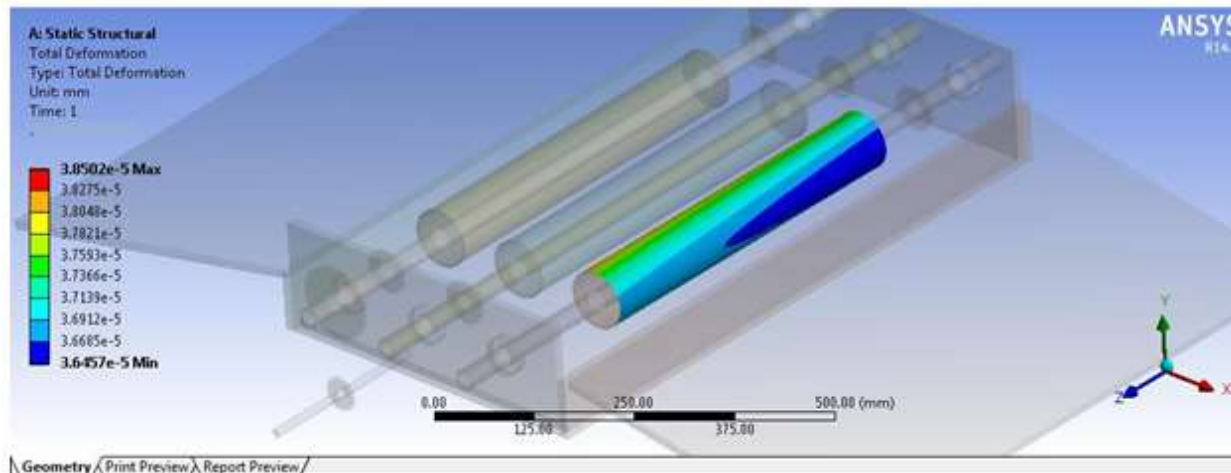

Figure 4. Roller Mechanism After analysis

Working

 When a vehicle is passing over the roller it tends the roller R1 to move due to friction between the tire and the roller surface. The Rollers R2 and R3 is connected with the R1 so these two rollers also will Rotate. And all three rollers are connected with each other roller will rotate if any of the roller rotates. So the end of the Roller R1 it is connected to Gearbox with help of Timing unequal pulley. The speed of the roller output is increased by means gearbox .The output of the Gear box is connected to 18 phase generator.

Table 1. Output Speed of the Gear box Shaft Connected To the generator Shaft

| S.no	Speed of the Roller R1(rpm)	Input Speed of the Generator Shaft(rpm)
1	5	350
2	11	760
3	15	1030
4	20	1375

PERMANENT MAGNET SYNCRONOUS GENERATOR

Generally in permanent magnet synchronous generator there will not be any external coil is there to excite the field. But the inbuilt permanent magnets will provide the excitation required by the generator. The word synchronous tells that the both the rotor and the stator are synchronous to each other that both are rotating at the same speed. This synchronous generators are used more and often in many industries or in many commercial methods to produce the power. The synchronous generator is connected to the turbines like gas, steam, water and converts their mechanical power into the electrical power.

NEW FRANKLIN THOMPSON'S 18 PHASE GENERATOR

The permanent magnet motor are developed day by day in technology and recently the franklin Thompson company as invented a new 18 phase split rotor permanent magnet synchronous generator that have the capacity of about 30 KW generation that also in a low RPM. This proposed PMSG is a modified model of a normal PMSG. Its coil arrangements have been modified in order to get a output of the above mentioned range. This hand wired generator gives an efficient of about 92.3%.

In this PMSG there is only one rotor and a stator which is modified into a 18 phase generator that has a better efficiency than the previous version of 9 phase generator. This generator can be modified to get a efficiency of 97%.
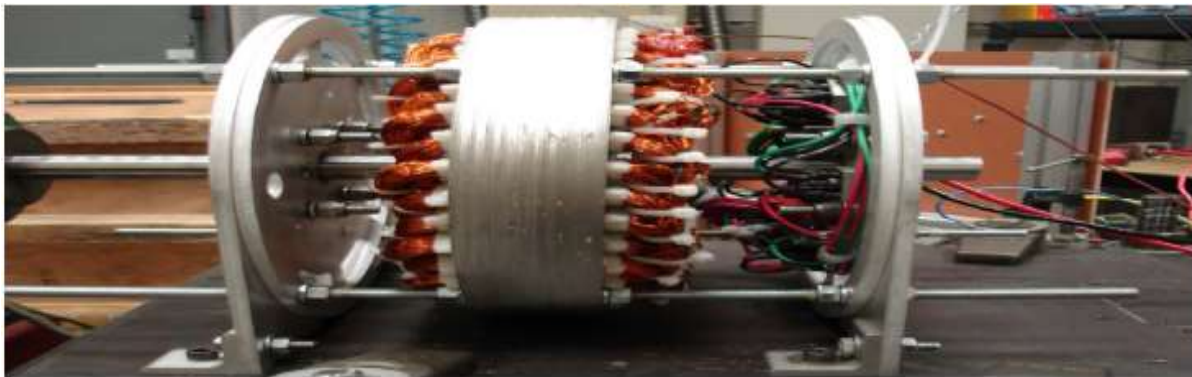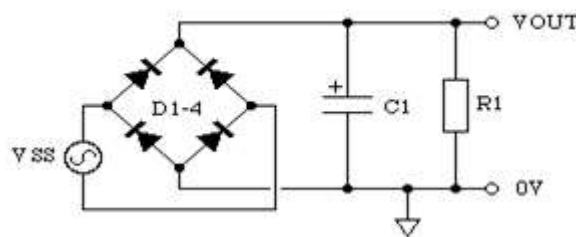

Figure 5. 18 Phase Generator

This generator gives the AC output but it already has a inbuilt rectifier hence the output ac is converted into the dc and given out as dc power.

RECTIFIER CIRCUIT

The Output Voltage generated is given to the rectifier which is given to the in-bulit rectifier which is shows in the Simulink modeling shown below.

Figure 6. Full wave rectifier Circuit

Simulation

The Simulation of Rectifier is done in Mat lab Software the output are obtained from the Mat lab software .
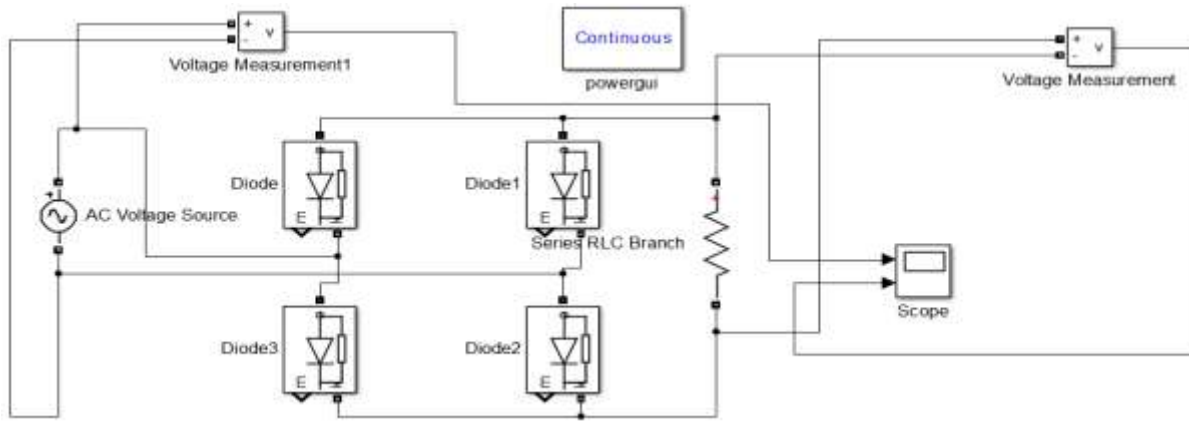

Figure 7 Simulation of Full wave rectifier Circuit in MATLAB

This rectifier converts the AC power into DC power and it gives the DC output.The below shown table are tested result.

Table 2. Output of Rectifier Circuit

Load	Speed(rpm) Input	Current(A)Output	Voltage (A)Output
20	350	4	79
20	760	8	160
20	1375	12	239

BOOST CONVERTER

In order to increase the output DC voltage of the rectifier we need DC-DC boost converter which boosts the given voltage into gain of four which is the gain of the boost convertor designed for this project.
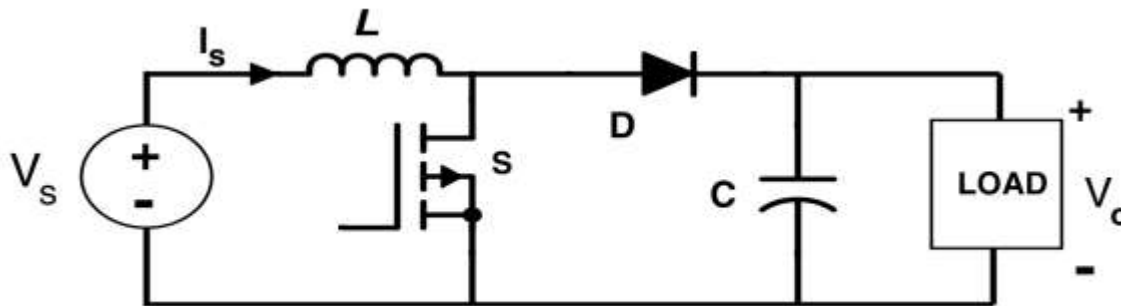

Figure 8. Boost Convertor Circuit

Simulation

Now the three different output voltages from rectifier is given to the boost convertor and the simulation results were given below. The Simulation of Boost convertor is done in Mat lab Software the output are obtained from the Mat lab software .
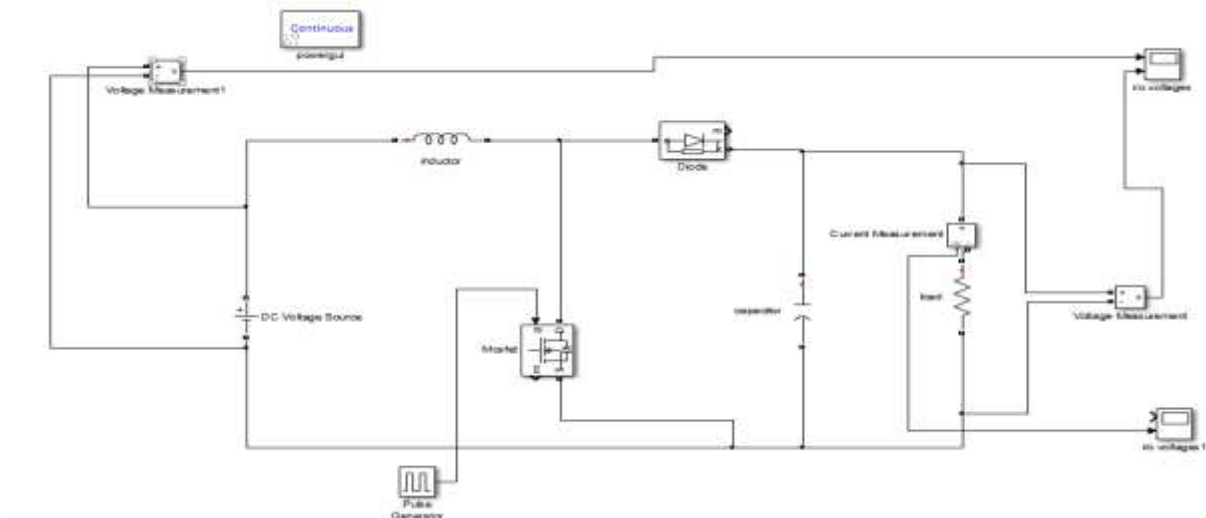

Figure 9. Stimulation of Boost Convertor Circuit in MATLAB

Table 3. Specifiation of Boost Convertor

S.no	Component	Input Speed of the Generator Shaft(rpm)
1	Input Voltage	79,160,260
2	Ouput Voltage	300,500,900
3	Inductor	470uF,1000V
4	Capacitor	35mH,50Amps
5	MOSFET	IXFB 60N80P
6	Driver circuit	TLP 250
7	Control Circuit	Pic Kit 3 Micro Controller
8	Diode	NTE 6047

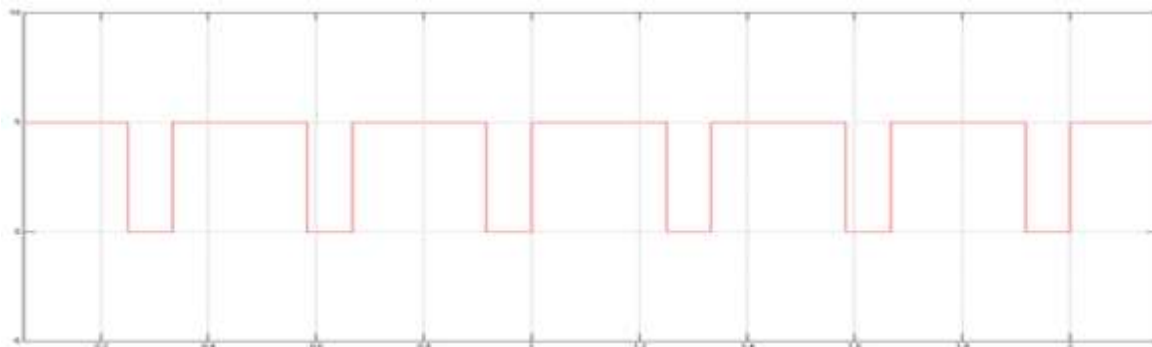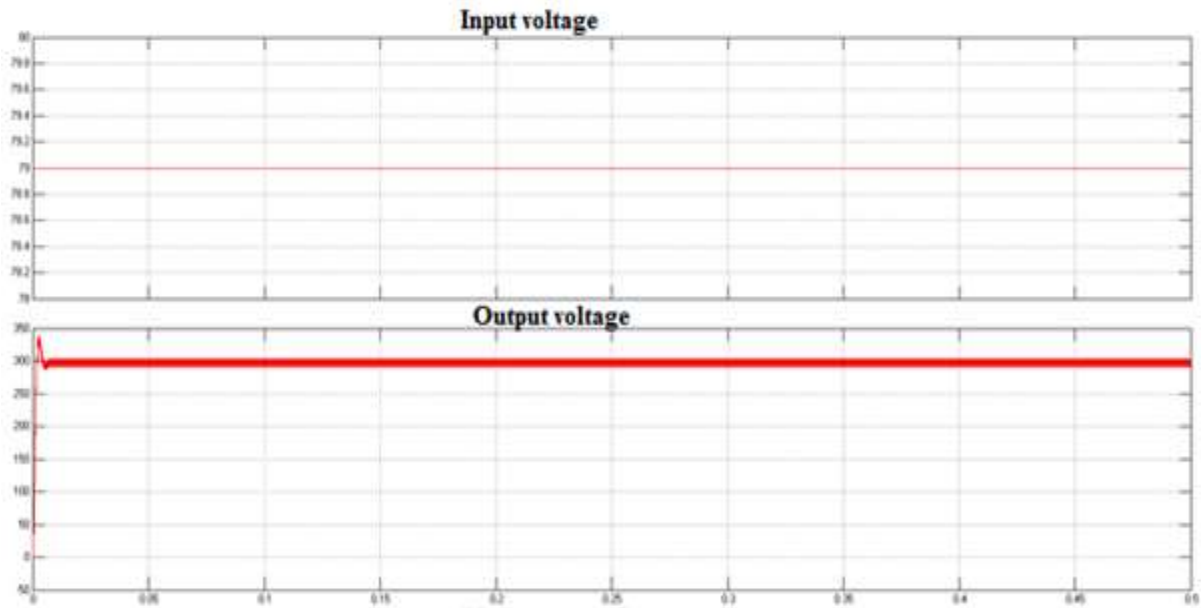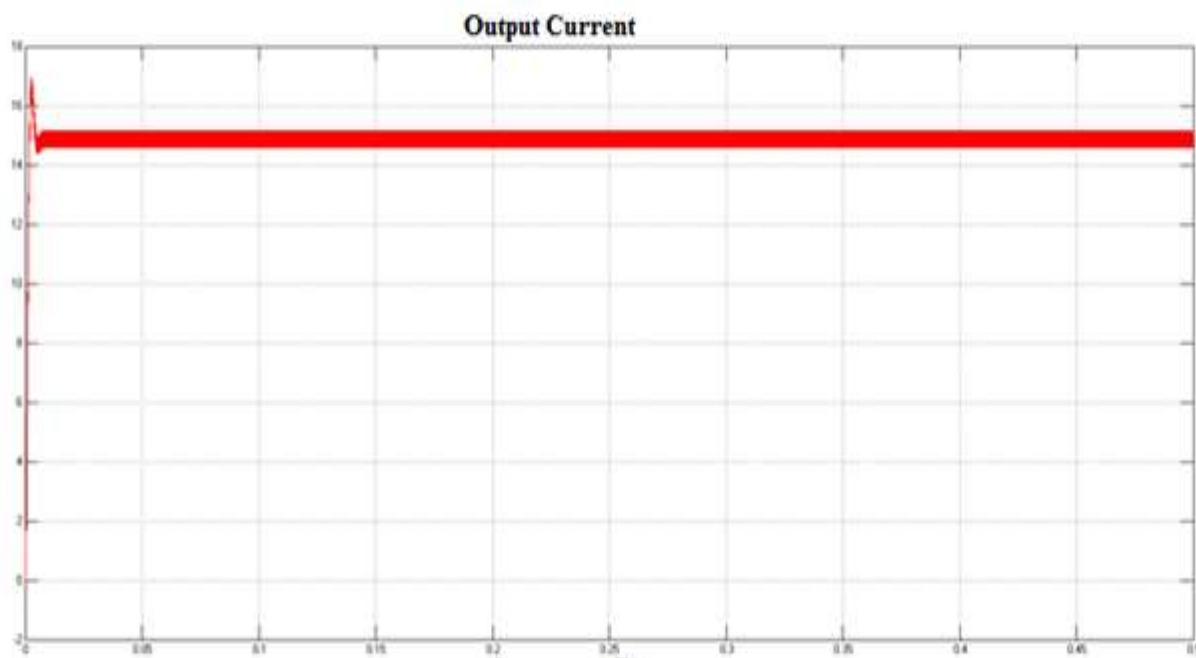The pulses generated for the Boost Convertor is shown Below

Figure 10.Switch pulse –Current vs Time

The output voltage for 79 volt input voltage
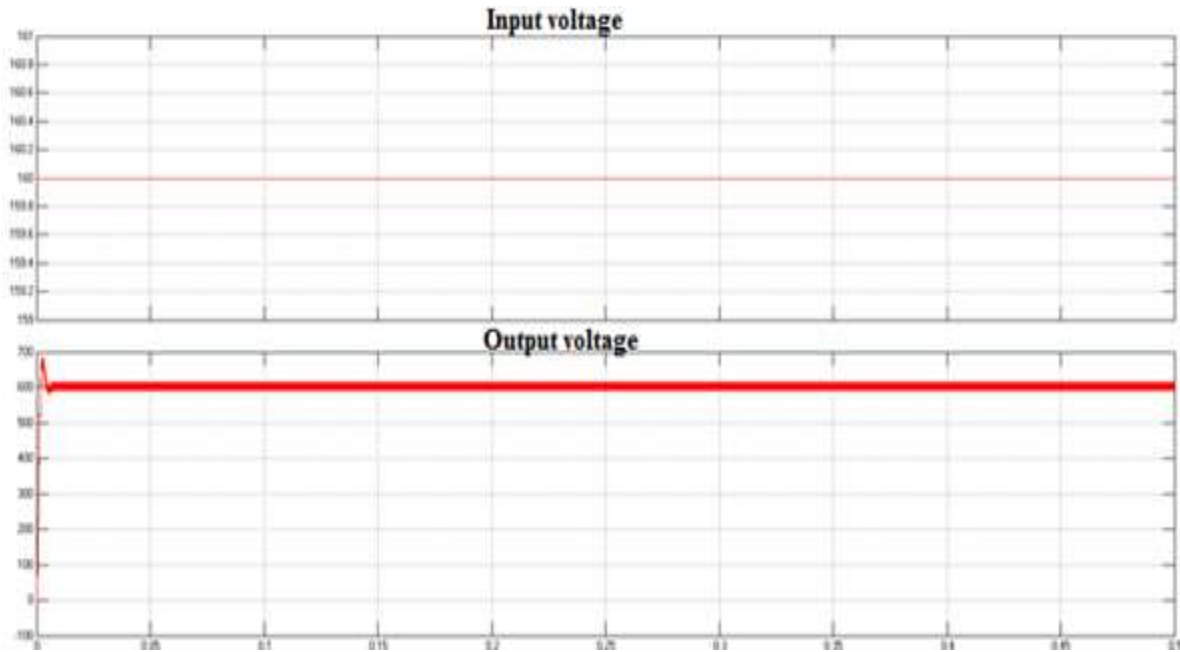

Figure 11.Voltage vs Time

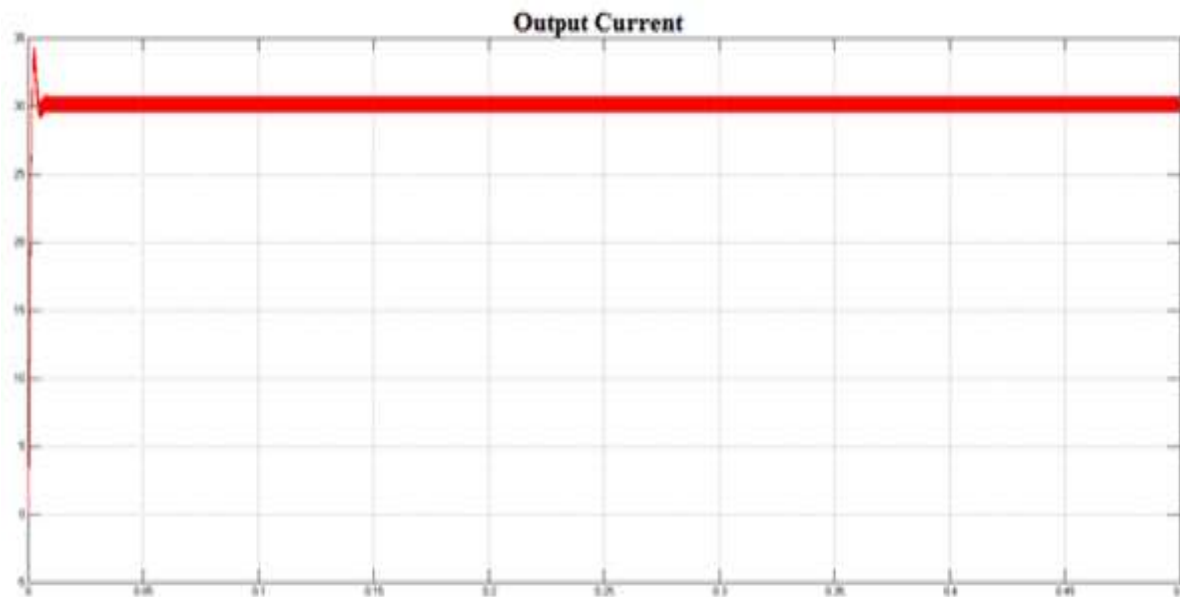The output Current for 79 volt input voltage

Figure 12.Current vs Time
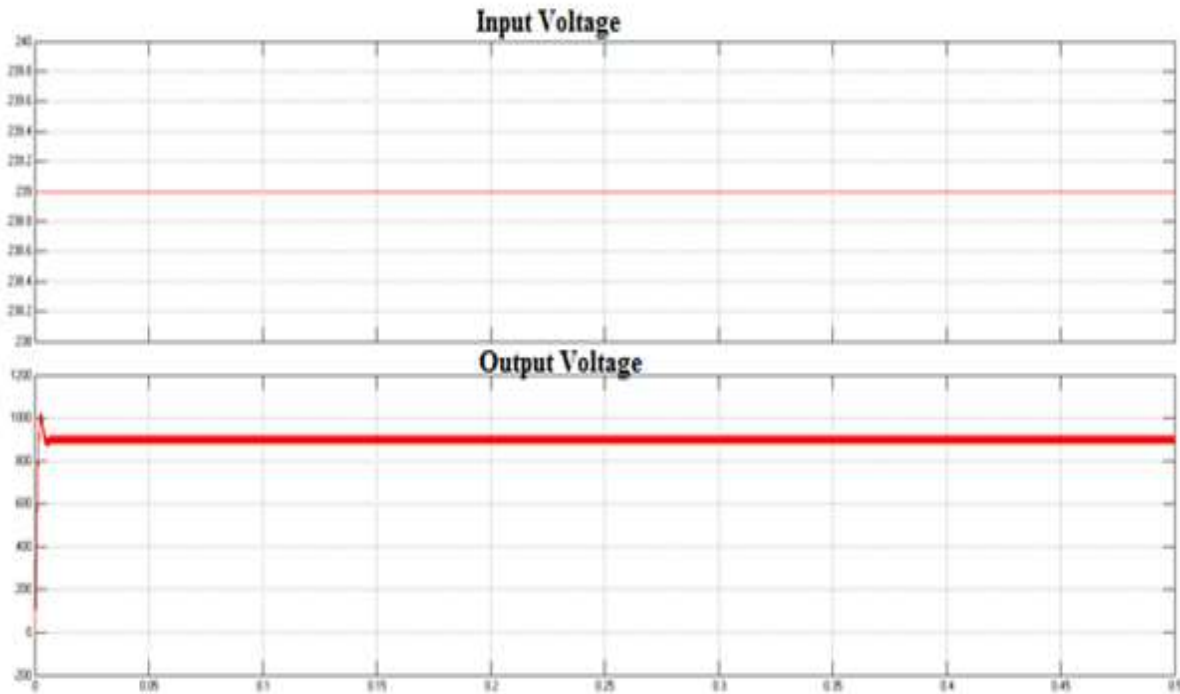
The output voltage for 160 volt input voltage

Figure 13.Voltage vs Time
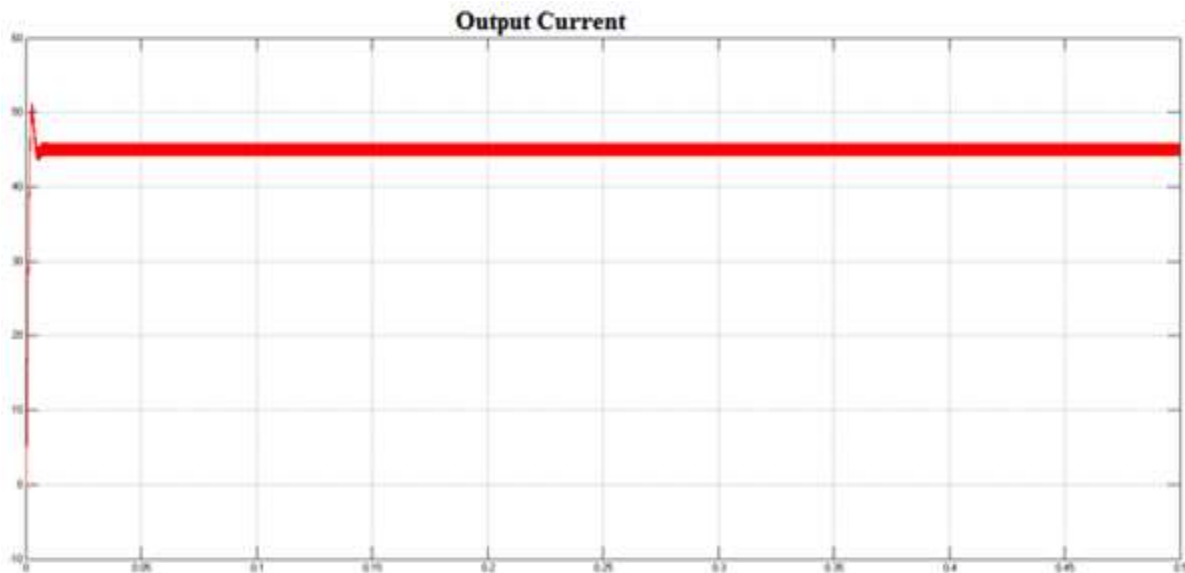
The output Current for 160 volt input voltage

Figure 14.Voltage vs Time

The output voltage for 239 volt input voltage

Figure 15.Voltage vs Time

The output Current for 239 volt input voltage

Figure 16.Voltage vs Time

Table 4. Output of the Boost Convertor

S.no	Load(Ohms)	Input Voltage(V)	Output Current(A)	Output Voltage(V)	Power Output(W)
1	20	79	15	300	4500
2	20	160	20	500	10000
3	20	239	45	900	40500

Battery used

The ouput DC power coltage generated is to be stored in the battery which can be used for the future purpose./The details of battery used is as follows.The battery used here is two 12 volt lead acid AGM UPS battery Deep cycle Solar 500AH .Battery connected in parallel to get a total capacity of 12 KW.This battery is connected at the load end of boost convertor which will be charged when the boost converter is operated.The figure of the battery is shown below

Figure 17. 12 volt lead acid AGM UPS battery

Table 5. Specification of the Battery

S.no	Description	Specfication
1	Voltage in	12V
2	Full Capacity	500AH
3	Size	513*250*210*240 MM
4	Weight	58 KG
5	Temperature	-35'C to 55'C
6	Battery Material	Lead acid
7	Total Powering Capacity	6 KW

CONCLUSION

The current rate of consumption of power needs an alternate mode of power generation to fulfill our requirements. This new power generation method uses potential energy of automobiles and generates electricity without consumption of any fossil fuels. Future work includes an experimental analysis of the same

ACKNOWLEDGEMENTS

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