VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELGAUM

PROJECT REPORT

on

"IoT Based Smart Solutions For EV"

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1.INTRODUCTION

1.1 Shifting Gears To Electric Vehicles

Increase in the greenhouse gas (GHG) emissions has created a shift in vehicles from a conventional internal combustion engine (ICE) to an electric motor powered by a battery. The Automobile Industry is undergoing a radical transformation; with most agreeing that the next 10 years will bring more change than the previous decade. Two of the most prominent things in future would be the Internet of Things and Electric vehicles.

An electric vehicle thus derives some or all of its power from electricity. Electric vehicles (EVs) are easy to operate, quite energy efficient, and also cost-effective than their gasoline or LPG-powered counterparts. EVs have been around since very long, and the first small electric car model was built by Professor Stratingh in Groningen during the year 1835, but the lack of batteries during that period prevented it's up scaling. In recent years with renewable sources gaining rapid popularity, there has been a revival of such clean modes of transport. As the recent trend suggests, this kind of transportation is going to substitute internal combustion engine (ICE) vehicles in the future scenario.

Electric vehicles, consisting of hybrid electric vehicle (HEV), fuel cell electric vehicle (FCEV), and battery electric vehicle (BEV), are day by day becoming more common in the automobile companies and automotive sectors. The technologies present in EVs are getting prominent and attractive, for the industry as well as for the customers. EVs are making significant impact on the power system and environment with lesser number of sensors, miniaturized components, and reduction of green house gases.

This implies a significant change in technical, digital and social dimensions of the transport and energy infrastructure. With EVs being the future, low cost maintenance and effective monitoring of these systems will become one of the major challenges for this growing technology.

Table 1.1 Comparisons of Conventional and Electric Vehicles

Conventional vehicles	Electric vehicles
Runs on nonrenewable sources	Runs on renewable sources
No tailpipe emission	Greenhouse gases emission
Requires more maintenance	Requires less maintenance
Produces noise	Does not produce noise
Costly refueling	Cheaper refueling
At present range is around 400 miles	Range varies between 60 and 200 in a single charge

1.2 Types Of Electric Vehicles (EV)

An EV can be broadly categorized into two types: Battery electric vehicle (BEV) one that runs solely on electricity and the hybrid electric vehicle (HEV) that combines the electric energy with any other source as shown in Fig1.1

Hybrid electric vehicles (HEVs) have an inherent advantage and it can stretch the fuel economy further by combining the best of both battery and an engine. Thus while in a populated/urban area the vehicle could be operated on battery and then could switch to the engine when outside the city. Hybrids can further be subdivided into plug-in hybrid electric vehicle (PHEV) and fuel cell electric vehicle (FCEV)

EVs could, therefore, be categorized into:

1. Battery electric vehicles (BEVs),
2. Hybrid electric vehicles (HEVs),
3. Plug-in hybrid electric vehicles (PHEVs), and
4. Fuel cell electric vehicles (FCEVs).

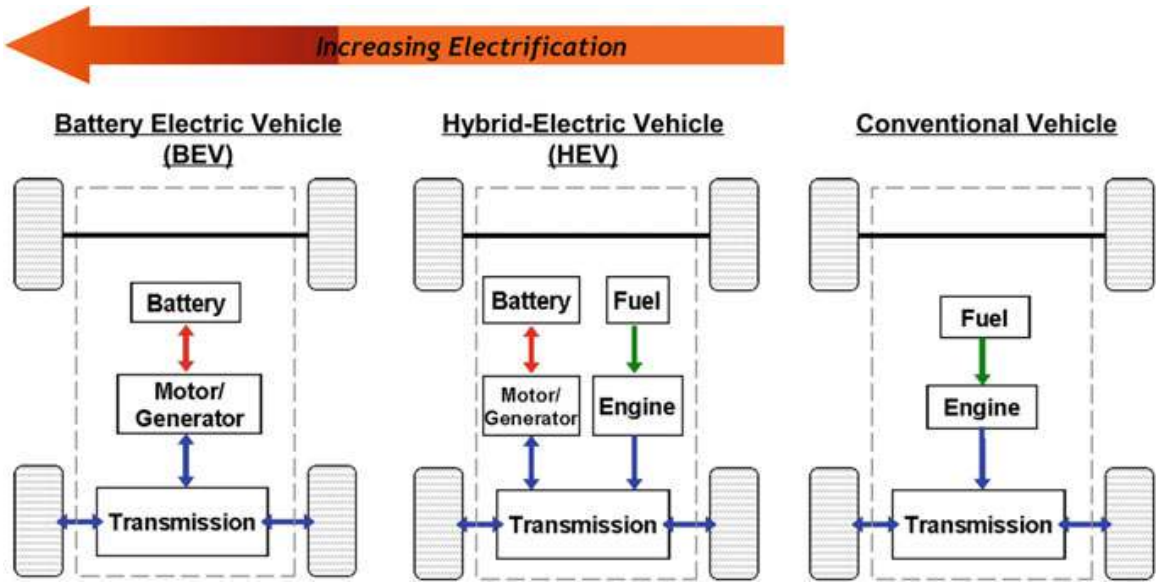


Fig 1.1 Basic Working of Different Types of Vehicles

1.2.1 Battery Electric Vehicle (BEV)

Battery Electric Vehicles, also called BEVs, and more frequently called EVs, are fully electric vehicles with rechargeable batteries and no gasoline engine. Battery electric vehicles store electricity onboard with high-capacity battery packs. Their battery power is used to run the electric motor and all on board electronics. BEVs do not emit any harmful emissions and hazards caused by traditional gasoline-powered vehicles. BEVs are charged by electricity from an external source. Electric Vehicle (EV) chargers are classified according to the speed with which they recharge an EVs battery.

The classifications are Level 1, Level 2, and Level 3 or DC fast charging. Level 1 EV charging uses a standard household (120v) outlet to plug into the electric vehicle and takes over 8 hours to charge an EV for approximately 75-80 miles. Level one charging is typically done at home or at your workplace. Level 1 chargers have the capability to charge most EVs on the market.

Level 2 charging requires a specialized station which provides power at 240v. Level 2 chargers are typically found at workplaces and public charging stations and will take about 4 hours to charge a battery to 75-80 miles of range.

Level 3 charging, DC fast charging, or simply fast charging is currently the fastest charging solution in the EV market. DC fast chargers are found at dedicated EV charging stations and charge a battery up to 90 miles range in approximately 30 minutes.

BEV Examples that can charge on DC Level 3 Fast Chargers:

- Tesla Model 3
- BMW i3
- Chevy Bolt
- Chevy Spark
- Nissan LEAF
- Ford Focus Electric
- Hyundai Ioniq
- Karma Revera
- Kia Soul
- Mitsubishi i-MiEV
- Tesla Model S
- Tesla X
- Toyota Rav4
- Volkswagen e-Golf

1.2.2 Plug-in Hybrid Electric Vehicle (PHEV)

Plug-in Hybrid Electric Vehicles or PHEVs can recharge the battery through both regenerative braking and "plugging in" to an external source of electrical power. While "standard" hybrids can (at low speed) go about 1-2 miles before the gasoline engine turns on, PHEV models can go anywhere from 10-40 miles before their gas engines provide assistance.

PHEV Examples:

- Chrysler Pacifica
- Ford C-Max Energi
- Chevy Volt
- Ford Fusion Energi
- Mercedes C350e
- Mercedes S550e
- Mercedes GLE550e
- Mini Cooper SE Countryman
- Audi A3 E-Tron
- BMW 330e
- BMW i8
- BMW X5 xdrive40e
- Fiat 500e
- Hyundai Sonata
- Kia Optima
- Porsche cayenne S E-Hybrid
- Porsche Panamera S E-Hybrid
- Toyota Prius
- Volvo XC90 T8

1.1.3 Hybrid Electric Vehicle (HEV)

HEVs are powered by both gasoline and electricity. The electric energy is generated by the car's own braking system to recharge the battery. This is called 'regenerative braking', a process where the electric motor helps to slow the vehicle and uses some of the energy normally converted to heat by the brakes.

HEVs start off using the electric motor, then the gasoline engine cuts in as load or speed rises. The two motors are controlled by an internal computer, which ensures the best economy for the driving conditions.

HEV Examples:

- Toyota Prius Hybrid
- Honda Civic Hybrid
- Toyota Camry Hybrid

1.1.4 Fuel Cell Electric Vehicle (FCEV)

A fuel cell has properties of both a battery and an ICE; it generates electricity from an electrochemical reaction like a battery and it can run indefinitely if it is supplied with a source fuel (hydrogen) similar to an ICE (Matthey 2013). The automotive industry uses proton exchange membrane fuel cell (PEMFC) as its fuel type.

FCEVs only produce water as a by-product which is ejected out of the tailpipes. Underdeveloped refueling infrastructure and lack of a cheap and sustainable method to produce hydrogen make fuel cell costly. Hydrogen also ignites faster than petrol and its flames are very hard to recognize. Nevertheless, researchers are addressing these issues and maybe in near future, they are eradicated.

Table 1.2 Comparing Various Characteristics of Electric Vehicles

EV type	Driving component	Energy source and infrastructure	Key features	Drawbacks
BEV	Electric motor	Battery and ultracapacitor	• Zero emissions • Short range • Crude oil independent • Commercially available	• Range • Battery capacity • Charging facilities
HEV	Electric motor and ICE	Battery, ultracapacitor, and ICE	• Very low emissions • Long driving range • Oil-dependent • Complex structure of drivetrains • Commercially available	• Management of energy sources • Battery sizing
FCEV	Electric motor	Fuel cell	• Ultra-low emission • High energy efficiency • Crude oil independent • Currently at a high cost • Independent to the supply of electricity • Under development	• The high cost of fuel cells • Feasible production of hydrogen • Lack of fueling systems

1.3 Drivers for growth of electric vehicles in India

Thirteen out of 20 cities in the world with highest air pollution are in India. It is envisaged that Low carbon scenario with 'highest' EV penetration shows 50 percent drop in PM 2.5 by 2035 (UNEP, DTU and IIM-A) . Master plans for most cities in India target 60-80 per cent public transport ridership by 2025-2030 (Center for Science and Environment).
With the Government of India targeting 100 GW of solar by 2022, electric vehicles can improve reliability and utilization of renewable by acting as storage.
However, there needs to be proper planning with reference to monitoring and control of charging infrastructure as unplanned increase in penetration of EVs in an area can lead to increase in peak load of already stressed distribution network.
Large scale penetration of EVs will require both demand side incentives (e.g., tax incentives) and improved charging infrastructures as well as integrated planning for distribution Grid management.
EVs offer the opportunity to act as a distributed storage in the urban energy system which could help in better integration of intermittent renewables like wind and solar and can feed the grid at peak timings if price incentives are designed in terms of dynamic tariff as part of Smart Grid implementation. (V2G)

1.4 Why electric vehicles are better than gas vehicles?

- **Electric vehicles are better for the air we breathe.**

Since electric vehicles have zero tailpipe emissions, we can look forward to cleaner air when there are more electric vehicles on the road. Cleaner air means less disease in the world, which means less stress on public health systems, hospitals, and so on.

- **Skip the gas station, you can 'fill-up' at home and work.**

With no gas to buy, or oil to change. To refuel, you simply plug in at home, at work or opportunity charge on the road. As an added bonus to EV charging, the power going into your batteries is increasingly produced by renewable sources. Non-renewable electricity charging your electric car is generated domestically.

- **Electric cars are the future of transportation**.

If you drive an electric car you're obviously planning for the future. In addition to being counted among the ranks of the "coolest people around", you'll be making a difference for the environment, and saving money.

- **EVs have to pass the same safety tests as gas-powered vehicles.**

EVs have to pass the same safety tests as gas-powered vehicles, so you can be assured that they are completely safe to operate. In fact many EVs score higher in crash test safety ratings, Tesla Model X for example has a perfect score. A widely-circulating concern about EV safety revolves around the potential for fire, but in reality, EVs are far less likely to catch fire than gas cars. On average, gas cars will catch fire at the approximate rate of 1 fire every 20 million miles driven. For EVs, the rate is 1 fire per 120 million miles driven. That's 80% less if you're taking notes.

2. REVIEWOFLITERATURE

2.1 Steps taken by Indian Government to promote EV

The Government started Faster Adoption and Manufacturing of Hybrid and Electric vehicles (FAME) scheme which provides incentives for purchasing electric vehicles. Government is releasing tenders to increase charging infrastructure in the country. Karnataka approved Electric Vehicle and Energy Storage Policy 2017.

The vehicle is covered under Government of India's FAME-India (Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles) scheme that offers incentives to the electric and hybrid vehicles ranging from Rs.1,800 to Rs.29,000 for scooters and motorcycles and Rs.1.38 Lac for cars. FAME is a part of National Electric Mobility Mission Plan by Government of India.

Recently, the Government released a two-pronged strategy aimed at both buyers and manufacturers, in which it offers $1.4 billion in subsidies to buyers while imposing a hike on import tariffs to increase manufacturing of these vehicles by domestic companies. The Government is mainly focusing to electrify public transportation as the subsidies, mainly available for two-wheelers, three-wheelers, and buses. This policy also earmarks $140 million to develop charging infrastructure which should further help the development of the EV industry in India. On 14 December 2018, the government also released a document which outlines the standard and guidelines for EV Charging infrastructure. Beyond the specifications of the charging infrastructure, the guidelines also required a charging station to be present every 25 km along a road/highway.

Some state governments like the Delhi government are playing a major role to increase the use of EV’s in India. The Delhi Government recently approved 1000 Electric buses to be used in Delhi’s public transport system. In 2018, the Uttrakhand Government introduced a new scheme to help the manufacturing and promote the use of EV’s as well. The scheme would provide companies with loans ranging between Rs 10 crore and Rs 50 crore to build EV's and charging infrastructure. The scheme also doesn't charge motor tax for first lakh customers of EV’s for five years. The Maharashtra Government is focusing on increasing EV use in the state by proposing to exempt EV’s from road tax and providing a 15% subsidy to the first lakh EV’s registered in the state. To improve suitable infrastructure, the government proposed to provide a maximum subsidy of Rs. 1 million (~$15,549) per charging station to the first 250 stations that are set up in Maharashtra.

Energy Efficiency Services Limited (EESL) is procuring 10,000 nos. of Electric Vehicles from reputed manufacturers for distribution to Government Departments on rental model and upfront sale model. EESL's tender of 10,000 nos. of EV's has reduced the cost of EV's substantially.

2.2 CASE STUDIES

2.2.1 EV revolution powered growth with the New Motion and Eseye

The New Motion offers advanced charging solutions for drivers of Electric Vehicles (EV) and is one of the largest and fastest growing EV charging networks in Europe.

- **IoT enabled data visualisation**

The company has an install base of over 14,000 intelligent charge points. Eseye's connectivity allows The New Motion's EV charge points to communicate with the back office, facilitating payments as well as presentation of customer charging data and services which are all visualized on The New Motion customer online charge portal.

In the years leading up to 2018, TechNavio are forecasting a CAGR of 28.8% for the Global Electric Vehicle Charger market making this particular market one of the fastest growing Internet of Things (IoT) application areas in the world.

- **Innovation ion EV product development**

As one of the first pan-European organisations in the EV market, The New Motion's customers benefit from their extensive experience. This is a company with an in-house team known for repeated innovation demonstrated through product developments and customized solutions. Their independence and device agnosticism have enabled them to build a middleware data management platform that is capable of connecting to all required hardware platforms.

- **One of Europe's largest EV networks**

In turn, this has allowed The New Motion to run one of Europe's largest EV networks. As well as growing its network in the Netherlands, where already two thirds of electric car owners use their charge card, The New Motion is going through expansion throughout Europe, where charge points and charging services are already available to electric car owners. Current The New Motion EV station locations include Belgium, Germany, Luxembourg, Austria, the UK and Norway.

- **An IoT cellular supplier was sought**

The New Motion were looking for a second supplier for cellular network connectivity with proven reliability, good debugging capabilities as well as competitive prices.

With each EV charge station expected to have a lifespan of 5-10 years, it is imperative that our suppliers understand our need to have reliable and future proof solutions.

- **Solution and benefits delivered**

The re-programmable network-agnostic Multi IMSI AnyNet SIM provides reliable mobile network coverage in even the most remote and challenging locations. The SIM card IMSIs can be reprogrammed Over-The-Air (OTA) which means Eseye is able to help The New Motion future proof their connected solution without having to return to site to change the SIM cards out if they need to switch mobile network providers. Eseye were also able to help with connectivity cost containment.
The solution Eseye's provides enables The New Motion to set their own reporting and alerting profiles using the SIM Information and Account Management Portal (SIAM).

- **Management simplified and risks reduced**

Not only were Eseye's services competitively and uniformly priced across all the required territories, their invoicing format helps The New Motion understand and control costs. Alerting on bill increases outside set criteria ensures that costs are confined, and the dreaded bill shocks avoided.
With business-critical connectivity in each machine to facilitate payment and charging credits it is equally important to note the suitability of Eseye's technical and support services; as well as the adherence to the agreed Service Level Agreement for network uptime and reliability.

- **Customer support and coverage complimented**

A major benefit of working with Eseye is that they can provide all the services required in one house and overseen by one team and The New Motion are very happy with one central helpdesk for all issues and the responsiveness and helpfulness of Eseye's technical support staff.

Eseye's coverage across EU28 means that The New Motion can pool their data charges across the various countries they serve which in turn may help reduce connectivity charges.

The New Motion are rapidly becoming differentiated leaders in their field. This is as a result of the Innovation and out-of-the-box thinking which drives their business. It was evident from the onset that success in partnering with The New Motion relied on delivering a core managed and highly reliable cellular solution. Eseye's multi IMSI managed connectivity which is a truly global roaming solution fitted the bill and is now underpinning The New Motion's worldwide large scale roll outs.

2.2.2 Connected car and IoT automotive cloud services With KAA automotive

- **IoT cloud services implementation for connected cars with KaaIoT**.

The Internet of Things is breaking fresh ground for car manufacturers by introducing entirely new layers to the traditional concept of a car. This upgrade — the connected, smart car — comes as a revolutionary way for us to drive and stay in touch with the world around at the same time. By offering a dazzling variety of infotainment services and connected car applications for drivers, the automotive sector has the potential to become a prominent IoT champion and pump up adoption of IoT cloud services adoption among car owners and walkers alike.

For companies in the automotive sector, entertainment and maintenance service providers, Kaa offers a stack of plug-and-play IoT components that streamline development of connected car applications by times and ensure smooth integration between separate modules of the connected car within a secure cloud environment. Kaa is highly scalable and can easily handle thousands of connected vehicles simultaneously as well as automatically balance out peak loads in cloud service usage. With Kaa, it is easy to enable new services over the air, and manage different service subscription plans and user groups.
Regarding connected car engineering, Kaa supports standard IoT protocols, such as MQTT, as well as allows for custom implementations. Its open APIs ensure seamless integration with different kinds of automotive equipment — sensors, control units, electronics — and help you introduce numerous smart features in coherence with the specific car design.
The sky's the limit for what you can do with Kaa. And even that is only until cars get winged

Kaa ensures successful implementation of end-to-end fleet management and vehicle health & telematics solutions by addressing each part of a typical use case scenario — in-vehicle data collection with embedded applications, in-cloud data management, and user analytics. With its elastic, enterprise-grade scalability, Kaa can be applied to monitor and manage an unlimited number of vehicles in real time:

- Connected vehicle sensors
- Real-time car telematics tracking
- Vehicle location tracking and scheduling solutions
- Fuel tracking

- Speed control
- Vehicle usage analytics
- Car leasing solutions
- Fleet and driver management
- Traffic management, workload management

Kaa translates the predictive maintenance concept into a highly practical and straightforward solution that integrates with your vehicle's sensors, hardware modules, data transmitters, and control units, and allows you tracking their performance, health, and damage factors.

- Connected vehicle sensors
- Real-time vehicle health monitoring
- Fault detection, A/B testing for vehicle prototypes
- Smart alerts and notifications
- Automated maintenance scheduling
- Maintenance history analytics

Kaa is widely deployed as a cloud-enablement platform for value-added user services and applications. Car manufacturers, maintenance and service companies, insurance companies, and entertainment providers can all offer a broad range of Kaa-powered innovative services for connected car owners

- Location-based services
- Drive-assist applications
- News and entertainment
- Smart home/smart office integration
- Car-on-demand services
- Usage-based insurance
- Remote diagnostics
- Car security services
- Over-the-air updates

2.2.4 Volvo and Ericsson

In 2012, Volvo Cars and Ericsson partnered to create connected vehicles that made life safer, more efficient and more entertaining. Today, the partnership is as strong as ever, as the two companies continue to work together to deliver the next generation of digital services to Volvo owners and users. Volvo Cars continues to rely on the industrialized Ericsson Connected Vehicle Cloud (CVC) platform to deliver scalable, secured, high-quality digital capabilities, including a full suite of automation, telematics, infotainment, navigation and fleet management services to its vehicles. All software is able to be supported and seamlessly updated over-the-air (OTA) through the Ericsson CVC.

Rapid data sharing and management is crucial to many of these innovations. All will be enhanced by the increased speed, low-latency and capacity that commercial 5G networks, also powered by Ericsson, will enable.

The connected automotive ecosystem can incorporate any number of third-party stakeholders, including merchants, insurance companies and transport authorities. The Ericsson Connected Vehicle Cloud gives Volvo Cars the power to control and manage this growing ecosystem.

Our industrialized Ericsson Connected Vehicle Cloud platform, provided as a managed service, enables Volvo Cars to swiftly deliver services at scale, to more cars, in more than 120 markets. The CVC platform continues to evolve to ensure that Volvo Cars can remain agile in their digital delivery goals.

Volvo Cars offers an exceptional suite of in-car infotainment, automation, telematics, fleet management and navigation services. Over-the-air updates ensure that vehicles never have to be brought to the dealer for software upgrades.

With the Ericsson CVC, Volvo Cars also offers in-car service and maintenance scheduling; secure, remote access to the car; and automated features such as their Cyclist Detection Auto Brake, Park Assist Pilot and Lane-keeping Aid.

3. OBJECTIVES

To develop an efficient prognostic system which will consist of sensors, controller, data acquisition system, prediction algorithms to perform sensor fusion, and predictive model to interpret the results. This system will track and monitor various EV parameters such as:

- Battery Parameters (Temperature, Voltage, Current)
- Safety Parameters (Seatbelt, door lock, accident reporting)
- ECU Parameters (Auto Viper ON, Speed measurement)

This system also provides a server and cloud connectivity through an android app which enables access to all the data to the user at his finger tips.

The other features of this system are:

- Message alerts and notifications on the occurrence of faults or degraded performance of any EV parameter.
- Safety features such sending SOS messages consisting of the GPS location to the nearest hospitals when the vehicle meets with an accident.

Hence making this system an ideal low cost smart solution for EVs.

4. MOTIVATION

IoT and electric vehicles are already existing as well as prominent technologies in future. Our motivation behind coming up with this project is to combine both these technologies and to develop an integrated system that will monitor ,track, maintain vehicle parameters, give feedback regularly and integrating them with cloud services will allow data logging the entire history of the vehicle, vehicle health analysis and reporting

It includes

- Battery Monitoring
- Data Acquisition
- Service and Maintenance(air bags, seat beltsetc)
- Vehicle performance and Management
- App to notify about the nearest charging station(charging station network planning and navigation)

All the above features are usually supplied by different vendors, but our main objective is to integrate all the features and develop a generalized and customized system which continuously monitors the battery and other vehicle parameters, notifies about nearest charging station. This monitoring system constantly reminds the user about the battery levels, vehicle breakdown and other parameters. Thus makes it a cost effective system by preventing it from major damages and repairs.

- ## Flexibility

Cloud-based services are ideal for businesses with growing or fluctuating bandwidth demands. If your needs increase it's easy to scale up your cloud capacity, drawing on the service's remote servers. Likewise, if you need to scale down again, the flexibility is baked into the service.

- ## Disaster recovery

Businesses of all sizes should be investing in robust disaster recovery, but for smaller businesses that lack the required cash and expertise, this is often more an ideal than the reality. Cloud is now helping more organisations buck that trend. According to Aberdeen Group, small businesses are twice as likely as larger companies to have implemented cloud-based backup and recovery solutions that save time, avoid large up-front investment and roll up third-party expertise as part of the deal.

- **Automatic software updates**

The beauty of cloud computing is that the servers are off-premise, out of sight and out of your hair. Suppliers take care of them for you and roll out regular software updates – including security updates – so you don't have to worry about wasting time maintaining the system yourself. Leaving you free to focus on the things that matter, like growing your business.

- **Capital-expenditure Free**

Cloud computing cuts out the high cost of hardware. You simply pay as you go and enjoy a subscription-based model that's kind to your cash flow. Add to that the ease of setup and management and suddenly your scary, hairy IT project looks at lot friendlier. It's never been easier to take the first step to cloud adoption.

- **Increased collaboration**

When your teams can access, edit and share documents anytime, from anywhere, they're able to do more together, and do it better. Cloud-based workflow and file sharing apps help them make updates in real time and gives them full visibility of their collaborations.

- **Work from anywhere**

With cloud computing, if you've got an internet connection you can be at work. And with most serious cloud services offering mobile apps, you're not restricted by which device you've got to hand.

The result? Businesses can offer more flexible working perks to employees so they can enjoy the work-life balance that suits them – without productivity taking a hit. One study reported that 42% of workers would swap a portion of their pay for the ability to telecommute. On average they'd be willing to take a 6% pay cut.

- **Document control**

The more employees and partners collaborate on documents, the greater the need for watertight document control. Before the cloud, workers had to send files back and forth as email attachments to be worked on by one user at a time. Sooner or later – usually sooner – you end up with a mess of conflicting file content, formats and titles.

And as even the smallest companies become more global, the scope for complication rises. According to one study, "73% of knowledge workers collaborate with people in different time zones and regions at least monthly".

When you make the move to cloud computing, all files are stored centrally and everyone sees one version of the truth. Greater visibility means improved collaboration, which ultimately means better work and a healthier bottom line. If you're still relying on the old way, it could be time to try something a little more streamlined.

- **Security**

Lost laptops are a billion dollar business problem. And potentially greater than the loss of an expensive piece of kit is the loss of the sensitive data inside it. Cloud computing gives you greater security when this happens. Because your data is stored in the cloud, you can access it no matter what happens to your machine. And you can even remotely wipe data from lost laptops so it doesn't get into the wrong hands.

- **Competitiveness**

Wish there was a simple step you could take to become more competitive? Moving to the cloud gives access to enterprise-class technology, for everyone. It also allows smaller businesses to act faster than big, established competitors. Pay-as-you-go service and cloud business applications mean small outfits can run with the big boys, and disrupt the market, while remaining lean and nimble. David now packs a Goliath-sized punch.

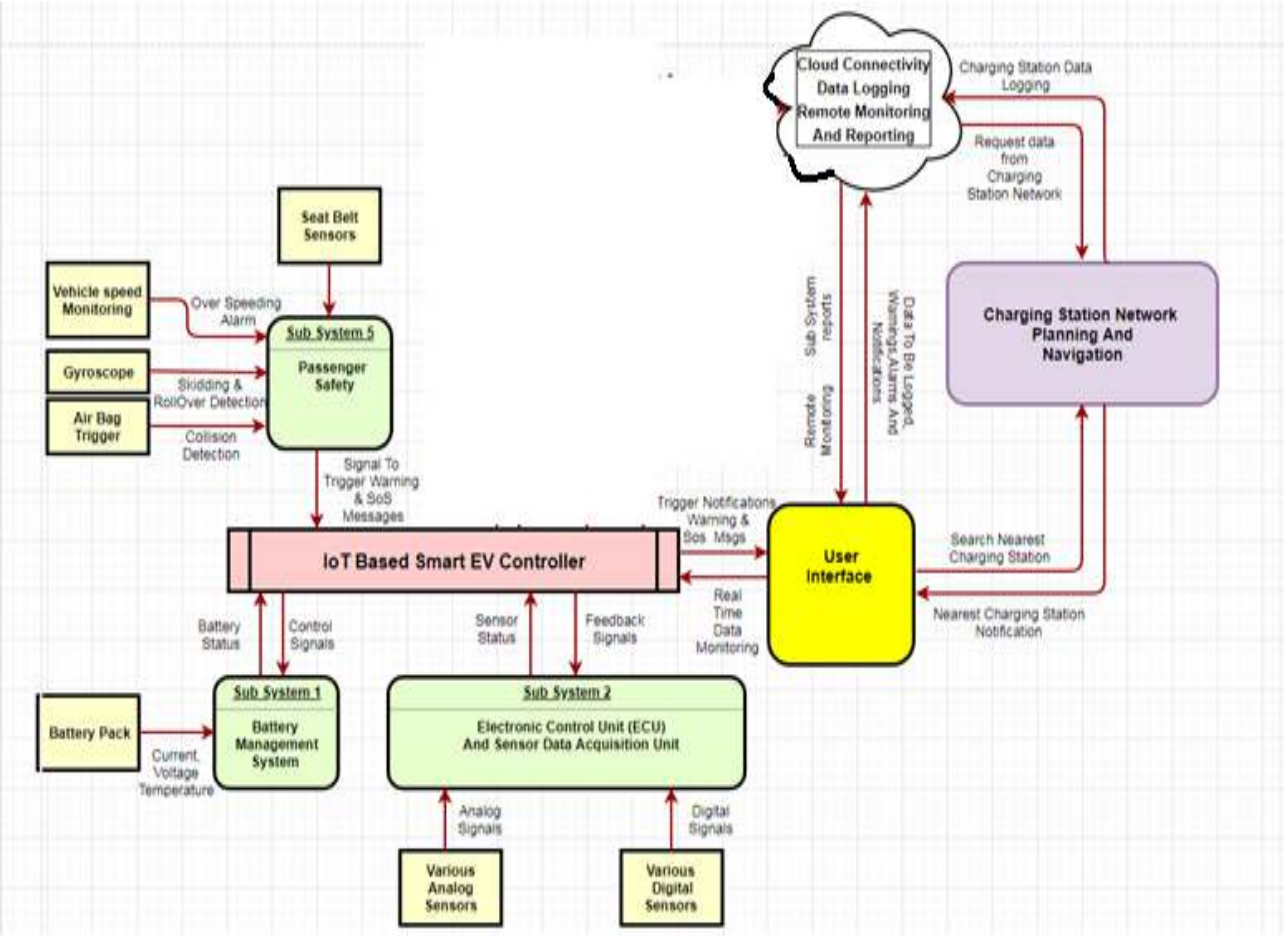
- **Environmentally friendly**

While the above points spell out the benefits of cloud computing for your business, moving to the cloud isn't an entirely selfish act. The environment gets a little love too. When your cloud needs fluctuate, your server capacity scales up and down to fit. So you only use the energy you need and you don't leave oversized carbon footprints. This is something close to our hearts at sales force, where we try our best to create sustainable solutionswith minimal environmental impact.

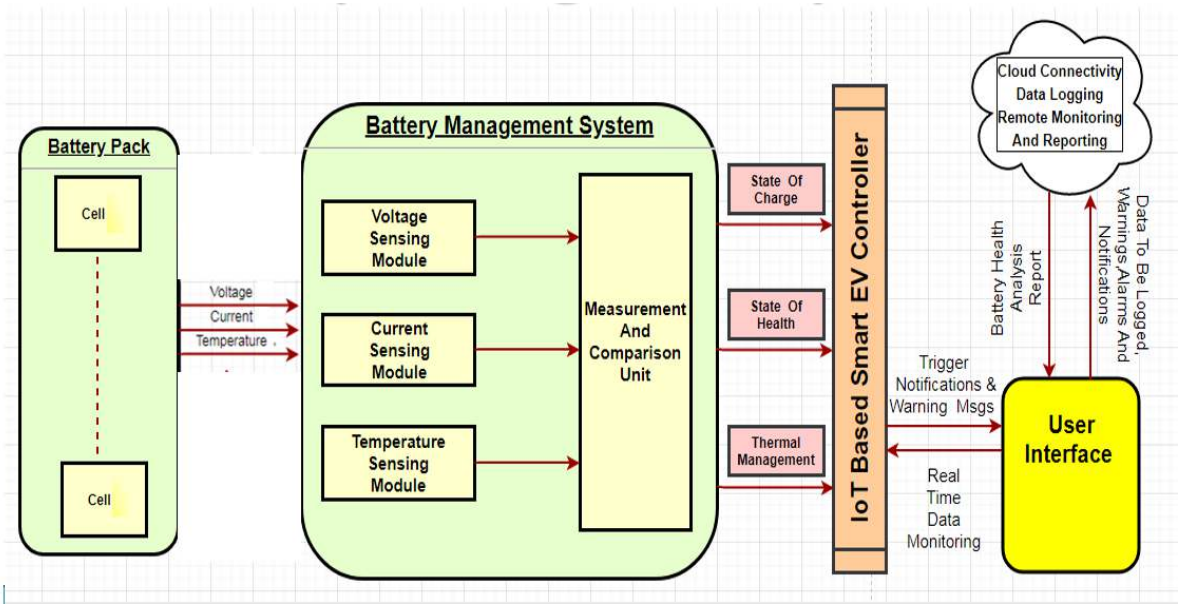
5. METHODOLOGY

The proposed project consists of the different subsystems. Each of these subsystems coordinate among themselves to make an EV work. Since it is an IoT based solution, it enables the users to access, monitor and control these sub systems in real time. The following are the various technologies of the proposed system.

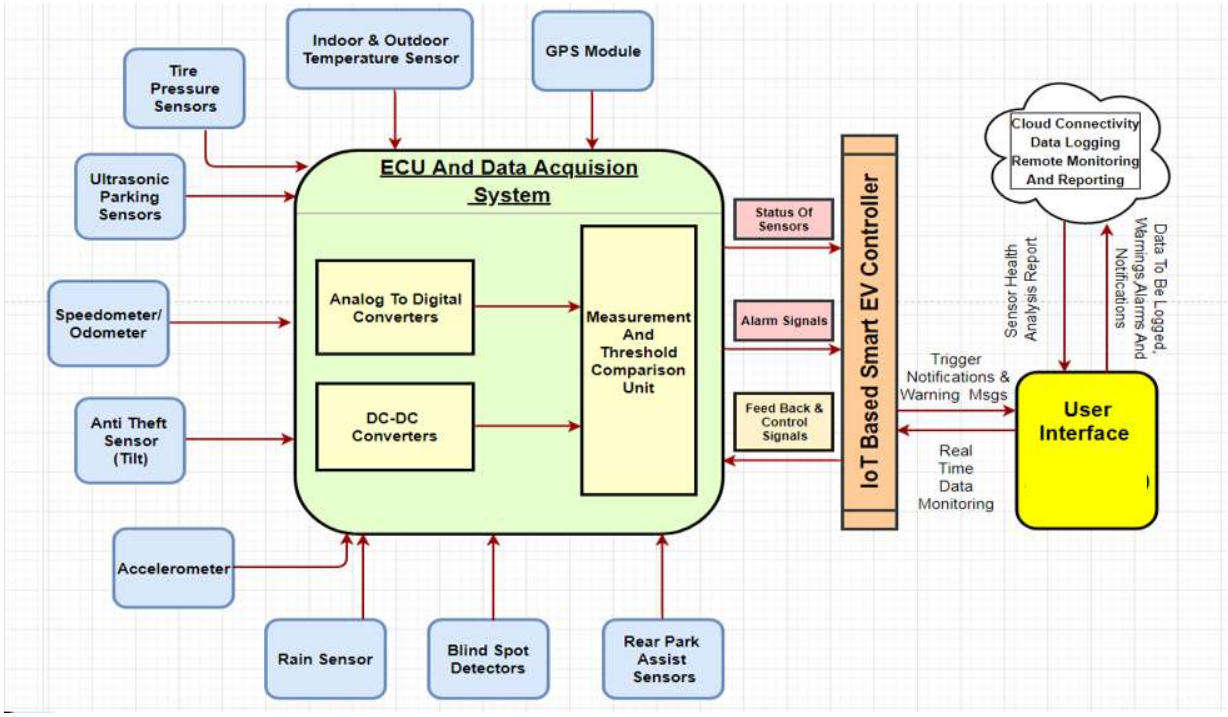
5.1 System Overview



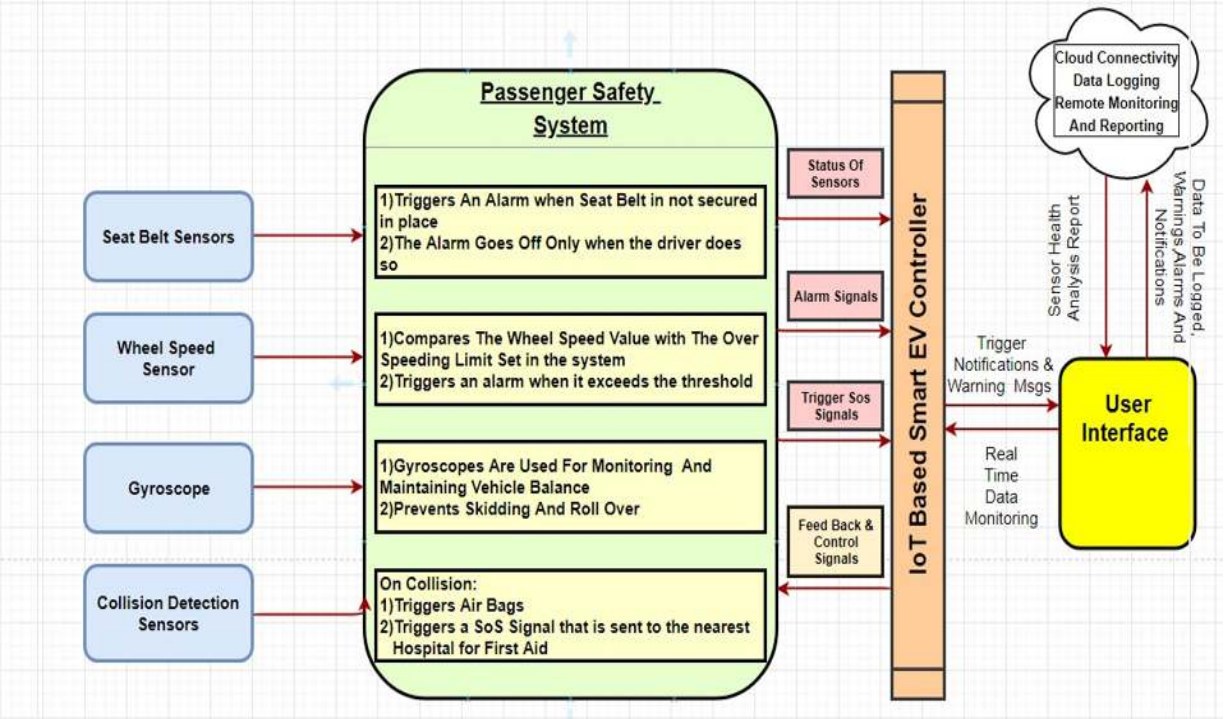
5.1.1 Battery Management System (BMS)



5.1.2 ECU and Sensor Data Acquisition Unit

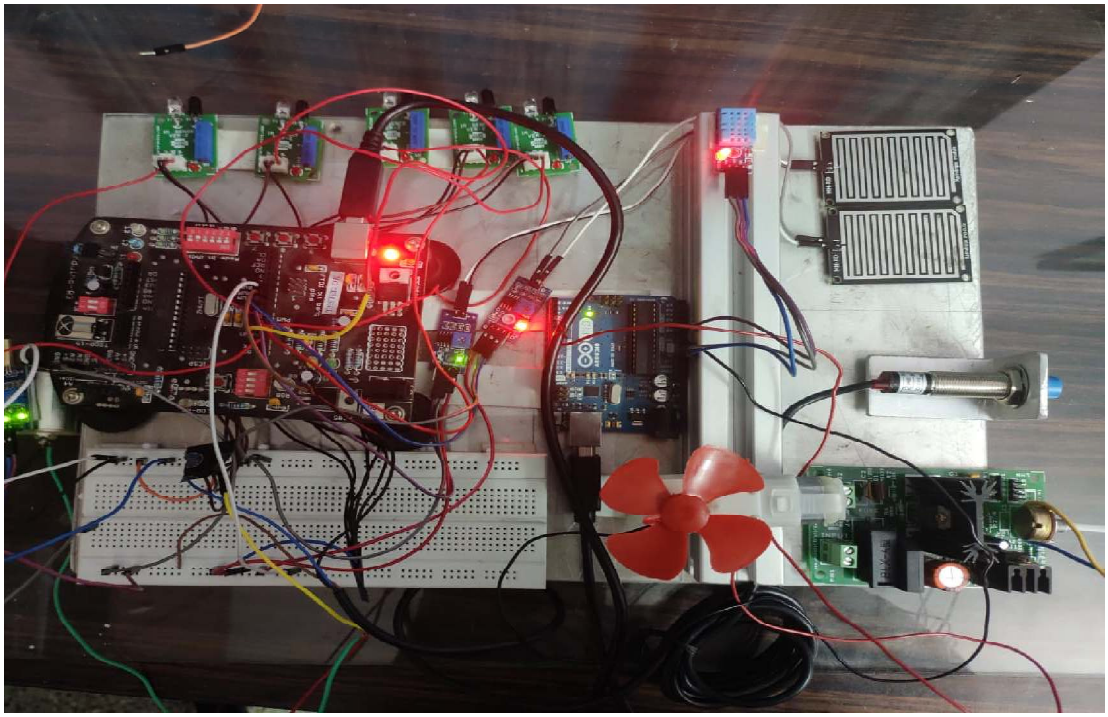


5.1.3 Passenger Safety System

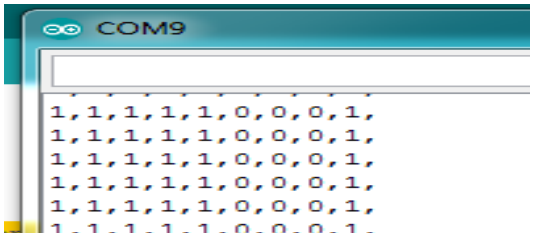


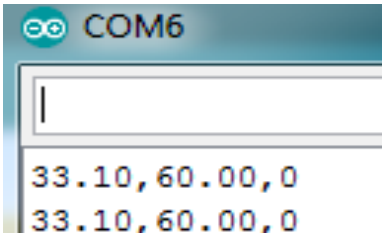
6. RESULTS

6.1 Hardware Circuit

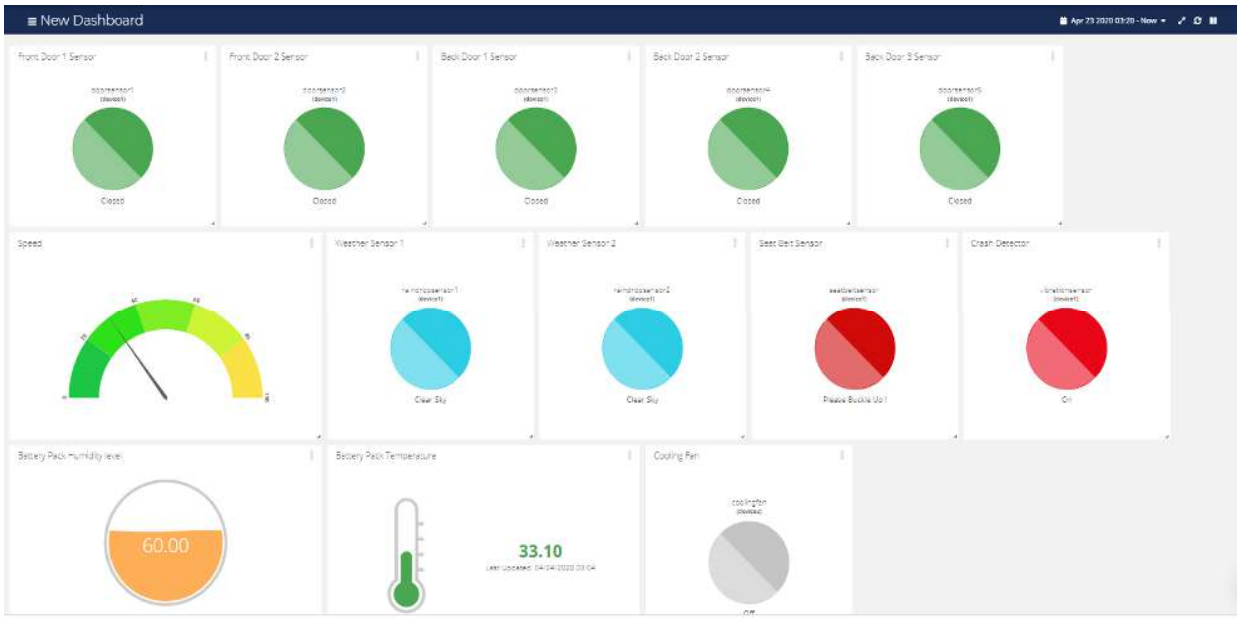


6.2 Arduino Simulation Results





6.3 Cloud Interface Results



6.4 Email Triggering