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Implementation of Regenerative System for Electric Vehicle By Using BLDC motor

[1]Mr. Divyesh Rana, [2]Prof. Mitul G Patel

[1]P.G Scholar, Electrical Department, LDCE, Ahmedabad, Gujarat, India

[2]Assistant Professor, Electrical Department, LDCE, Ahmedabad, Gujarat, India

Abstract With an emphasis on a cleaner environment and efficient operation, Electric vehicles are now widely used. However, the electric vehicle suffers from a relatively Short driving Range and long charging times. Regenerative System is an effective approach for electric vehicles to extend their driving range. Every time we step on our electric vehicle's brake to slow down or stop the vehicle, we are wasting energy. So when the electric vehicle slows down, the kinetic energy that was propelling it in a forward direction has to go somewhere. Most of it simply gets released in the form of heat and becomes useless. That energy that could have been used to do work, is essentially wasted. So by using Regenerative System, we can recollect energy during the coasting and braking period. In this regenerative system, the Kinetic energy of the front wheel is utilized and the Regenerative mechanism is implemented. The regenerative system not only results in recovery of the energy but, also increases the efficiency of our electric vehicle and we can also charge the battery of the electric vehicle. Hence Regenerative system helps to increase the driving range.

Keywords-Regenerative System, BLDC , Electric vehicle etc

I. INTRODUCTION

Storage device have long been common in power system, their use in continuity device and more generally their applications in residential or similar appliances . Start…. stop... start... stop... start. If you make a habit of driving in city traffic, you'll know it can be a huge waste of time. What's less obvious is that it's also a waste of energy. Advances in battery technology and significant improvements in electrical motor efficiency have made electric vehicles and attractive alternative, especially for short distance commuting .

An attempt to increase the battery efficiency by restoring energy back into the battery, which is not possible to do in the ICEs . As now days the all vehicles run on fossil fuels that made pollution that is harmful.

Every time we step into automobile's brake, we are wasting energy . So the regenerative braking system has used for generate the power that back to battery if we press brake then energy has lost in the form of heat so in regenerative system. Kinetic energy stored in moving parts can be directly used during braking for supplying power to the other drives of same plant, whereas the excess energy .

Regenerative breaking works on principle of energy conversation law. Energy conversation law states that "energy neither can be created nor be destroyed, but it can be converted from one form to another form." Now a days, every person use vehicles which required fossil fuel like petrol, diesel, CNG, LPG etc. So they pollute our environment (like air pollution, noise pollution etc.) and increase global warming effect.

To reduce pollution and global warming effect we can use EV (Electric Vehicles). As the global economy strives towards clean energy in the face of climate change, the automotive industry is researching into improving the efficiency of automobiles. Electric Vehicles (EV) are an answer to the crisis the world is about to face in the near future. But the question that is being constantly asked is, how can the driving range of electric vehicles be increased? The answer to this question lies in the success of the research for an efficient and power. Packed energy source like a magic battery or success with fuel cells, efficient regenerative braking systems etc. In conventional braking system, kinetic and potential energy of a vehicle is converted into thermal energy (heat) through the action of friction.

Studies show that in urban driving about one-third to one-half of the energy required for operation of a vehicle is consumed in braking. With regenerative braking, this kinetic energy can be converted back into electrical energy that can be stored in batteries for reuse to propel the vehicle during the driving cycle. Therefore, regenerative braking has the potential to conserve energy which will improve fuel economy while reducing emissions that contribute to air pollution. Now discuss some limitations of Regenerative system.

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A regenerative brake is an energy recovery mechanism which slows a vehicle or object by converting its kinetic energy into a form which can be either used immediately or stored until needed.
Regenerative braking is an effective approach to extend the driving range of EV and can save from 8% to as much as 25% of the total energy used by the vehicle, depending on the driving cycle and how it was driven .

Generally, the regenerative braking torque cannot be made large enough to provide all the required braking torque of the vehicle. In addition, the regenerative braking system may not be used under many conditions, such as with a high state of charge.
State of Charge (SOC) or a high temperature of the battery. In these cases, the conventional hydraulic braking system works to cover the required total braking torque.

Thus, cooperation between the hydraulic braking system and the regenerative braking system is a main part of the design of the EV braking control strategy and is known as torque blending. This torque blending strategy helps to avoid the drive line disturbance.

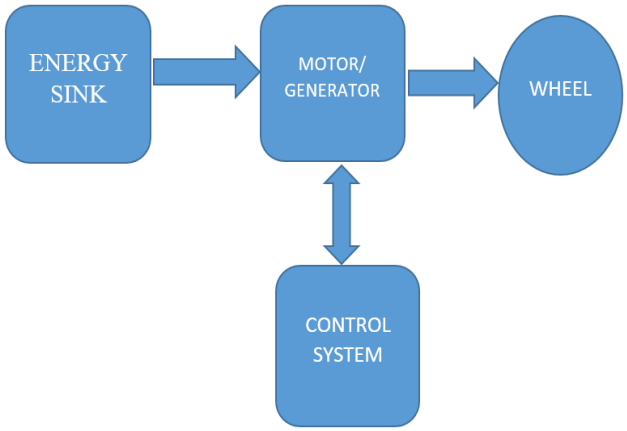

Figure-1.1 Working of Regenerative System in Drive Mode

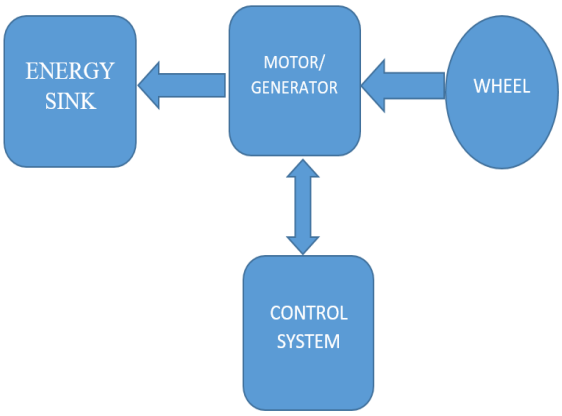

Figure-1.2 Working of Regenerative System in Braking Mode

Problem Identification :

Electric vehicle suffers from a relatively Short driving Range

Frequent Battery charging and long charging time are also major drawback of electric vehicle .

Regenerative System is an effective approach for electric vehicles to extend their driving range.

The regenerative system not only results in recovery of the energy but, also increases the efficiency of our electric vehicle and we can also charge the battery of the electric vehicle

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Problem Formulation :

The effect of regenerative braking decrease with the speed of electric vehicle.

At low speed, friction brakes are required to bring most vehicles to a complete stop. That means there is still energy being lost. Hence, at low speed regenerative brake cannot recover energy.

Regenerative Braking systems feel different to drivers who are used to traditional systems. The brake pedal on the vehicle often feels soft.

Until driver get used to the regenerative braking, he may have a lack of confidence in the capabilities of their brakes.

Lesser driving range can be increased by Regenerative braking system.

II. PROPOSED WORK

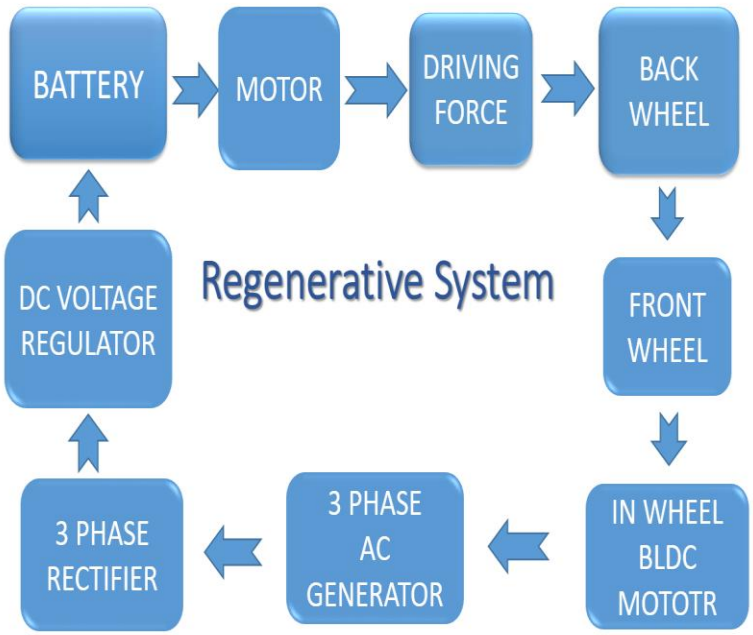
When we give dc supply to the motor of the Electric Vehicle by using battery, the front wheel of the motor will rotate along with the back wheel

In front wheel, BLDC motor is fitted by some modification in yo bike. So the front wheel BLDC motor will work as generator and it will give variable 3 phase a.c voltage.

Hence by using 3 phase rectifier, variable a.c. voltage is converted to variable dc voltage.
Now to charge the battery of electric vehicle, we need constant voltage.

So by using boost converter variable output of rectifier is stepped up and regulated to Constant voltage to charge the battery of Vehicle.

To overcome the problem of reverse current when voltage generated is less than the battery voltage, one diode needs to placed between the boost converter and Battery.



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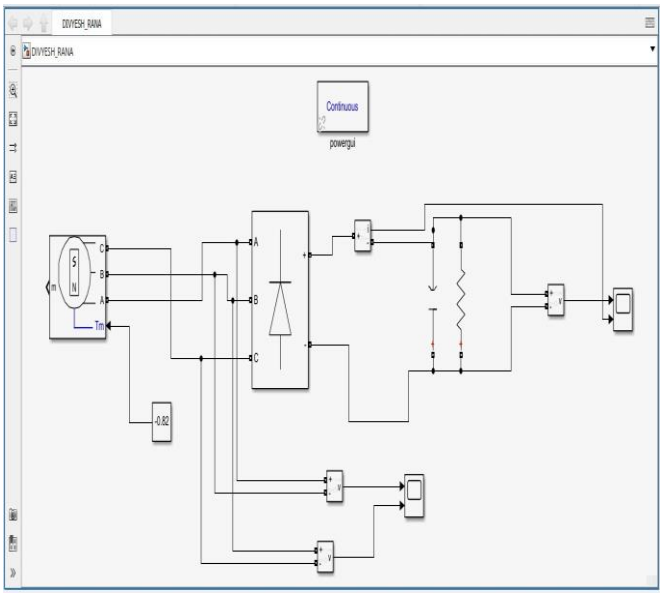
III. SIMULATION AND RESULTS

Simulation and results without boost converter



SIMULATION RESULTS WITHOUT BOOST CONVERTER

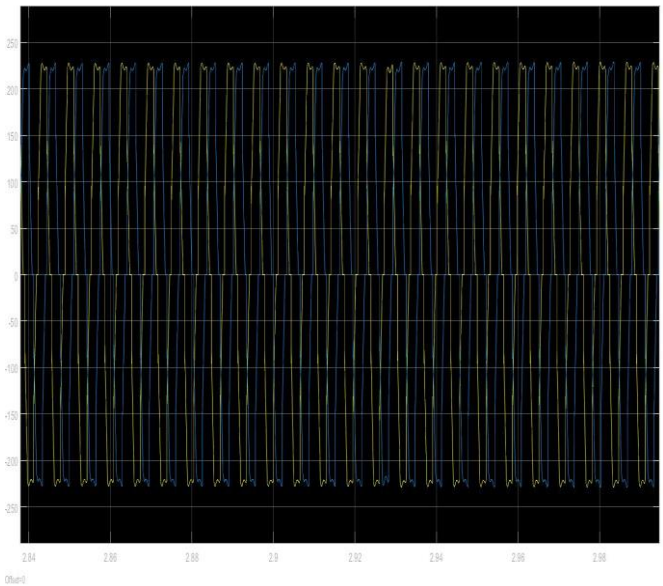


Fig Line to line voltage.

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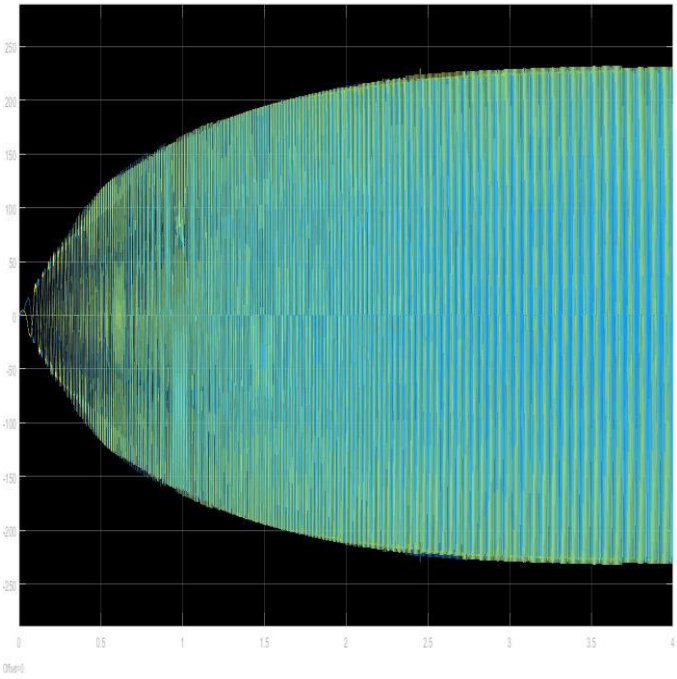

Figure 5.3 Current Measurement

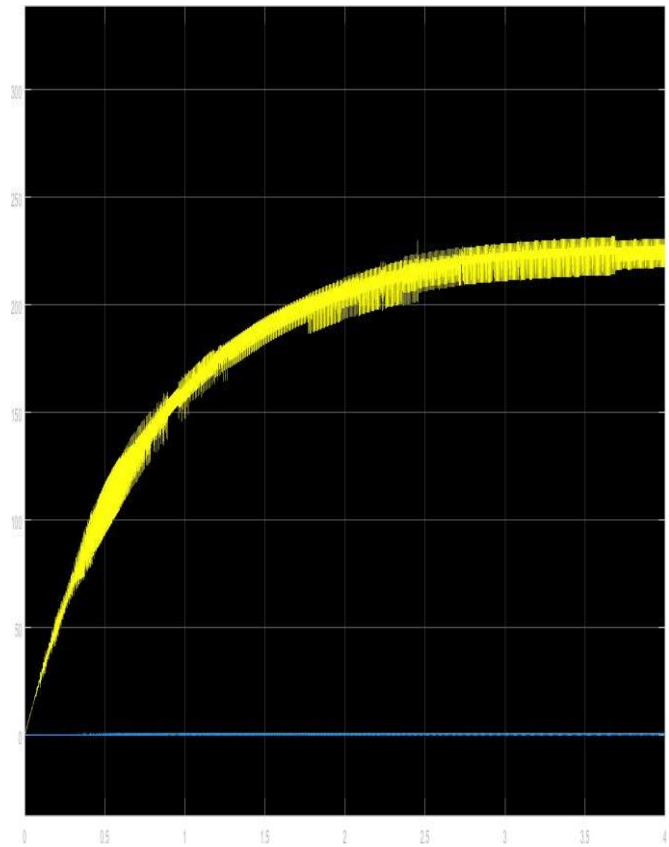

Figure 5.4 Dc output voltage of Rectifier

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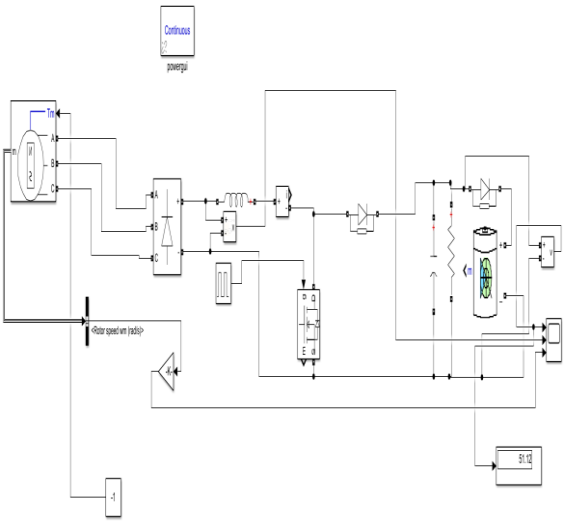
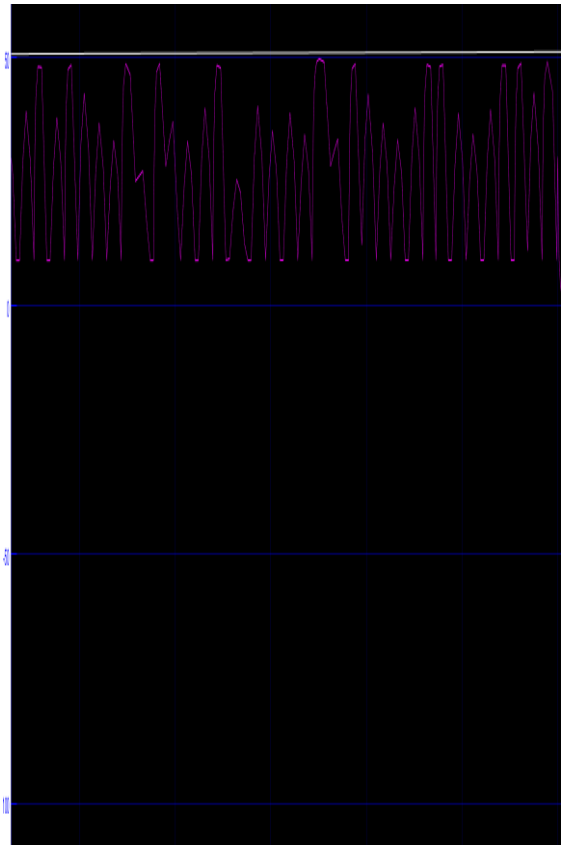
Simulation and results with boost converter





In the above simulation results, variable output voltage of rectifier and constant output voltage of boost converter is studied.

By using Boost Converter, Variable DC voltage is maintained Constant to 51.12v for charging purpose of 48 voltage EV' s battery. And we can easily charge the battery by 51.12 voltage.

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IV EXPERIMENTAL SETUP AND OBSERVATION

Experimental Setup using multimeter

In the laboratory, experimental setup has been done as shown in figure. Bldc motor is rotated by using drill machine and pully type arrangement has been done to measure output voltage of the motor. So by using such type of arrangements analysis of output voltage has been done. But we cannot observe the output of voltage with respect to speed. So another experiment set up has been carried out by using tachometer.

Experimental Setup using Multimeter and Tachometer

To measure speed of motor in terms of rmp to analysis output voltage i.e. at how much speed we get how much output, observation has been done by using multimeter and tachometer. The final conclusion of the observation has been carried out and that is we get around 5 voltage at 86 rpm. So based on this observation various calculation for different speed is carried out . As the vehicle speed is in km/h we need to convert rpm to km/h. So here 86 rpm is converted into km/h and further calculation has been carried out. As the output voltage of BLDC motor is directly proportional to speed we can analysis output voltage at various speed by using this observation.

Outcome of observation

AT 86 RPM , WE GET AVERAGE 5 V OUTPUT.

CALCULATION FOR ANALYSIS OF VOLTAGE

❖ Linear Velocity in m/s $v = r \times w = r \times (2\pi/60) \times N$

Here w is Speed in rps

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❖ Velocity in km/ hr V = v ×3600/1000

V=r ×(2π/60)×N×3600/1000

❖ V= (3π/25)×r × N ;

Here r is radius in m , N is Speed in rpm, V is Velocity in km/ hr

❖ In our case speed is 86 rpm and radius of rim is 0.21m

❖ Hence Velocity V in km/ hr= 3π/25 ×0.21×86 = 6.808 km/ hr

So for 6.808 km/ hr i.e. 86 rpm we get 5v output

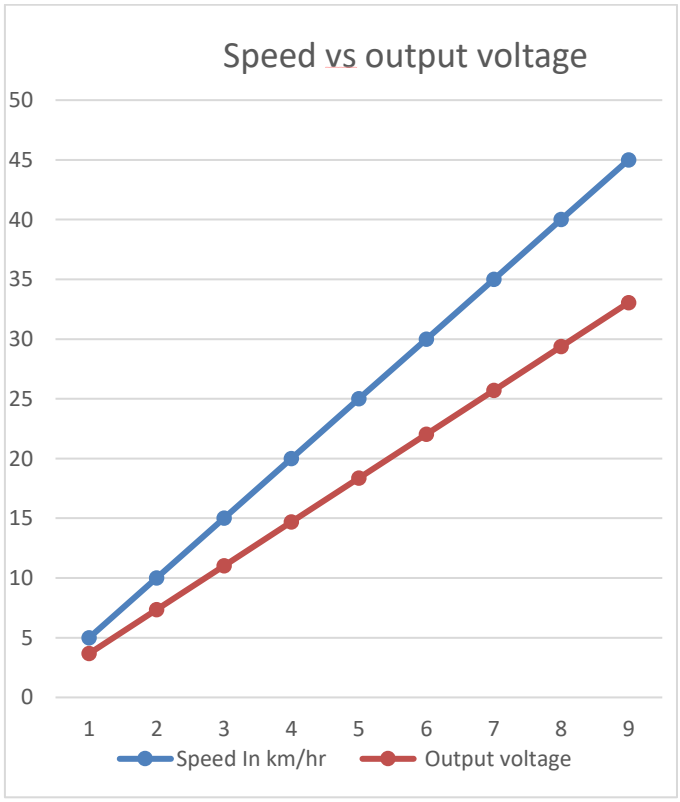
❖ E is directly proportional to speed.

❖ Hence for various speed of yo bike we can calculate Output voltage

So after This experimental set up, conversion of rpm to km/h and calculation, we can able to analysis at how much voltage will generate at vehicle speed in km/h. So to conclude this whole analysis, I prepared one graph that will show the analysis of output voltage.

V ANALYSIS OF OUTPUT VOLTAGE

Speed In km/hr	Output voltage	speed in rpm
5	3.67215	63
10	7.344301	126
15	11.01645	190
20	14.6886	253
25	18.36075	316
30	22.0329	380
35	25.70505	442
40	29.3772	506
45	33.04935	569



Hardware Configuration

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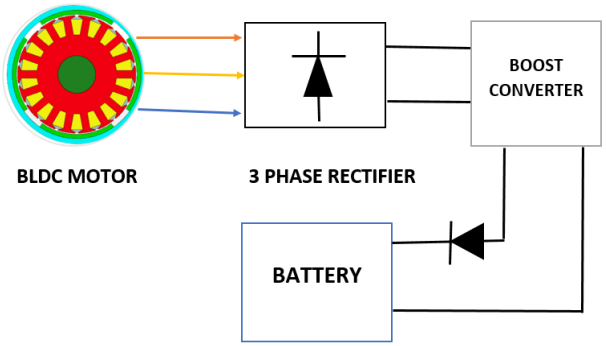

Specifications of Components used

Apparatus	Ratings
Front wheel BLDC motor	750 W
Uncontrolled Rectifier Three Diodes	1N4004
Dc to Dc Boost step up Converter • Input Voltage Range • Output Voltage Range	1200 W and 20 A 8 – 60V 12 – 83V
Diode used for Reverse blocking	6A10 MIC
Battery Used	48 V 30 Ah

VI. FINAL RESULTS OF WORKING MODEL

Working Model :

Trial of Working Model :

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Final Result of Trial

Results and Outcome of Trial :

When the speed of vehicle exceeds 13 Km/h, we got 53.3 constant Voltage. And we can Charge 48 Volt battery of Electric Vehicle.

FINAL CONCLUSION

When speed of Electric Vehicle exceeds 13 km/h, we obtain 53 Constant DC voltage and diode between battery of Yo bike and boost converter Conduct in forward bias and Charging system activate. Hence by using this regenerative system we can charge the battery of Electric vehicle when vehicle speed exceeds 13 km/h.

FUTURE SCOPE

By using More Efficient BLDC motor, We can operate charging System below 13 km/h speed, and we can charge Electric Vehicle Energy even at low speed and More driving Range can be increased.

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