SMART HYBRID SYSTEM FOR 2-WHEELER VEHICLE

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Introduction

In recent years, the automotive industry has experienced a major shift towards sustainable solutions. With growing concern about climate change and environmental degradation, there is a growing demand for vehicles that reduce emissions and improve fuel efficiency. To solve these complex problems, hybrid vehicles have emerged as a promising solution, combining the benefits of gasoline engines and electric motors. This introduction aims to shed light on the concept of hybrid vehicles, exploring their key features, advantages, and their role in shaping the future of transportation.

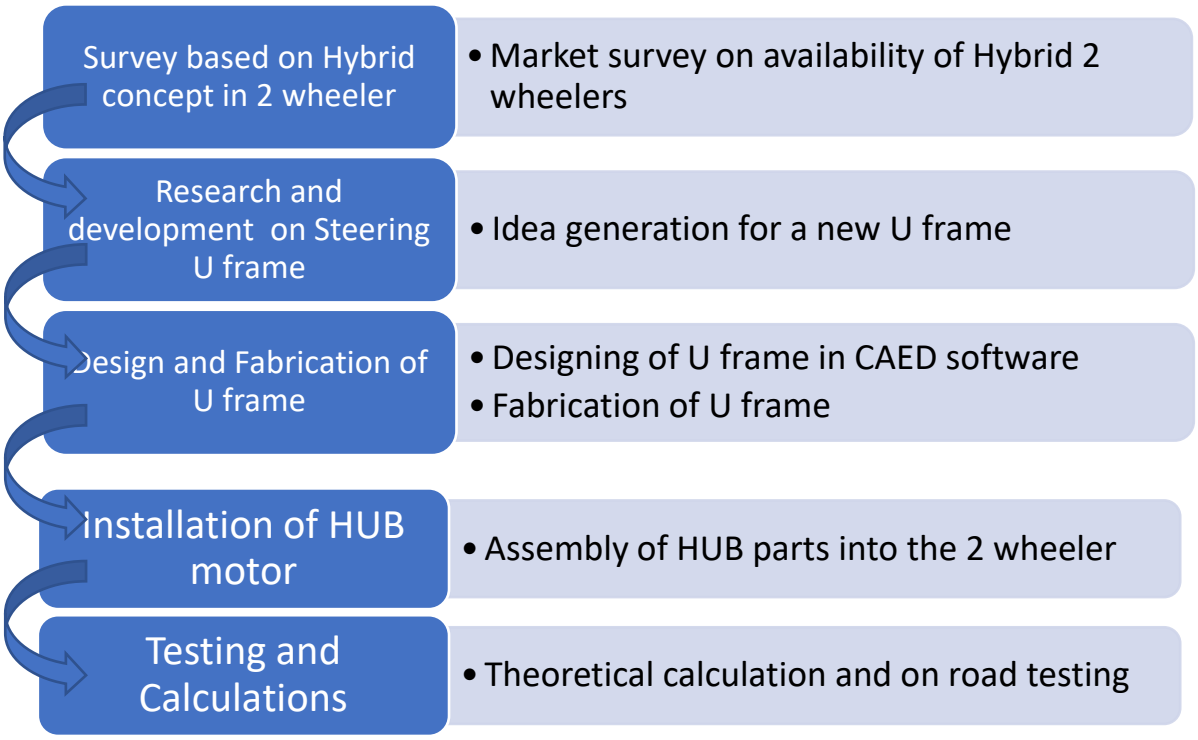
Our model consists of both ICEs drivetrain and EV drivetrain. We have achieved integrating both systems successfully by using front wheel drive for EV motor and rear wheel drive for IC Engine. The front wheel drive system is commonly used in cars but using it in 2-wheeler is one of the key features of the project. The EV motor has a control unit and is run on a rechargeable lead acid battery to provide electricity to the motor. The IC engine remains the same and no change is done on it.

The hybrid vehicle we designed is to optimize fuel efficiency and minimize environmental impact. Unlike conventional vehicles that solely rely on internal combustion engines (ICEs) fuelled by gasoline. This innovative combination allows hybrid vehicles to operate in various modes, seamlessly switching between the gasoline engine, the electric motor.

Project Objectives

- To Improve fuel efficiency, Reduced emissions, and Smoother acceleration of two-wheeler vehicle
- To Install HUB motor in Front wheel for EV drive.
- To Improve long range travel and quick charging of battery.
- To Produce Hybrid vehicle at low cost.
- To reduce dependence on fossil fuels, mitigate climate change, and achieve sustainable transportation.

Methodology



Front wheel drive and Rear wheel drive

Rear-wheel drive (RWD) is a popular drivetrain configuration where power is transmitted to the rear wheels of a vehicle. It offers several advantages that make it a preferred choice for certain applications. One key advantage of rear-wheel drive is superior handling and balance. With the engine and transmission located at the back of the vehicle, the weight distribution tends to be more evenly spread between the front and rear axles. This results in better balance and a more neutral handling characteristic, allowing for more precise and responsive steering.

The advantage of rear-wheel drive which is connected to IC engines transmission provides excellent traction during acceleration. When power is delivered to the rear

wheels, the weight of the vehicle shifts towards the rear, increasing traction and minimizing wheel spin. This makes rear-wheel drive particularly suitable for applications that require strong acceleration.

However, rear-wheel drive does have its disadvantages. One notable drawback is its performance in slippery or challenging road conditions. Compared to front-wheel drive or all-wheel drive, rear-wheel drive vehicles can be more prone to losing traction and stability on wet, snowy, or icy surfaces.

Front-wheel drive (FWD) is a drivetrain configuration in which power is transmitted to the front wheels of a vehicle. It offers several advantages that make it a preferred choice for many car manufacturers. One key advantage of front-wheel drive is improved traction in slippery conditions. By placing the weight of the engine and transmission over the driven wheels, FWD vehicles tend to have better grip and traction on wet or snowy surfaces. This enhances their stability and control, especially in adverse weather conditions, making them more suitable for regions with inclement weather.

The main disadvantages of Front wheel drive in 2-wheeler vehicles would be transmission of power to the front wheel and handle steering. The chain or the belt can't be used for transmission as the steering of vehicles affects it. The HUB motor is a direct drive connected to the front wheel so there's no need of chain, belt or gears as transmission drives. Secondly the front wheel provides enough weight to withstand the traction in the 2-wheeler we used and the additional weight of the battery in the front leg space makes Front wheel Drive much easier to handle. Another advantage of front-wheel drive is its space-efficient design. By combining the engine, transmission, in the back axle and HUB in the front axle makes it a compact unit. This makes front-wheel drive compatible in 2-wheeler vehicles also.

MATERIALS USED KINETIC HONDA 4S

Fig 4.1.1: Kinetic Honda 4S

The Kinetic Honda 4S was a popular scooter model known for its reliable performance and stylish design. The scooter was introduced in 2005. It is installed with a

113.1cc, 4 Stroke, Air cooled, Single Cylinder Engine. It is powerful enough to produce max power of 7.2 HP @ 7500 rpm and max power of 7.7 Nm @ 5000 rpm. The two-wheeler is run by automatic transmission. The scooter is offered both electric and kick start. Drum brakes and telescopic suspensions were fitted at both ends. The machine ensured a mileage of 40 kmpl. The scooter's design showcased a sleek and aerodynamic body, with a comfortable seating arrangement for both the rider and pillion. The Kinetic Honda 4S was a reliable and practical choice for urban commuting, combining performance, style, and convenience to our project in a compact package.

HUB Motor

Fig 4.1.2: HUB motor

A hub motor, also known as a wheel motor, is an electric motor that is directly integrated into the hub of a vehicle's wheel. It is a compact and efficient design that eliminates the need for traditional power transmission systems like driveshafts, differentials, and gears. The hub motor can be located in either the front or rear wheels, or both, depending on the desired configuration.

The HUB motor is Brushless DC motor with power rated of1000w. It has a rated voltage of 48v/60v. Maximum Torque rating of 45-55Nm, One of the main advantages of hub motors is their simplicity and compactness. By integrating the motor directly into the wheel hub, it eliminates the need for complex mechanical components, reducing weight and increasing overall efficiency. This design also allows for better weight distribution, as the weight of the motor is positioned near the wheel, enhancing vehicle handling and stability.

Another advantage of hub motors is their potential for regenerative braking. Since the motor is directly connected to the wheel, it can function as a generator during deceleration or braking. This allows it to convert the vehicle's kinetic energy into electrical

energy, which can be stored in the battery for later use. Regenerative braking helps improve the overall energy efficiency of the vehicle and extends the range of electric vehicles.

CHARGER FOR BATTERY:

Fig 4.1.3: Power Adaptor

A 60V lead-acid battery charger is a device specifically designed to charge 48–60-volt lead-acid batteries, commonly used in a variety of applications such as electric scooters, electric bikes, and golf carts. Lead-acid batteries are known for their reliability and affordability, making them a popular choice for these types of vehicles.

The 60V lead-acid battery charger operates by converting the alternating current (AC) from a power source into direct current (DC) at the appropriate voltage and current levels required to charge the battery. The charger is equipped with safety features such as overcharge protection, short-circuit protection, and temperature monitoring to ensure the battery is charged safely and efficiently.

The charging process for a lead-acid battery typically consists of multiple stages, including bulk charging, absorption charging, and float charging. The charger automatically adjusts the charging voltage and current during each stage to optimize the charging process and prevent overcharging. It is important to use a charger specifically designed for 60V lead-acid batteries to ensure compatibility and prevent damage to the battery.

CONTROLLER UNIT:

Fig 4.1.4: Controller Unit

The controller unit used in a hub motor system plays a critical role in managing the operation of the motor and ensuring optimal performance. The controller acts as the brain of the system, receiving input from the rider or vehicle's controls and translating that into signals that control the speed, torque, and direction of the hub motor.

The primary function of the controller unit is to regulate the power flow to the hub motor. It controls the amount of current delivered to the motor based on the user's input, such as the throttle position. By adjusting the current, the controller determines the speed and acceleration of the vehicle. It also provides various safety features, such as overcurrent protection and thermal monitoring, to prevent damage to the motor and ensure safe operation.

Additionally, the controller unit may offer additional features and functionalities. For example, it can provide regenerative braking, where the kinetic energy from braking is converted into electrical energy and stored back into the battery. The controller may also include programmable settings, allowing the rider to customize parameters such as speed limits, power output, and assist levels.

The controller unit communicates with other components of the hub motor system, such as the battery, throttle or pedal sensors, and display unit, through a combination of electrical signals and protocols. This allows for seamless integration and coordination of all system components, resulting in a smooth and responsive riding experience.

BATTERY:

Fig 4.1.5: Amptek Battery

A 12V 28 Ampere Amptek battery in 5 no. is a rechargeable battery that can provide a continuous current output of 28 Amperes (A) at a voltage of 60 Volts (V). The Amptek battery is a type of sealed lead-acid (SLA) battery, which is commonly used in various applications, such as emergency lighting, security systems, and small electric vehicles.

The 60V 28A Amptek battery is designed to provide reliable and consistent power output for a the HUB motor. The battery is rechargeable, meaning it can be used multiple

times by recharging it after each use. It is also maintenance-free, which means it does not require any special care or attention.

The battery is typically made up of lead plates, sulphuric acid, and other materials that help it to store and release electrical energy. It is housed in a plastic or metal casing that protects it from damage and allows for easy handling and transport. The 60V 28A Amptek battery is relatively small and compact, making it easy to install in various devices. It can be connected to the device using simple wiring or connector terminals. The battery's capacity and output power are generally sufficient to power small to medium-sized devices for extended periods, depending on the device's power requirements.

In summary, a 60V 28A Amptek battery is a reliable and durable rechargeable battery that can provide consistent power output for a variety of devices. Its compact size, ease of installation, and maintenance-free design make it an ideal choice for various applications where reliable and consistent power is needed.

Types of Sensors Available to Measure Rpm with Digital Device

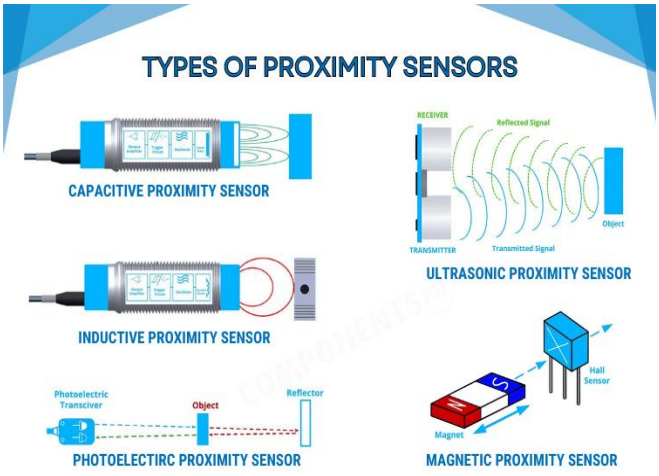


Fig 4.2.3: Types of Sensors

Comparison of Proximity Sensors

Proximity Sensor Types	Inductive Proximity Sensor	Capacitive Proximity Sensor	Ultrasonic Proximity Sensor	Optical Proximity Sensor	Magnetic Proximity Sensor
Operation Principle	Based on current induced by magnetic fields to detect nearby metal objects	Based on that when an object bets near the sensor, it changes the capacitance between the sensing elements.	Based on ultrasonic waves and time taken to reflect it back.	It consists of a light sensor, which will be triggered by an object.	Based on magnetic field. When a magnet is near the reed switch will be activated.
Material supported	Metallic only	All material	All material	All material	Magnet
Operating distance	<50mm	<50mm	15m	100mm	<80mm
Cost	Low	Moderate	High	Moderate	Low
Environmental factors affecting Sensitivity	Metal Objects	Humidity& vapors	Air flow & temperature variation	Dust, oil, aspect of object	Magnets, EMI, Metals

Fig 4.2.3:Sensors Comparison

The Proximity sensors play a crucial role in modern industries, enabling automation, safety, and efficiency in various applications. These sensors are designed to detect the presence or absence of objects within a certain range without physical contact. In this article, we will delve into the **different types of proximity sensors** commonly used in industries, understanding their working principles and exploring their applications.

The above fig shows the types of sensors available in the market for various of applications, Special type of sensors are used in current 2-wheeler vehicle that is used as Rpm sensor, commonly used sensors for Rpm are inductive type and Magnetic type with better accuracy and efficiency. **Inductive proximity switches** are effective in detecting metal objects and are commonly employed in position sensing, object detection, collision

detection, speed sensing and automated machinery. They are also used in industrial manufacturing facilities to detect the presence of metallic objects.

Sensor used To Measure Rpm for Microcontroller

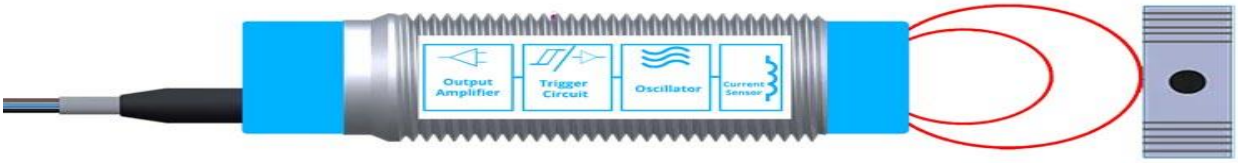


Fig 4.2.4: Inductive sensor to measure rpm

Inductive Proximity Sensors

Inductive proximity sensors are widely used in industrial environments for their robustness and reliability. They operate on the principle of electromagnetic induction. When an object approaches the sensor's electromagnetic field, it induces eddy currents, leading to a change in the sensor's output. This output signal is fed into Digital input of Microcontroller (Arduino board). The signal read from sensor are converted in revolution per min hence vehicle speed is read accordingly and based on this output the microcontroller Auto code controls the vehicle based on speed sensing. The sensor Is placed in the vehicle wheel hub to detect the Wheel rotations and sense speed.

Applications of Inductive Proximity Sensors

Inductive proximity switches are effective in detecting metal objects and are commonly employed in position sensing, object detection, collision detection, speed sensing and automated machinery. They are also used in industrial manufacturing facilities to detect the presence of metallic objects.

Examples of Inductive Proximity Sensors

If we look at Inductive proximity sensors the most popular ones are the LJ12A3-4-Z/BX, PR12-DN, and SN04-N

Smart Traffic Assist using Integration Circuit and Microcontroller {Arduino uno}

Figure 5 Microcontroller Arduino Uno Rev3 a) Arduino UNO, b) Software Arduino IDE

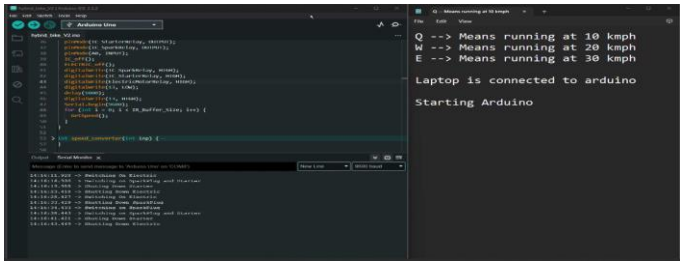
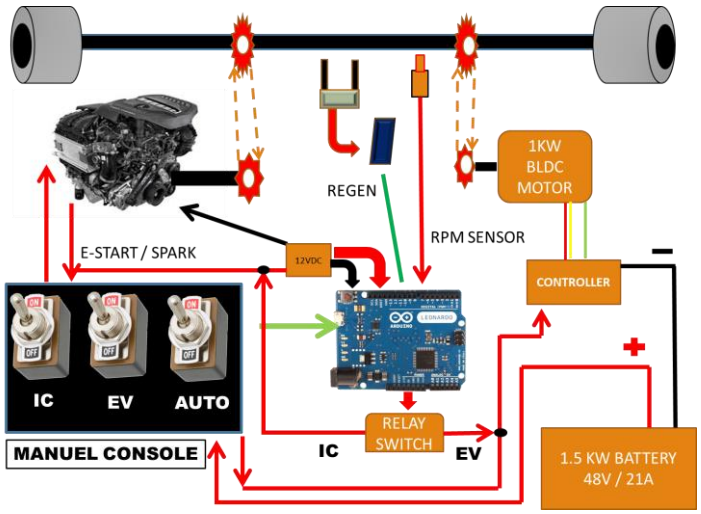


Fig 4.2.5.a: Arduino Uno Software Fig 4.2.5.b: Arduino Uno Auto Code

To obtain the full potential of the hybrid vehicle, it was necessary to make possible to measure speed of the vehicle, rpm of the IC engine, the battery level etc. Sensors and other devices had to be used with a control unit. For that purpose, the microcontroller Arduino was chosen. Arduino Uno Rev3, is shown in Fig. 4.2.5. Arduino enables data processing from various types of sensors. Also, it provides the possibility to control devices which are connected to it. To accomplish this, programming of the Arduino has to be done. The programming takes place in a software package called Arduino IDE, shown in Fig. 5. b. The software has a large data base from which various code lines can be taken and implemented. For this occasion, Arduino Pro Mini was chosen. the vehicle's control unit, which optimizes the power distribution based on various factors like vehicle speed, battery state of charge, and driver input.

Smart Hybrid Circuit and Auto Mode Parameters



1: When the bike is turned on and the smart hybrid mode switch is turned on then the smart integrated circuit turns on, with all pre written codes and operation are enabled .

2: The first operation set is that when the bike is turned on the bike starts with Electric mode for instant torque and low speed driving condition this saves fuel consumption at low speed. This is done using a Arduino controlled relay switch to turn on and turn of motor.

3: when the bike speed reaches the set limit say 25km/h. The Arduino board Is connected to a rpm sensor which helps the system analyse speed of vehicle and automatically cut of the electric drive train circuit by relay switching.

4: Immediately the Arduino system sends electric start signal to the IC Engine but relay system and continues unit the speed drops back below 25km/h to which the Arduino cuts off the spark plug connection and turns and engine off until necessary speed is acquired.

5: The Electric drive train kicks in and continues for low-speed requirements. This alternate switching is what make it a smart auto hybrid system for user benefits.

Testing And Results

EXPERIMENTAL WORK

Trial No.	Range in km(EV only)	Charging time
1	55 km	5 hrs
2	60 km	5 hrs
3	58 km	5 hrs

Trial No.	Range in km(IC Engine only)	Petrol consumed
1	38 km	1 ltr
2	40 km	1 ltr
3	39 km	1 ltr

The project team has tested the EV range and the mileage of the 2 wheeler taken which gives and avg range of EV to be 58km and IC to be 38km. The range of the EV can be increased by adding more batteries and weight distribution in the vehicle.

NUMERICAL WORK

- Battery Specifications: 60 Volt, 28 Amp DC Motor (Amptek)

Watt = Volt * current
= 60v * 28ah
Watt = **1.68kw**

- Motor specifications- 1 kw (48v/60v)
- Average km produced in Ev = **58 km for 5 hrs charge**
- Mileage given by the IC engine is **38kmpl.** It consists of a 5 ltr fuel tank
- The avg range of both IC and EV is **248km**

Conclusion

Fig 6.1: Prototype of Hybrid 2-wheeler vehicle

The project team has successfully designed and built a hybrid vehicle that is both electric and IC convertible. The completion of the hybrid vehicle project marks a significant milestone in the pursuit of sustainable transportation. The development and construction

of a hybrid vehicle require planning, engineering expertise, and a commitment to environmental responsibility. Through this project, we have successfully integrated the best features of electric and internal combustion engines, creating a vehicle that combines fuel efficiency with reduced emissions.

The hybrid vehicle serves as a tangible example of our dedication to reducing our carbon footprint and promoting a greener future. The completion of this project not only represents our technical capabilities but also highlights our commitment to innovation and addressing the pressing challenges of climate change.

In conclusion, hybrid vehicle technology represents a significant step forward in the automotive industry, offering a balance between improved fuel efficiency, reduced emissions, and practicality for consumers. As the technology evolves, hybrid vehicles will continue to play a crucial role in the global efforts to reduce dependence on fossil fuels, mitigate climate change, and achieve sustainable transportation.

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Future Work Scope

Fig 2.2.1: On Road Tested Vehicle

HEVs may have the new technology that make them affordable in the future. Hybrid Electric Vehicles play a vital role in bridging the gap between EVs and conventional vehicles. With better battery technology, they could be more efficient and provide an engaging driving experience. Also, expect HEVs to be more environmentally-friendly with advanced electric powertrains and efficient IC engines. Our proposed system is to reduce carbon foot print and a smart design that can implemented in old vehicles that are subjected to scrapping with can be converted into hybrid and obtain benefits of it with increased range and efficiency.

We aim to implement product development and market ready Smart hybrid vehicle with smart features for user friendly experience. With help and collaboration with government we can successfully implement our objective and goals of implementing smart hybrid vehicle.

Our future plan is to get it tested with Rto norms and regulations and plan ahead for market production with aid of government or private sector aid.

Our Hybrid vehicles offer advantages such as improved fuel efficiency, regenerative braking, and reduced emissions. They provide a greener and more sustainable transportation option, especially for city driving and stop-and-go traffic. However, the higher upfront cost and continued reliance on gasoline are factors that should be considered. As technology advances and manufacturing costs decrease, hybrids are expected to become more affordable and offer even greater environmental benefits.

Description Of The Innovation In The Project

This project is a successfully designed to smart hybrid vehicle that is both Electric and IC convertible. we have successfully integrated the best features of electric and internal combustion engines, vehicle that combines fuel efficiency with reduced emissions &

reducing our carbon footprint and promoting a greener future. It highlights out to innovation and addressing the pressing challenges of climate change. In conclusion, hybrid vehicle technology represents a significant step forward in the automotive industry.

Innovation Outcomes:

1. Smart auto switching B/w IC & EV based on speed sensing.
2. Rider safety Auto cut off system using relay.
3. First in segment front wheel EV drive.
4. 2- in throttle for both EV and IC.
5. Front wheel electric drive for better traction
6. Convenient traffic assist switching system
7. Alternator based Recharging
8. Market ready product development
9. Microcontrollers for Smart Traffic assist system