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IOT BASED SMART ELECTRIC VEHICLE SYTEM

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Abstract: The transportation sector accounts for large and growing share of global green house gas emissions. Worldwide motor vehicle emits 900 million metric tons of carbon-dioxide each year. In response to the significance growth in smart city mission in the field of transport management this project highly contributes towards the successful and remarkable vehicle design. Our proposed project is a well defined Internet of Things (IOT) based electric vehicles for wide area unified operation and monitoring management. The Internet of Things platform monitors the overall working of the E-Vehicle and our aim's is to develop a smart battery operating system averting the incident and reacting to the incident with the focus on integrating technology into the system. Our battery operated electric vehicles will be an efficient alternative on the market available today to vehicles with internal combustion engine. Our design of cloud interfaced e-vehicle will be a key technology in reducing future emissions and energy consumption in mobility sector.

Keywords—electric vehicle;connected vehicle;BLDC motor control

I. INTRODUCTION

Electric Vehicles provide more than just individual benefits. It also provides benefit to the environment. EVs are very responsive and have very good torque. It reduces harmful exhaust emissions which is good news for our health. EVs are also quieter than petrol/diesel vehicles, which mean less noise pollution. The significant difference between electric vehicles and gasoline-powered vehicles is the number of moving parts. The electric vehicle has one moving part, the motor, whereas the gasoline-powered vehicle has hundreds of moving parts. Fewer moving parts in the electric vehicle lead to another important difference. [1] The electric vehicle requires less periodic maintenance and is more reliable. The gasoline-powered vehicle requires a wide range of maintenance, from frequent oil changes, filter replacements, periodic tune ups, and exhaust system repairs, to the less frequent component replacement, such as the water pump, fuel pump, alternator, etc. The running cost of the vehicle is also very low compared to traditional gasoline vehicles.

The electric vehicle has higher advantages then the petrol and other fossil fuel vehicles. They are eco-friendly, provide less smoke emission. Researchers and scientists say that they will be an end of non-renewable resources in other 40 years.[1] So, the world is moving on to the renewable resources and there is huge development in the energy and their conservation. Every country appreciates the use of eco-friendly and smokeless vehicle emission. Due to pollution everywhere, there is risk for human beings and they support them. [2]

The electric motor can be DC motor, AC motor, and reluctance motor are usually used in the electric vehicle. These vehicles comprise of electric motor, controller, driver system and other sensors for monitoring. Here we are using Brushless Dc motor **(BLDC)**. These are having many advantages over other motors which has higher efficiency, lasts longer due to less physical contact and less wear and tear, reliable, rotate at high RPM in loaded and unloaded condition. They are also less in weight and small which can fit easily into the vehicle design. [1] According to recent trends there is huge development in the communication by Internet. People move towards recent trends. One of the recent trends would be Internet of things **(IOT)**.

The ease of monitoring through internet and controlling over them which can be done in any part of the world. Each and every device is connected through the internet through the Wi-Fi modules are the 4G/3G GSM and establish the connection through them. Every device which is connected to the internet can be identified uniquely using IP of devices and uses IPV6 version.[4] The major advantages of this technology are providing people with better quality of life and provides, efficient and saves money because of accurate results in real time and optimal utilization of energy and resources, also surveillance of the devices.

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II. COMPARISON BETWEEN ELECTRIC AND GASOLINE VEHICLES

TABLE 1

PARAMETERS	FUEL CARS	HYBRID CARS	ELECTRIC CARS
FUEL AVAILABILTY	LOW	LOW	HIGH
ECO-FRIENDLY	NO	MODERATE	YES
EMMISSION	HIGH	MODERATE	NO
COST	LESS	HIGH	HIGH
SIZE	LARGE	MEDIUM	SMALL
TORQUE	LESS	MODERATE	HIGH
SPEED	HIGH	HIGH	MODERATE
MAINTENANCE	HIGH	MODERATE	LOW
DISTANCE	HIGH	MODERATE	LOW

III.PROPOSED METHOD

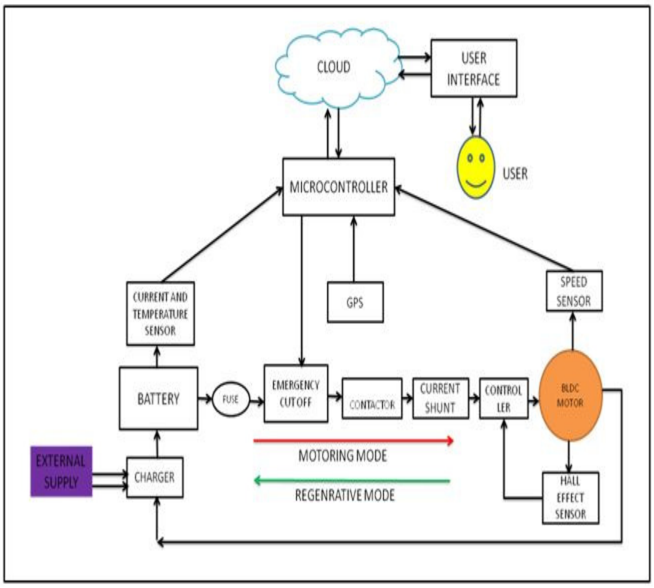

Fig.1 Block Diagram of Cloud connected Electric Vehicle

A. BLDC Motor
It is used to convert electrical energy to mechanical energy. It can be used in any type of weather condition and it does not produce any noise pollution because of absence of brushes and commentator's.[1]

B. Hall Effect sensor
It is used to determine the rotor position of the motor which helps the controller to make decision which phase needs to be excited next.[2]

C. Motor Controller
It processes the data from Hall Effect sensor and produces the required gate pulse for the controls of motor direction of rotation and speed.

D.Microcontroller
It is the control and processes the various data from the sensor and sends it to the cloud for user monitoring and control.

E. Current Shunt
It is used to determine the amount of current flowing in the circuit.

F. Voltage sensor
It is used to measure the amount of voltage left over in the battery. This will make the user informed about the battery voltage level. And make the user aware of the range of the vehicle.

G. Temperature Sensor
It measures the temperature of the battery and motor makes the user aware of the battery temperature and shut down the controller if the battery or motor temperature goes beyond the critical value.

IV.FOUR QUADRANT OPERATION

Here the 1st Quadrant shows the motor is on the forward motoring mode which means that torque and speed are Positive. Conversely, 3rd Quadrant is on reverse motoring mode that means torque and speeds are in negative. For 1 st and 3rd Quadrant the input voltage is greater than the Back EMF voltage.

2nd Quadrant is on forward braking mode, in this mode the motor speed up in clockwise direction in order to achieve the braking the torque is applied in counter clock wise direction and Finally the 4th Quadrant I is entirely different because the motor speed up in counter clockwise direction

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and the brake applied in the form of torque in clockwise direction. For the 2nd and 4th Quadrant the Back EMF voltage is greater than the supply voltage. [4]

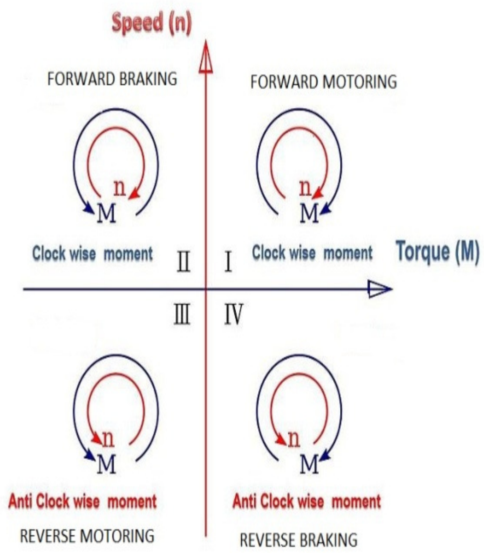

Fig.2Four Quadrant Operation of Motor

In this controller we have used the 1st and 4rd quadrant is to achieve the motoring and regenerative braking capability

V. CONTROLLER WORKING

The regulation of speed is accomplished with PI Controller. By increasing the proportional gain of the speed controller, the controller's sensitivity is increased to have faster reaction for small speed regulation errors. An increase of the integral gain will allow the motor speed to catch up with the speed reference ramp a lot faster during sampling periods. The PI controller is used to get the error from the reference speed and motor speed. [1] With respect to the error value we get the output voltage. Voltage is directly proportional to the speed that means voltage increases speed increases. From the of Hall Effect sensor we can achieve the position of rotor, whenever the rotor magnetic poles pass near the Hall Sensors they give a low or high signal, indicating either N or S is passing near the sensors.

From the output of individual phase winding should be energized, so that voltage source inverter send the signals to motor winding in order to achieve the continues rotation of BLDC motor to achieve desired speed. Current limiter is used to limit the current.

Inputs from hall sensors			Outputs to inverter					
C	B	A	S1	S2	S3	S4	S5	S6
1	0	1	1	0	0	1	0	0
0	0	1	1	0	0	0	0	1
0	1	1	0	0	1	0	0	1
0	1	0	0	1	1	0	0	0
1	1	0	0	1	0	0	1	0
1	0	0	0	0	0	1	1	0
X	X	X	0	0	0	0	0	0

Fig.3 Emf to Gate pulse decoder

The control techniques of BLDC motor make use of Six MOSFET switches and the motor is connected in delta. The six switches on and off according to the signal from hall sensor.[1]

The current in the circuit is measured using the current shunt which is connected in series with the circuit. Emergency cut off switch will automatically switch off the motor if the current in the circuit is increased beyond specified limit. When the ignition key switch is ON the contactor will close the contact and the supply to the motor is turned ON. The contactor will switch on and off the motor. This motorcycle can be wirelessly controlled and monitored from a server using the cloud connectivity.[3] By measuring the motorcycle parameters using electronic sensors and processing the data using the microcontroller and to the cloud. These values can be monitored and controlled using the web server. This improves the safety and smartness of the motorcycle.

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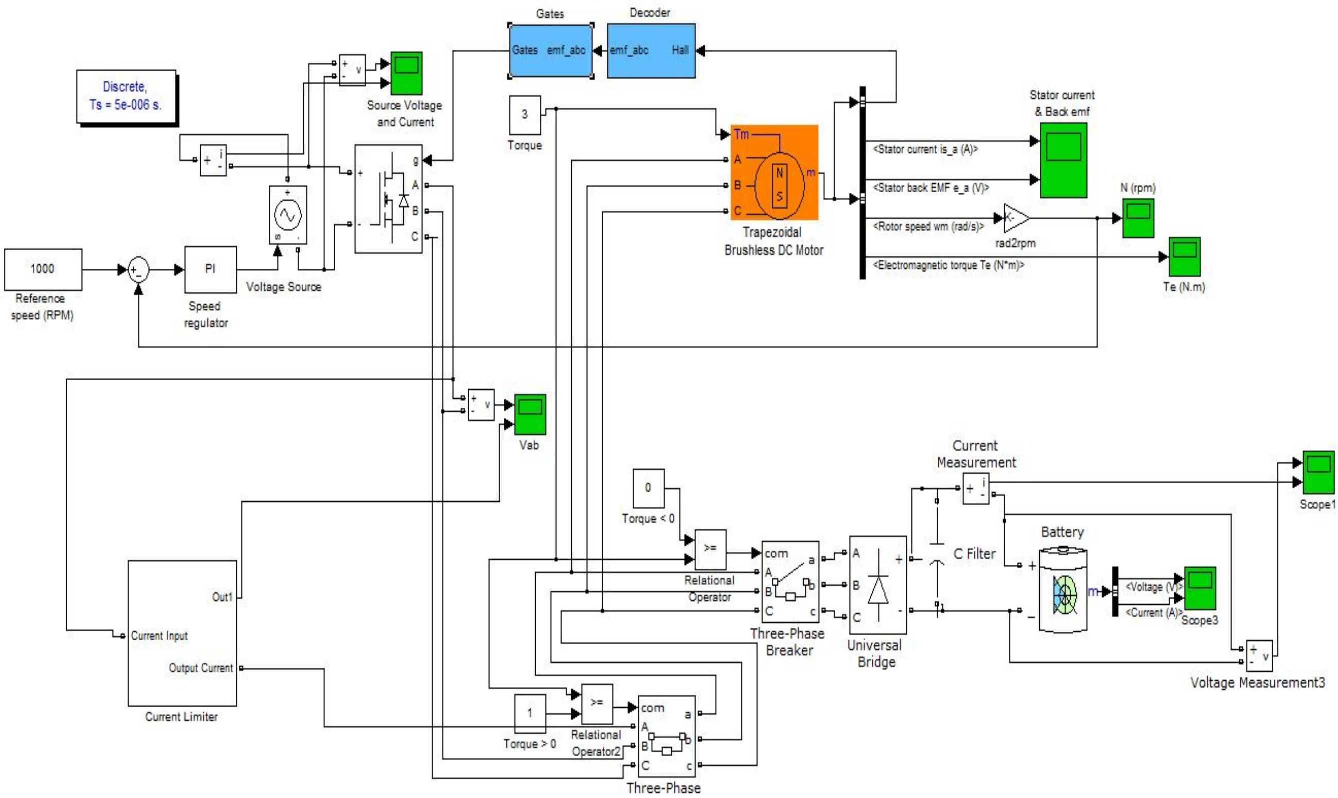

Fig.4 Simulink Model of BLDC motor Controller

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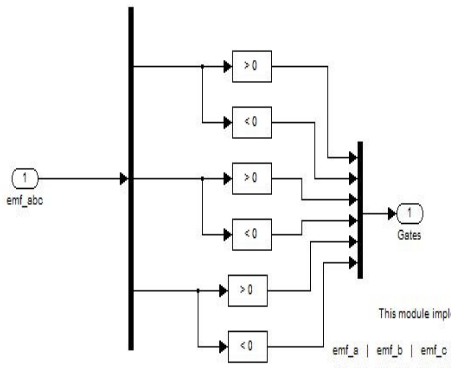

This module implements the following true table

emf_a	emf_b	emf_c	Q1	Q2	Q3	Q4	Q5	Q6
0	0	0	0	0	0	0	0	0
0	-1	+1	0	0	0	1	1	0
-1	+1	0	0	1	1	0	0	0
-1	0	+1	0	1	0	0	1	0
+1	0	-1	1	0	0	0	0	1
+1	-1	0	1	0	0	1	0	0
0	+1	-1	0	0	1	0	0	1
0	0	0	0	0	0	0	0	0

Fig.5 Simulink Model of Emf to Gate Decoder

IV. SIMULATION AND RESULTS

For the input voltage of 150v the stator voltage and the current waveform is given in Fig 5. For this input voltage the motor rotates at 1000 Rpm Fig.6 which can be seen using the Simulink Scope.

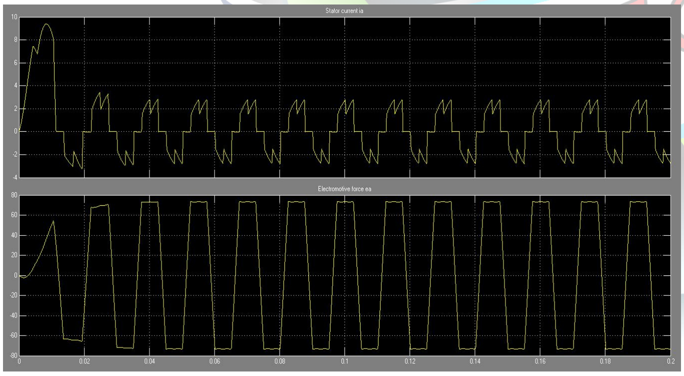

Fig.6 Output of Simulink model—Stator current (A), Stator back Emf (V).

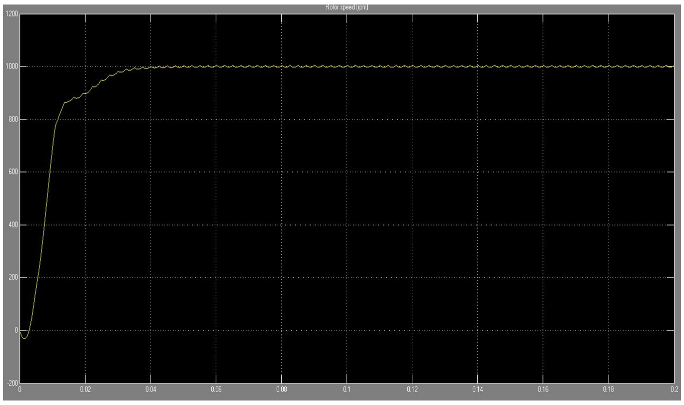

Fig.7 Output of Simulink model— Rotor Speed(N)

V. FUTURE SCOPE

The concept of electric vehicles, which run on large rechargeable batteries as opposed to gas-powered internal combustion engines, has been around for decades. But rising climate-change fears, tougher fuel-efficiency standards, billions in government subsidies, and rivers of venture capital appear to be creating a tipping point that could move electric cars from the transportation fringes into the mainstream. Yet there are considerable obstacles—starting with the price. Even if the oil price is lowered, the future for electric vehicles is bright. Electric vehicle (EV) sales grew 60 percent worldwide last year.

VI. CONCLUSION

A high performance BLDC motor controller with Regenerative braking capability is very useful in today's trend of electric vehicle. Because the electrical braking mechanism help to convert the kinetic energy exerted during braking into electrical energy this energy is used to recharge the battery. Hence this will improve the overall range of the vehicle. Along with this the cloud based intelligent monitoring system gets the data from the battery and motor and it helps the user to stay connected with the vehicle. The GPS help to locate the vehicle remotely by the user. Thus this model has very efficient and has high performance than a conventional gasoline vehicle.

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