Electric bike design with anti-theft system using fingerprint recognition

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ABSTRACT

Electric Vehicles represent one of the most promising solutions toward sustainable transportation system. To tackle the issues related to environment and vehicle thefts, additional assistance must be provided to EV drivers, through ICT based solutions. Biometric system serves as a best robust security mechanism in various domains. Vehicle security is an important issue these days due to rising number of vehicle thefts. Here we propose a solution to this problem by using a fingerprint authenticated vehicle starter system. It is much convenient to have a system that monitors and communicates to authorized person, this leads to utilize the fingerprint authentication system along with GSM technology which is programmed to fulfill this purpose. With this if anyone tries to steal a bike then in fraction of time a text alert or message is sent to the stored mobile communication number reporting of tempering with bike and bike will not start without authorized persons.
Keywords— Fingerprint sensor, GSM module, Arduino UNO controller

ARTICLE INFO

I.   INTRODUCTION

The electric bike is a bike which is driven with the help of battery which is connected to electric motor. Main reason to recognize the necessity of finding and modifying E-Bike is to control the issue of the pollution because of vehicles in metro cities and urban regions is swelling uninterruptedly. Considering the all class of society it is not affordable for all to purchase (scooters, mopeds).So, combining both issues, environmental progress supporting and economical affordable alternative,E-Bike would be the best solution. Typical parts of the E-Bike are motor(propulsion system), throttle,energy storage unit,controller,bike chassis and other common bicycle parts.

The electrically assisted bikes are normally powered by rechargeable batteries,and their driving performance is determined by battery capacity, motor power,road types,operation weights,control and particularly,by the management of assisted power. Biometric systems serves as vigorous security mechanisms in various domains.Vehicle security is an important issue these days due to the increasing number of vehicle larceny. Another issue with vehicles is handling its keys.Here we propose a solution to this problem by using a fingerprint authenticated vehicle starter system.This ignition system is designed using Arduino UNO controller.The biometric system provides a secure and struggle free way to start/stop the vehicle engine and the system only allows authorized users to start the vehicle.

Users must enroll into the system by uploading their fingerprints.It allows multiple users to register as authorized personnel.During the monitoring mode,the system scans for the user's biometrics and the engine gets ignited through authentication.GSM module is also interfaced with controller to send the text alert or message as per it is programmed in Arduino IDE software to authorized person to give the information regarding persons tempering with bike.

II.   LITERATURE SURVEY

In 2016 Dumitrache,Florin, Marius Catalin Carp,and Gheorghe Pana said that,the electric vehicle industry is

continuously evolving.A such electric vehicle is an electric bike.Electric bike like another electric vehicle,implement a BLDC motor.This paper present way of designing and using an electronic module for an electric bike. The paper shows how a low power,8 bit microcontroller can be used to drive such motor and also manage other useful functions of E- bike[1].In this paper the author proposed a solution for misplacing keys or losing keys using fingerprint access to the vehicle.A fingerprint of every person is unique even identical twins don't have the same fingerprint[2].In 2017,Kunjan shinde said that, all work on electric bike as it is a modification of the existing cycle by using electric energy and solar energy if solar panels are provided ,that would sum up to increase in energy production.With the increasing consumption of natural resources of petrol, diesel it is necessary to shift our way towards alternate resources like the electric bike and others because it is necessary to identify new way of transport.The operating cost per/km is very less and with the help of solar panel it can lessen upmore[3].

Tony Foale in 'Motorcycle Handling and Chassis Design-the art and science provides practical, applicable,design guidelines and theories to design and fabricate a motorcycle chassis.He elaborates on various geometries associated with frame building and the different forces and moments on the frame and other vehicle systems during the dynamic behavioural conditions like acceleration, braking, cornering, etc.of the vehicle.The author explains the use and applications of various materials and cross-section types of the frame along with various manufacturing processes for the fabrication of the motorcycleframe[4].In his paper basically focus is on the replacement of keys with the biometric specially fingerprint based lock systems in the vehicles because fingerprints are the oldest and most widely used form of biometric identification and also provide a robust security mechanism for various security domains.The prototype consist of fingerprint software module used to store the database of the valid users,a hardware unit for interfacing and the ignition system module to ignite the vehicle[5].C.H. Neeraja, C.R. Sireesha and D. Jawaharlal have modelled a suspension frame used in two- wheeler. Modelling is done in Pro/Engineer.They have done structural and modal analysis on suspension frame using four materials Steel,Aluminium Alloy A360,Magnesium and carbon fiber reinforced polymer to validate our design. By observing the results, for all the materials the stress values are less than their respective permissible yield stress values.So the design was safe,by conclusion.By comparing the results for four materials,stress obtained is same and displacement is less for carbon fiber reinforced polymer than other three materials so for design considered,CFRP is better material for suspension frame[6].
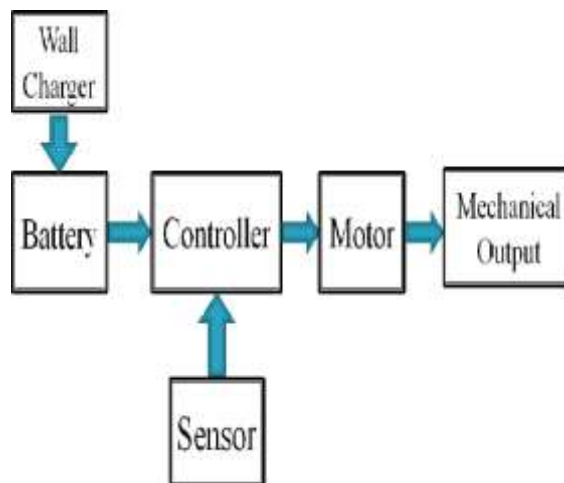
III. BLOCK DIAGRAM
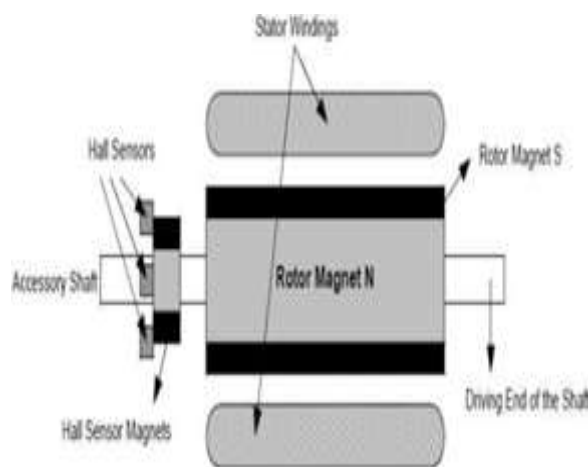

Fig 1. Block diagram of proposed system

1.BLDC MOTOR

Fig 2.BLDC Motor Construction

Fig. shows a transverse section of a BLDC motor.Brushless DC (BLDC) motors are synchronous motors consisting of armature windings on the stator and permanent magnets on the rotor.There are many advantages of BLDC motor such as better speed versus torque characteristics, high dynamic response, high efficiency,long operating life,noiseless operation,higher speed ranges.The Hall sensors are embedded into the stationary part of the motor.Here hall sensors are connected with hall sensor magnet to detect the position of the rotor.In BLDC motors, the phase windings are distributed in trapezoidal fashion in order to generate the trapezoidal waveform.The commutation technique generally used is electronic commutation where only two phases will be conducting at any given point of time.

Typically, BLDC motors have three phase windings that are wound in star or delta fashion and need a three-phase inverter bridge for the electronic commutation.The brushless motors are generally controlled using a three-phase power semiconductor bridge.The motor requires a rotor position sensor for starting and for providing proper commutation sequence to turn on the power devices in the inverterbridge.

2. Wall Charger-

Fig 3.Wall Charger

Wall chargers are used for recharging the battery.There are different kinds of chargers which are suitable for different batteries.Every new electric bicycle should come with its own designated charger.Proper charging will ensure a long batterylife.

3. Lead Acid Batteries-

Fig 4. Lead Acid Battery

Almost every portable and handheld device consist a battery.The battery is a storage device where energy is stored to provide the power whenever needed. There are different type of batteries available in this modern electronics world, among them Lead Acid battery is commonly used for high power supply.Usually Lead Acid batteries are bigger in size with hard and heavy construction, they can store high amount of energy and generally used in automobiles and inverters.Even after getting competition with Li-ion batteries,Lead Acid batteries demand is increasing day by day, because they are cheaper and easy to handle in comparison with Li-ionbatteries.

4. Fingerprint Sensor-

Fig 5. Fingerprint Sensor

A fingerprint sensor is a type of biometric scanner which scans the human fingerprint.Its function is to capture the human fingerprint.There are two types of fingerprint scanner which are optical and capacitive fingerprint scanner.The differences between these two types of fingerprint is that the optical fingerprint and capacitive fingerprint scanner captures images by light and current respectively.In this project, the optical scanner is used because it is less accessible to electrostatic discharge (ESD) compared to capacitive fingerprint scanner.The fingerprint scanner is frequently implemented in control access system.The reason being is because every human have different fingerprint image which helps in identifying the true data of a person accurately.In this project the Adafruit fingerprint scanner used can cater up to 250 fingerprints.Thecaptured fingerprints are stored inthe on board Flash Memory which has the size of 512bytes.The fingerprint sensor which we are going to use isR307.

5. Motor Controller-

Fig 6. Motor Controller

Motor controller is a device that improves the performance of an electric motor in a prearranged manner.Motor controllers can include an automatic or manual means for starting/stopping the motor,choosing forward/reverse rotation,selecting and controlling the speed,modifying or limiting the torque,and shielding against faults and overloads. An electric vehicle motor controller is a machine that is employed to regulate the torque generated by the motors of electric vehicles by means of modifying the energy flow from the power sources to the motor.The controller simply helps in driving the motor. The vehicular motors which are generally BLDC does not have brush and commutator assembly for this. This is done by the inherent controller.The DC provided will be converted to a pulsed waveform in the driving circuit for driving the vehicular motor.
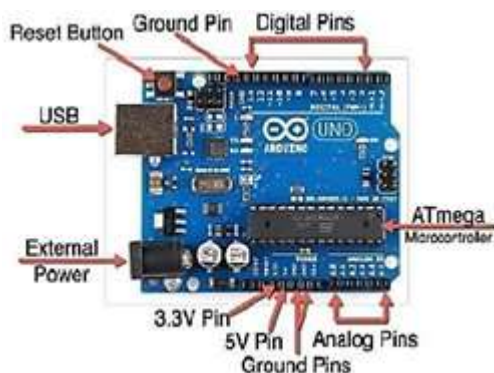
6. Arduino Board-

Fig 7. Arduino UNO Board

Arduino is a development board that integrates a microcontroller and its support circuitry with digital and analog inputs and outputs.It has an opensource computing development platform based on an environment for programs creation.Arduino boards were originally created in 2005 by Massimo Benzi of IVRAE Institute for the need to learn of the computer and electronic students.By then the acquisition of microcontroller board was expensive and did not offer adequate support,instead he obtains as a result an open-hardware board with a lot of potential and,what is more,at a very economical cost.Years later it becomes a DIY (Do It Yourself) technology,a great support for students. The Arduino UNO microcontroller operates at 5v with 2Kb of RAM, 32Kb of flash memory for storing programs and 1Kb of EEPROM for storing parameters.It operates at a clock speed of 16MHz, that translates 3,00,000 lines of C source code per second.The board has 14 digital Input output pins and 6 analog input pins.The device holds a variety of configurations features of usual peripherals: internal oscillator,timer including PWM watchdog,USART andSPI.

7.   SIM900 GSM Module-

IV. METHODOLOGY

The SIM900 is a complete Quad-band GSM/GPRS solution in a SMT module which can be embedded in the customer applications.Featuring an industry-standard interface,the SIM900 delivers GSM/GPRS 850/900/1800/1900MHz performance for voice, SMS, Data,and Fax in a small form factor and with low power consumption.With a tiny configuration of 24mm x 24mm x 3 mm, SIM900 can fit almost all the space requirements in your M2M application, especially for slim and compact demand of design.

V. WORKING OF PROPOSED SYSTEM

An electric bike is powered by an electric motor instead of a petrol engine.The electric motor gets energy from a controller,which regulates the amount of power.The electric bike (also known as electric vehicle or EV) uses energy stored in its rechargeable batteries,which are recharged by common household electricity.Thus an electric vehicle will have three basic parts:-

1.   Energy StorageUnit
2.   Controller
3.   Propulsion system

The energy storage unit will have a way to store power.A chemical battery is the most common energy storage technology currently,although it can be different-for example - A fuel cell (which gets its electricity from hydrogen rather than a battery pack),can be used instead of a chemical battery as the energy storage unit.The controller acts as a pipeline or gateway to the electric motor.The controller will do other things too-it moderates the power or it might also increase or decrease the amperage etc. The controller is the brain of the system. The electric motor, which is the propulsion system, converts the electric power and converts this into mechanical energy for movement.

i.Working of biometric system-

The starter circuit of the vehicle is controlled using the Arduino UNO.A fingerprint sensor is coupled with the Arduino UNO for biometric authentication.The relay is the switch which is controlled by the Arduino UNO.The starter circuit is initially open. When the user places his finger on the fingerprint sensor,his fingerprint is authenticated.After successful authentication,the Arduino UNO sends a trigger to the relay which closes the starter circuit to start the engine and at the same time GSM module will send the text alert or message to authorized person as per it is programmed using Arduino IDE software. After successful drive the engine and the Arduino UNO are simultaneously turned off which resets the program in the microcontroller.

If the authorized person is going to operate the bike then fingerprint will matched with stored fingerprint and LED will be ON and bike will start. If the unauthorized person is going to operate the bike then fingerprint will not match, LED will not give any indication and bike will not start.And at the same time in both cases GSM will send the text alert or message to authorized person as per it is programmed.
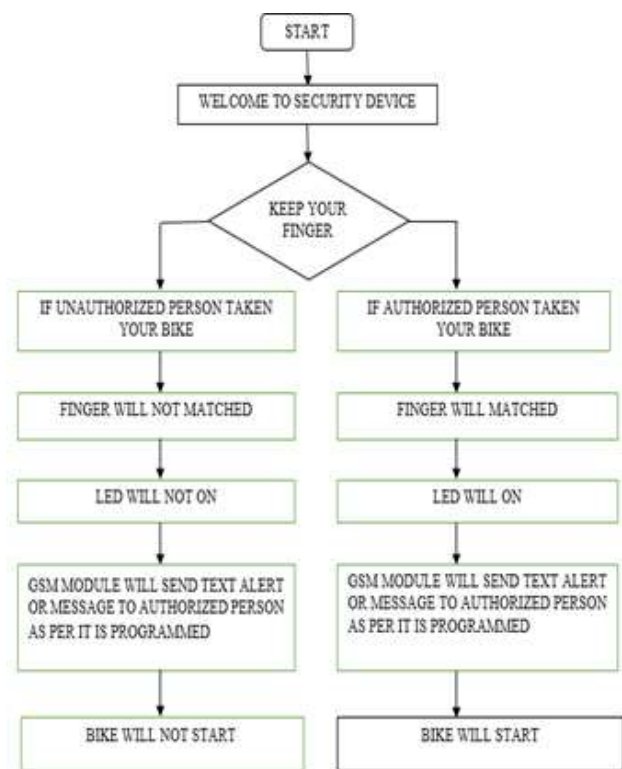

Fig.8 Flowchart of biometric and GSM technology working

VI. CONCEPTUAL MODEL OF BIKE

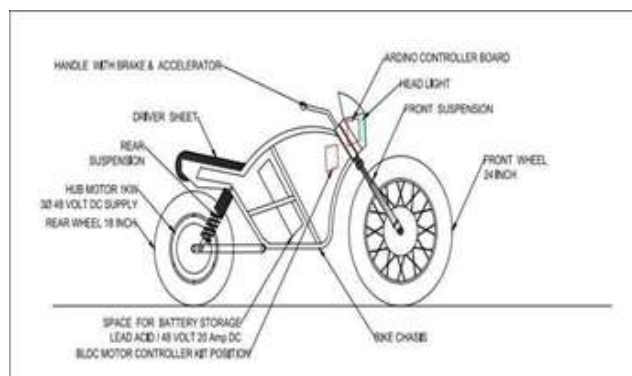Fig 9.Conceptual model of bike

SILENT FEATURES OF PROJECT DESIGN

1.   Engine- In the E-Bike there is no use of engine because it depends upon only electricity so in the place of the petrol engine we use "Hub Motor".The hub motor is placed in the rear wheel of the E- Bike.Due to having centre position in the rear wheel it has high moment of inertia which helps in the smooth running.

2.   Petrol Tank- In the E-Bike there is no requirement of the petrol tank because it runs with the help of electricity so we replace the battery box by the petrol tank for giving the 48V supply to the hub motor.We use four set of batteries,each battery have rating of12v/20amp.

VII.FUTURE SCOPE

1.   Solar panels can be used for batterycharging
2.   Activities such as whether authorized or unauthorized person is going to handle bike is informed to the user with the help of message through GSM technology.

VIII.   CONCLUSION

Thus fingerprint identification enhances the security of a vehicle and makes it possible only for some selected persons to start the bike.Thus by implementing this relatively cheap and easily available system on a bike one can ensure much greater security and exclusivity than that offered by conventional lock and key.The only authorized person can operate E-bike.Thus design of an Electric- bike which may be solution to our problems which we are experience now-a days   like traffic congestion,parking difficulties and pollution from fossil fuel vehicles.

ACKNOWLEDGEMENT

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