Title: Electric Scooter Conversion.

Converted an IC Engine Scooter to Electric

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ASTRACT

Electric scooters are plug-in electric vehicles with two wheels that can be recharged from any external source of electricity, and the electricity is stored in a rechargeable battery, which provides power to one or more electric motors to attain movement. Electric scooter, as differentiated from scooters, do not have a step-through frame. The electricity generated from an external source helps in acceleration of the motorcycle. The speed of this cycle is limited (45km/h). The electricity is stored using a battery and the locomotion and movement of the vehicle is hence propelled using an electric hub motor the electric scooter are not using an engine, becomes an effective way of road transport as it causes no pollution. It is eco-friendly and it definitely reduces human effort. In this project report, work concerning product design and manufacturing process making of an electric scooter is described, which was the outcome of a collaborative project for new product development. The final product was satisfactory, and was designed according to the aesthetic principle of golden section proportion, and subsequently our chassis was of Electric vehicle. Not only the product appearance was created, but an electric scooter was also built using various traditional modelling and engineering techniques. The electric scooter we made was also come with some technologically advanced features especially safety features, which makes scooter more reliable and safer.

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Introduction

Concern about global warming and urban air pollution have become central issues in transport policy decision-making, and as a result much research in recent years has focused on the development of vehicles which are environmentally friendly. Air quality in cities is currently significantly lower than in rural areas and this has been shown to be directly link to the level of vehicle emissions from private vehicles. Conventional Vehicles or IC engine vehicle works on fossil fuel which is one of the main cause of for rising of air pollution, global warming. Study predicted that we will run out of fossil fuels in this century. Oil can last up to 50 years, natural gas up to 53 years, and coal up to 114 years. To reduce this kind of consequences E Vehicle was introduced. This E vehicles do minimum or zero carbon emission to environment and also produce negligible sound pollution compared to IC engines. However, although the number of electric scooter users has increased, safety and comfort issues need to be addressed if the number of users is to increase to a level at which a significant effect on environmental pollution can be achieved.

The History of E-bikes: Electric bikes and scooter alike serve many purposes in our world. Some are considered a tool with which the rider makes a living or a mode of transportation with roots in a cleaner technology. For others, it simply serves a recreational or leisurely purpose or as a way to experience the world around them. With over one billion bicycles in the world and 40 million of them expected to be electric bikes by 2023, it is incredible to see how far electric bikes have come and just how far they can take us.

In the United States, one of the first patents was awarded to Ogden Bolton Jr. in 1895 for a battery-powered bicycle that had its hub motor mounted inside the rear wheel and a battery sitting inside the main triangle of the frame, which is not too different in concept to some modern electric bikes (*image above*). As time began to pass, more designs and bikes entered the world, some of which represent the foundational ideas behind many of our present-day machines. In 1897, Hosea W. Libbey of Boston invented an electric bicycle that was propelled by a "double electric motor" (*image below)*. The motor was designed within the hub of the crank set axle. This model follows similar principles of design and operation to present day mid-drive motors we see on some bikes. With creative and industrious minds working, many designs for electric bikes were drafted but many of them never reached production, often sitting in patent offices and on the drawing board until they expired or were discarded. Due to the explosion in growth and popularity of the automobile and combustion engines, electric bicycles were left on paper for the most part. Through the middle of the 20th century, electric bikes began to experience their earliest occurrences of mass production. Europe was one of the first places to see these early adoptions with higher production levels and greater usage. One of the first was a collaboration between Philips and Simplex to create the 1932 Phillips Simplex Electric Bike (*image above)*. As time wore on, Japanese technology and manufacturing entered the field of electric bikes with the 1975 Panasonic and the 1989 Sanyo Enacle. These bikes were still using lead-acid and NiCad batteries, respectively, which were heavier than the newer, lower weight battery compositions. The benefits of new players in the world of ebikes led to greater innovation and creation of more electric bikes.

In 1989, one of the most important innovations was created in the form of the first ‘Pedelec’ or Pedal Electric Cycle (now known as pedal-assist) in which the motor power is triggered as assistance when any pedaling action is registered by the bike. Rather than using a throttle mechanism to control the motor, as all previous models had, this allowed riders to utilize an electric bike not so dissimilar to how one would ride a regular bike. Michael Kutter developed these pedelec systems on a few of his own personal bikes (*image below)* but then went on to assist the Velocity Company in creating the 1992 Dolphin Electric Bike for consumers to purchase. Following Kutter’s pedelec bicycles, pedal assist has become commonplace for modern electric bicycles. Some companies opt for the throttle-style assistance whereas some opt for the pedal assistance, with some companies building both technologies into their designs (like us!). Further improvements have been made into modern electric bikes as well in the form of Lithium-Ion batteries to increase capacity while keeping overall battery weight significantly lower than some of its competitors and predecessors.

In 1988, Ed Rannberg, who founded Eyeball Engineering, tested his electric drag motorcycle in Bonneville. In 1992, the January issue of Cycle World carried an article about Ed Rannberg's bike called the KawaSHOCKI. It could complete a quarter mile (0.25 miles (400 m)) in 11–12 seconds. In 1995, Electric Motorbike Inc. was founded by Scott Cronk and Rick Whisman in Santa Rosa, California. In 1996, EMB Lectra was built by Electric Motorbike Inc., which used a variable reluctance motor.[18] It had a top speed of about 45 mph (72 km/h) and a range of 35 miles (56 km). About a 100 of these were built. In 1996, the first mass-produced electric scooter, Peugeot Scoot ‘Elec, was released. It used Nickel-Cadmium batteries and a range of 40 km (25 mi).

On 26 August 2000, Killacycle established a drag racing record of completing a quarter mile (400 m) in 9.450 seconds on the Woodburn track in Oregon. Killacycle used lead acid batteries at a speed of 152.07 mph (244.73 km/h).[21] Later, Killacycle using A123 Systems Li-ion nano-phosphate cells set a new quarter mile record of 7.824 seconds breaking the 8 seconds barrier at 168 miles per hour (270 km/h) in Phoenix, Arizona at the All Harley Drag Racing Association (AHDRA) 2007, on 10 November 2007.

In 2006, Vectrix introduced the first commercially available high performance electric scooter, the VX-1. Following insolvency and initial bankruptcy reorganization, the Gold Peak battery group purchased the company in 2009. Vectrix expanded product lines, offering the VX-2 and the three wheeled VX-3. But Vectrix ceased operations in January 2014 and filed for Chapter 7 bankruptcy liquidation, with its remaining assets auctioned off the following June.

In February 2009, at the TED conference, Mission Motors, a San Francisco startup led by a former Tesla Motors engineer, unveiled the Mission One, an electric motorcycle capable of 150 mph. If achievable, this would make the Mission One the fastest production electric vehicle in the world.

On April 4–5, 2009, Zero Motorcycles hosted the "24 Hours of Electricross" event in San Jose. It is considered the first all-electric off-road endurance race.

On June 14, 2009, the first electric Time Trial Xtreme Grand Prix (TTXGP) all-electric street motorcycle race took place on the Isle of Man in which 13 machines took part. Rob Barber riding a motorcycle built by Team Agni won the race. He completed the 37.73 miles (60.72 km) course in 25 minutes 53.5 seconds, an average speed of 87.434 miles per hour (140.711 km/h).

In September 2009, product manager Jeremy Cleland of Mission Motors broke the AMA electric motorcycle land speed record during the BUB Motorcycle Speed Trials at the Bonneville Salt Flats in Utah, US riding the company's Mission One. The bike registered a speed of 150.059 miles per hour (241.497 km/h).

In 2010, ElectroCat, made by Eva Håkansson, set the record time for an electric motorcycle to climb Pikes Peak. The motorcycle, ridden by John Scollon, completed the 12 miles (19 km) course in 16 minutes 55.849 seconds. ElectroCat uses batteries manufactured by A123 Systems.

On June 26, 2011, Chip Yates broke Electro Cat's previous record at Pikes Peak. He completed the course in 12 minutes 50.094 seconds.[30] On 30 August 2011, Yates riding his prototype SWIGZ.COM electric superbike established the official Guinness record of the fastest electric motorcycle. The motorcycle clocked a speed of 316.899 km/h (196.912 mph) at Bonneville.

In 2012, Paul Ernst Thede set an SCTA record run of 216.8 miles per hour (348.9 km/h) at Bonnevile Salt Flats, Utah, US. This did not qualify as a Guinness World record as it wasn't timed by the FIM timing association.

In 2012 Electro Force cycles made their debut as a commuter cycle for commuters to ride to work or for enjoyment. These cycles were built by Jennifer Northern of Issaquah WA. She became the first woman to develop and manufacture an electric vehicle in the US. The max speed reached was 85 mph, while immediate speeds reached up to 60 mph in 6 seconds, programmable with regenerative braking or on the throttle. Their range was up to 100 miles while maintaining 65 mph in all weather and hills. It was the first of their kind built by a woman in the US. In 2012, Jim Higgins rode the street-legal Mission Motors' Mission R at the Sonoma Raceway quarter-mile drag strip and set a National Electric Drag Racing Association (NEDRA) street-legal electric motorcycle record for the SMC/A3 class with a time of 10.602 at 122.57 miles per hour (197.26 km/h).

On June 30, 2013, Carlin Dunne riding a Lightning Motorcycle-built electric bike beat conventional motorcycles at Pikes Peak. He clocked a 10 minutes 00.694 seconds at the 12.42 miles (19.99 km) course.

On November 20, 2018, VinFast from Vietnam introduced two electric scooter models in Hanoi, with 4 model: VinFast Klara A1 (Lithium-ion battery), VinFast Klara A2 (Lead–acid battery), VinFast Ludo and VinFast Impes. In 2020, Ola Electric Mobility, a division of Ola Cabs, planned to construct world's largest electric scooter factory near Bangalore, Karnataka, India. The company aims to produce 10 million vehicles annually. In 2020, Odysse Electric, an Indian manufacturer of electric motorcycles and scooters became India's first on-sale sports bike-inspired electric bike maker[39]

In 2020, Juan Ayala, an urban planning design professor at Rutgers University, invented smartphone app based rentable e-scooter systems.

LITERATURE SURVEY

1: Zuink Retrofit, a subsidiary of Bounce which is a dockeless scooter sharing company, provides economical electric conversion kits that can get you an e-scooter for as low as Rs 26,999. This becomes the lowest entry price point for anyone to own an EV. For example, say you own a 7-year-old Honda Activa scooter and want to make a transition to electric. If you buy a new EV two-wheeler off the market, it would cost you between Rs 70,000 to more than Rs 1 lakh. With us, you can convert it to an EV for just Rs 26,999 or an EMI of Rs 899 per month with no upfront costs," says Sachin Shenoy, Vice President of Zuink Retrofit, speaking to The Better India**.** Consumers in Bengaluru can reserve one of their conversion kits today for Rs 499, and Zuink Retrofit will give them a date and slot in December when the installation process begins. By June 2022, the venture is expected to have a presence in major cities which have a large density of IC-engine scooters like Delhi, Ahmedabad, Pune, Mumbai and Hyderabad. When you convert your petrol scooter to electric, your monthly fuel costs come down by more than 50%. As per our assessment, consumers spend about Rs 3-3.50 per km on a petrol scooter. If you convert to electric, it comes down to about Rs 1.50 per km company claims.

2: Asad Abdullah from Uttar Pradesh converted his IC engine bike into an electric vehicle without altering the original configuration and prepared a battery box which fits the vehicle chassis perfectly. Asad Abdullah is one such individual who is under vocational training in Azamgarh, Uttar Pradesh, whose passion has enabled him to convert his KTM bike into an EV. His efforts show impressive results as his bike tops 130 km on a single charge and gain a top speed of 140 km per hour. He claims he always felt intrigued and inclined towards electronics. "I dismantled and pulled apart electric toys during my childhood days, and I started learning about electronic instruments as I grew older," he says. In recent years, his interest grew in EVs as the market in the segment boomed. "I tried to understand how these vehicles worked and realised that their functioning and mechanism is not extremely complicated," he adds. A couple of years ago, Asad experimented with a bicycle by mounting an electric motor on the same. "It was a hybrid vehicle as one could pedal and use electric assist to ride," he says. Feeling confident about his achievement, Asad decided to use his 200 cc KTM bike as an EV. "I was spending a lot of money on fuel which cost me Rs 6,000 a month. The skyrocketing fuel hikes only burned a hole in my pocket," he says, adding, "I learned about installing motors from YouTube and the modifications made by others." Asad knew that his success could save thousands of rupees he spent on fuel. Taking cues from multiple videos and streaming countless hours of screen time, Asad dismounted the vehicle engine. "I replaced it with a 4,000-watt motor that gives peak power of 25 kW for 30 seconds when pushed to its limits. I installed a motor controller from QS motors, a company in China which also supplies to leading EV companies in India," he claims. He assures that the brand is safe and reliable compared with other companies offering EV packages"My unique tweak to the installation is that I have not changed even a bit of the original configuration of the bike. There are no cuttings, additional weldings or any tampering. I prepared a battery box, which fits precisely into the original vehicle chassis," Asad says. Moreover, he has made arrangements to fix the vehicle charger on the petrol tank. This way, it does not become additional baggage or an item to carry. "The battery pack works as plug-and-charge, which takes a little over four hours for a full charge," he explains. Asad says a fast charger can also be used for the same but warns that it may affect battery life. "The overall configuration delivers a speed of 125 km per hour and can increase to 140 km by configuring controller settings. The performance is impressive as the vehicle with IC engine delivers a top speed of 160 km per hour," he says.

3: Prashanta, CEO of Voltrider Private Limited, explains the features of the Volton Booty series of electric cycles, which come in three models, offering a battery range of 35 km to 150 km, and a top speed of 25 kmph Launched last month, the Volton Booty comes in three models. The Booty-30 comes with a 25.6V/12 Ah LFP (lithium iron phosphate) battery pack, which offers a range of 30-35 km on throttle mode and 45-60 km with pedal assist. The Booty-60 comes with a 25.6 V/20 Ah LFP battery pack offering a battery range of 55-60 km on throttle mode and 75-80 km with pedal assist. The version with the best specifications is the Booty-120, which offers a range of 90-120 km on throttle mode and 130-150 km with pedal assist backed by a 25.6 V/36 Ah battery pack. All these e-bikes have a maximum speed of 25 kmph, and it takes approximately 3.5 hours to fully charge its batteries, which can be done from any socket at home. The Booty comes with a detachable battery (except the Booty-120), making it convenient to charge at home or the office.

4: Electric Vehicles in India: A Literature Review : Conference: 7th International Conference on "New Frontier in Energy, Engineering and Science (NFEES), 19-20 March 2021 At: Jaipur. In present scenario, air pollution has become a serious concern for the India. According to recent global report, many cities in the India are most polluted cities. Major sectors contributing to the air pollution are industrial sector and transport sector. Among this 51% of air pollution is caused by the industrial sector and 27% by the transport sector. Air pollution contributes to the premature deaths of 2 million Indians every year. In order to minimize the air pollution, Electric Vehicle (EV) can act as blessing in lowering the GHG emission. Electric Vehicles offer numerous advantages such as decreasing the pollution level and reduction in oil import bills etc. Although there is considerable amount of threats in establishing the Electric Vehicles in India. This paper provides the brief literature review on the Electric Vehicles and compiles the advantages and threats in promoting EVs in India.

SYSTEM MODELING

1. **Chassis:** The chassis is the backbone of the moped; it must support all the vehicle subassemblies as well as protect the driver. The chassis design is crucial to the success of the project because if the chassis fails, that puts the moped and the driver at tremendous risk. The goal of the frame will be to protect the driver, offer sturdy mounting for all subsystems, maintain all safety rules and regulations, and still be lightly. These mopeds are all powered by electric motors. To extract maximum acceleration from this motor a lightweight chassis is necessary. At the same time the chassis must undergo the rigors of Indian roads. So, here we used chassis of Eletric vehicle . Eletric vehicle chassis was completely fulfilling our requirements for perfect chassis for electric scooter.

Fig.1. Electric vehicle Chassis

2. **Swing arm:** A **swingarm**, or "swinging arm" originally known as a swing fork or pivoted fork, is a single- or double-sided mechanical device which attaches the rear wheel of a motorcycle to its body, allowing it to pivot vertically. The main component of the rear suspension of most modern motorbikes and scooter, it holds the rear axle firmly, while pivoting to absorb bumps and suspension loads induced by the rider, acceleration, and braking. The given picture is of swing arm which we designed and Fabricated by using M.S square pipe. This M.S pipe is of 1*1 inch. 6mm thick M.S. plats welded at ends of pipes which is use to attached Hub Motor. Other dimensions are given in figure below.

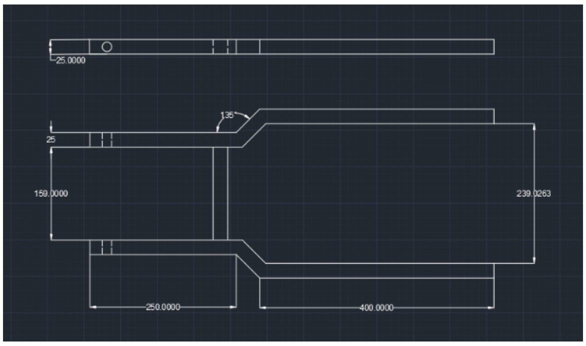

Fig.2 Swing arm design

Fig.3 Swing arm

3.Shock Absorber: Shock absorbers are an integral part of a vehicle’s suspension. A shock absorber is designed to absorb or dampen the compression and rebound of the springs and suspension. They control the unwanted and excess spring motion. Shock absorbers keep your tires in contact with the road at all times. Before going any further, let’s discuss some key terms that will help us understand how shock absorbers work. Back in elementary school we learned about energy, more specifically, we learned about potential and kinetic energy. We also learned about the Law of Conservation of Energy. The Law of Conservation of Energy states that energy cannot be created or destroyed, it can only change forms. Potential energy is stored energy and kinetic energy is energy in motion. Now, let’s get back to shock absorbers. When you hit any bump or dip in a road, your vehicle’s suspension and springs move so the tire can stay in contact with the road and absorb the energy. The shock absorbers dampen the movement of the springs by converting the spring’s kinetic energy into thermal (heat) energy. This thermal energy is then degenerated in hydraulic fluid. Shock absorbers are an oil-filled cylinder. When your vehicle’s suspension moves, a piston moves up and down through the oil-filled cylinder. The up-and-down movement of the piston forces small amounts of fluid through orifices (tiny holes) in the piston head. Since only a small amount of fluid is forced out, this slows down the suspension’s movement and dampens the compression and rebound of the springs. Shock absorbers are also velocity-sensitive. This means that the faster the springs are moving, the more resistance the shock absorber provides. The Eletric vehicle comes with single shock absorber. But for attaching hub motor we need to connect pair of shock absorber for proper support. Here we replaced old shock absorber with new pair of Bajaj Platina shock absorbers made by Gabriel.

Fig.4 Shock absorbers

3. **Hub Motor:** Hub motors are typically **brushless motors** (sometimes called brushless direct current motors or BLDCs), which replace the commutator and brushes with half-a-dozen or more separate coils and an electronics circuit. The circuit switches the power on and off in the coils in turn creating forces in each one that make the motor spin. Since the brushes press against the axle of a normal motor, they introduce friction, slow it down, make a certain amount of noise, and waste energy. That's why brushless motors are often more efficient, especially at low speeds. Getting rid of the brushes also saves having to replace them every so often when friction wears them down. The given Picture is of Hub motor with tubeless tire. The motor comes with power output of 1000 watt and 48Nm torque. The voltage of this motor is 60v with 24A rated current. For fitting this motor into our swing arm , we designed another part which can hold motor on swing arm along with rear brake.

Fig.5 Hub Motor

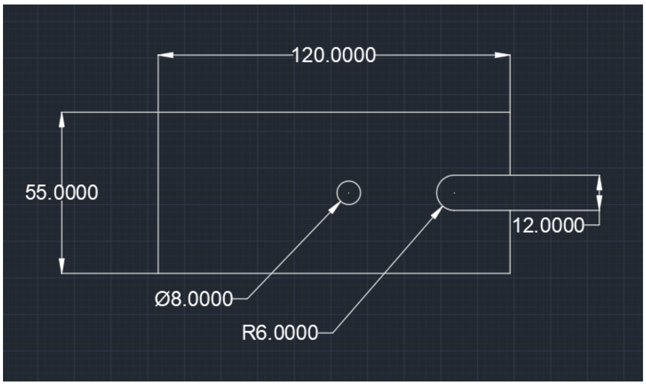

Fig.6 Motor holding attachment

4. **Battery:** Battery pack we used here is Lithium Phosphate battery. A lithium iron phosphate (LFP) battery is a type of lithium-ion battery that is capable of charging and discharging at high speeds compared to other types of batteries. It is a rechargeable battery consisting of $LiFePO_4$ as its cathode material. The major distinction that lithium iron phosphate batteries have from other li-ion batteries is that LFP is capable of delivering a constant voltage and also has a comparatively higher charge cycle, in the range of 2000-3000. LFP batteries are environmentally safe and structurally stable. They have a lower energy density and low discharge rate. They do not heat up easily and are relatively cooler than other batteries. The chemistry of the battery saves it from thermal runaway, and hence it is considered to be safe for home use. Due to their constant voltage and safe discharge, LFPs have found applications in cars, bicycles and solar devices. They are also used as replacements for costly lead-acid starter batteries. They are well suited for applications that require high-load currents and endurance. They are easy to store and carry due to their light weight and ability to provide huge amounts of energy. Battery pack is of 60 volt and 24 amperes. Purpose of using Lithium phosphate battery over lithium ion was that it does not catches fire. The battery gives range of 45-60km. Battery pack placed on front side foot rest for proper cooling purpose.

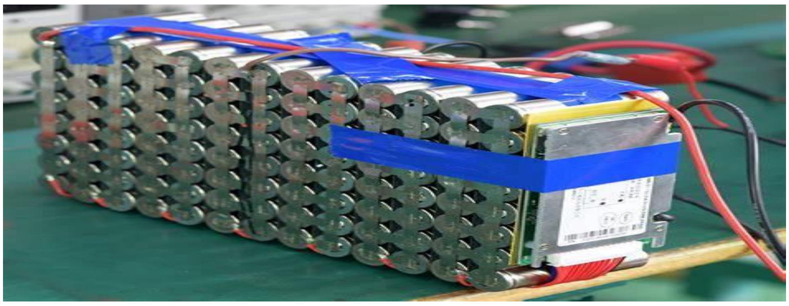

Fig.7 Battery pack

5. **Controller Unit:** The controller or electronic speed controller (ESC) is an electronic circuit that controls the speed of the motor in an electric scooter. It receives input from the throttle and precisely controls the flow of current from the battery to the motor. For most scooters, the controller also provides regenerative braking capabilities. Controllers are rated in terms of current (measured in amps) and voltage (measured in volts), with higher-current, higher-voltage controllers being capable of driving more powerful scooters. Controllers range from having sustained max outputs of tens of volts and just a few amps all the way up to 100 volts and 400 amps on Rion hyperscooters. The microcontroller/processor is the brain of the ESC and is basically a small computer running a control program or firmware. The ESC listens to various signals and determines the appropriate output and timing signal. The throttle signal is basically a request to the ESC to set the motor at a specific speed (revolutions per minute). The ESC monitors the motor speed either via a hall sensor or by sensing back-EMF from the electric motor and modulates the motor signal in order to achieve the speed "requested" by the throttle. The controller unit we used here content two parts, first Main controller and second DC to Dc converter. Main controller controls every actions in vehicle, were Dc to Dc converter converts 60v supply to 12v. Controller comes with rated voltage of 48/60v and current upto 30A with phase angle 120 degree. MSB is provided between controller unit and Battery to cut down power supply.

Fig.8 Controller unit

6. **Sensors:** A sensor is a device that detects and responds to some type of input from the physical environment. The specific input could be light, heat, motion, moisture, pressure, or any one of a great number of other environmental phenomena. The output is generally a signal that is converted to human-readable display at the sensor location or transmitted electronically over a network for reading or further processing.

Sensors we used here are as follows:

1: Temperature sensor: A temperature sensor is an electronic device that measures the temperature of its environment and converts the input data into electronic data to record, monitor, or signal temperature changes. There are many different types of temperature sensors. Some temperature sensors require direct contact with the physical object that is being monitored (contact temperature sensors), while others indirectly measure the temperature of an object (non-contact temperature sensors).

Fig. 9 Temperature sensor

2: Gyroscope sensor: Gyroscope sensor is a device that can measure and maintain the orientation and angular velocity of an object. These are more advanced than accelerometers. These can measure the tilt and lateral orientation of the object whereas accelerometer can only measure the linear motion. Gyroscope sensors are also called as Angular Rate Sensor or Angular Velocity Sensors. These sensors are installed in the applications where the orientation of the object is difficult to sense by humans. Measured in degrees per second, angular velocity is the change in the rotational angle of the object per unit of time. Besides sensing the angular velocity, Gyroscope sensors can also measure the motion of the object. For more robust and accurate motion sensing, in consumer electronics Gyroscope sensors are combined with Accelerometer sensors. Depending on the direction there are three types of angular rate measurements. Yaw- the horizontal rotation on a flat surface when seen the object from above, Pitch- Vertical rotation as seen the object from front, Roll- the horizontal rotation when seen the object from front.

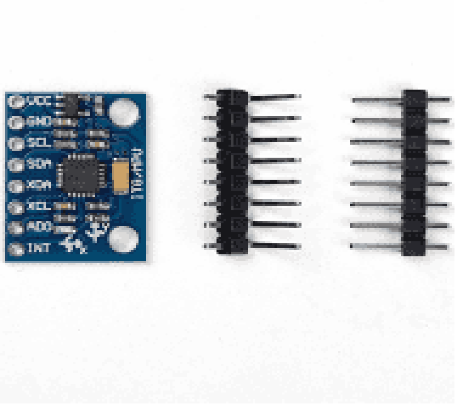

Fig. 10 Gyroscope sensor

7. **Arduino**: Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. You can tell your board what to do by sending a set of instructions to the microcontroller on the board. To do so you use the Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing. Over the years Arduino has been the brain of thousands of projects, from everyday objects to complex scientific instruments. A worldwide community of makers - students, hobbyists, artists, programmers, and professionals - has gathered around this open-source platform, their contributions have added up to an incredible amount of accessible knowledge that can be of great help to novices and experts alike. Arduino was born at the Ivrea Interaction Design Institute as an easy tool for fast prototyping, aimed at students without a background in electronics and programming. As soon as it reached a wider community, the Arduino board started changing to adapt to new needs and challenges, differentiating its offer from simple 8-bit boards to products for IoT applications, wearable, 3D printing, and embedded environments. Here we used Arduino Nano in our electric scooter.

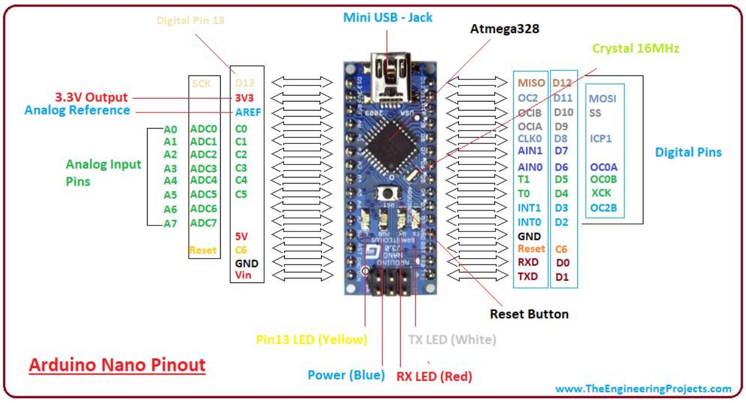

Fig.11 Arduino nano

8. **Relays:** A relay is an electrically operated switch. It consists of a set of input terminals for a single or multiple control signals, and a set of operating contact terminals. The switch may have any number of contacts in multiple contact forms, such as make contacts, break contacts, or combinations thereof. Relays are used where it is necessary to control a circuit by an independent low-power signal, or where several circuits must be controlled by one signal. Relays were first used in long-distance telegraph circuits as signal repeaters: they refresh the signal coming in from one circuit by transmitting it on another circuit. Relays were used extensively in telephone exchanges and early computers to perform logical operations. The traditional form of a relay uses an electromagnet to close or open the contacts, but relays using other operating principles have also been invented, such as in solid-state relays which use semiconductor properties for control without relying on moving parts. Relays with calibrated operating characteristics and sometimes multiple operating coils are used to protect electrical circuits from overload or faults; in modern electric power systems these functions are performed by digital instruments still called protective relays. Latching relays require only a single pulse of control power to operate the switch persistently. Another pulse applied to a second set of control terminals, or a pulse with opposite polarity, resets the switch, while repeated pulses of the same kind have no effects. Magnetic latching relays are useful in applications when interrupted power should not affect the circuits that the relay is controlling.

Fig. 12 Relay

9. **Mcb:** An MCB or miniature circuit breaker is an electromagnetic device that embodies a complete enclosure in a moulded insulating material. The main function of an MCB is to switch the circuit, i.e., to open the circuit (which has been connected to it) automatically when the current passing through it (MCB) exceeds the value for which it is set. It can be manually switched ON and OFF as similar to normal switch if necessary. MCBs are time delay tripping devices, to which the magnitude of overcurrent controls the operating time. This means, these get operated whenever overloads exist long enough to create a danger to the circuit being protected. Therefore, MCBs don't respond to transient loads such as switches surges and motor starting currents. Generally, these are designed to operate at less than 2.5 milliseconds during short circuit faults and 2 seconds to 2 minutes in case of overloads (depending on the level of current). A typical external appearance of an MCB is shown in figure. MCBs are manufactured in different pole versions such as single, double, triple and four pole structures with different fault current levels. Mostly, MCBs are linked to give two and three-pole versions such that a fault in one line will break the complete circuit and hence complete circuit isolation is provided. This feature will be helpful in case of single phasing in three phase motor protection. These are rated at 220V for DC supply and 240/415 for AC supply (single and three-phase) with different short circuit current capacity. Typically, single phase devices have load current range of up to 100 A. Some MCBs have facility to adjust its tripping current capacity while some devices are fixed for some load current and short circuit rating. MCBs are used to perform many functions such as local control switches, isolating switches against faults and overload protection devices for installations or specific equipment or appliances.

CONCLUSION & APPLICATION

The fact that we already have less energy in this world in the form of fossil fuel and until there is possibility gained for some stable solutions. It is better to be careful and not totally finish off this fossil fuel option. It might have many other benefits than just the fuel for vehicles. Therefore those particularities we should never undermine is always a safer choice, is the moral lesson of this study. Besides when people use car, usually people ride alone to go to offices and other places, when the capacity consisting of four, suggesting clearly that it is the wasting of scarce fossil fuel for limited gain. We may some situations where there is no better option than car riding, but still there are so many possibilities where it can be easily replaced with other transportation services, and importantly the fuel saving services. That is why, to suggest the possible area we propose this e-bike as one of the better options for saving energy, especially in short distant traveling. This helps save the fuel and also the environment altogether by reducing pollutions causing mainly by combustion engines. The objective of the study was to design a customizable vehicle which will be affordable to everyone. E-scooter has been fabricated and tested successfully. This vehicle will run up to 50-60 km with fully charged battery.

FUTURE SCOPE

This thesis is in a way defining e-scooter, trying to analyse the basic functions of various mechanisms which are available only in such e-scooter. Besides the aim is to highlight its importance in general, to promote the possibility for global Welfare, where Clean Climate plays a role. Having this basic purpose in place, it is also be said that this subject contains simple to advanced features containing all three departments, therefore very useful Thesis for Bachelor level students, just because in e-scooter all three variations of engineering is associated. Such as electronics in controller, mechanical in motor, and electrical in batteries. Therefore it can be a very resourceful work if it is possibly done using equipped labs, and somehow by using the same level of possibilities in advanced simulation software to analyse e-scooters properties better. The study of e-scooters can be done extensively, and it has been left for those interested researchers for exploring in depth of its possibilities in defining it. Along with it our future plan is design its outer fairing such that it should be aerodynamic and aesthetically will be appealing. And also we like to add some more safety features like vehicle idling indication.

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