

## **ELECTRIC BIKE WITH SMART FEATURES AND AUTOMATIC SECURITY LOCK**

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### **Abstract**

Bicycles are very familiar to all of us. People of all classes use bicycles due to low prices than other vehicles. Bicycles are stolen due to insecurity which is a big problem nowadays. The proposed system has been introduced to address this issue. This paper recommends a smart kit for bicycles as a safety precaution and converting a normal bicycle to an electric bike. Notable features in electric bike Kit are automatic smart lock, color display, alarm, notification via ring and call from the device to user and location tracking. Automatic Smart Lock (ASL) which can be easily locked and unlocked by connecting to an Android mobile. Even this ASL can be locked and unlocked through the display used on the bicycle. Alarm is another remarkable feature. After shifting the device to alarm mode, when the bicycle is moved from its initial position, the alarm will sound through the speaker. With the alarm, the ring and call will go to the mobile number given by the user. If the bicycle tries to take the unauthentic person three times which means the bicycle moves three times from its initial place, SMS will go and if it moves 5 times the call will go to the user. Especially in SMS, the latitude and longitude values of that position of the bicycle will be passed on to the user. The color display is a significant feature where all the features show on the display such as setting lock-unlock condition, alarm status, speed meter, battery health, charging status, total travel time and location track mode on and off. These tasks are done by selecting different options through different buttons used in the display. One of the most noted advantages is that this device does not require any keys. The display has a hidden password provided by the user through which the display is unlocked by pressing that password using the button. So the device proposed in this paper will help people against bicycle theft.

*Keywords: Electric-Bike, Automatic Smart Lock, Color display, Location track, Alarm, SMS and Call.*

## 1. Introduction

In this 21st century, we are using advance technology in everywhere. In this innovation world we always need to think out of the box. And the technology updates day by day. Other hand Energy crisis is one of the major concerns in today's world due to fast depleting resources of petrol, diesel and natural gas. In combination with this, environmental decay is an additional factor which is contributing to the depletion of resources which is an alarming notification. Now we also talk about innovation to make our life easy. And also trying to update the old things in advance mode. Scientists are always trying to make our life easier.

Cycling is always good for health. Also cycle is used for fashion and stunts etc. But now the picture is completely different. There is a common matter in everywhere, we use new things and new technology. And also use the old things in update version very widely. Electric bike also known as e-bike is a bike with integrated electric motor that can be used for driving. There are many types of e-bikes around the world. The Electric bike which will be running on battery, the power is supplied by the motor, thereby supplying this power to drive the other gear components and electric bikes can travel from 25 to 32 km/h according to local laws, while more standard items can often exceed 45 km/h. [1].

In the 1890s, electric bicycles were documented. Two years later, in 1897, Boston's Hausa W. Libby invented an electric bicycle. By 2007, using and manufacturing of E-bike increases. But the features are very poor which are Motor, Head Light and Battery Indicator Light. Here we try to keep bicycle in an advance level. We use modern bicycle and set up 24V 250W BLDC brushed motor.[2] 24V15ah Li-ion battery. Color Display which indicates charging level, speed and time etc. Speed meter sensor, which is situated in the front wheel. Smart lock which is operated by phone with Bluetooth and display button too. This smart lock is very challenging part of this project because Nowadays E-bike theft indeed has become a big problem of the community. Although, the authorities are said to be doing the best they can to stop these thieves but Security plays a vital role in today's society. Safety of vehicles is extremely essential for every private and public vehicle owner. For this reason, various security systems have been carried out, but most of these security systems are expensive, complicated and best suits to cars. As for E-bike, basic and affordable security system only gives siren indication and will make a lot of noise that disturb people. But if the person is far from the motorcycle location, he will not be able to hear the alarm. Physical type counter measures are also used to prevent theft, such as padlocks, disk break lock and other more which is a preventive action but it is not safe enough.

Due to these reasons, this study proposed to adapt the security system solutions to E-bike.[3]

So it contains completely new and different system. It has anti-thief security system, App control automation locker which is metal gear lock. On Display have a program controller we can lock from display controller and GPS functions security system. It has Gyro sensor which is used to detect movements and vibrations from the E-bike. SIM 800A GSM/GPRS Module to track, where the E-bike is travelling. HC-05 Bluetooth module to connect phone and control the smart lock on, off. And all the functions or module are operated and controlled by a controller i.e. Adriano board. This E-bike has top speed of 30km per hour. One full charge can run about 45km. It has charging system and need 4 hours to full

charge. The main purpose of using this E-bike is that it is user friendly, economical and relatively cheap cost security. The efficiency of this system undeniable compared to conventional modes of transport and non-polluting modes of transport.

## 2.Literature review

Every day we are converting to digital from analogy, we are going to develop an electric bike with some of the new features. The large traveling problem solves our e-bike with an amazing feature. The human sensibility for the energetic and environmental problems solved using electric power bicycles. After a long time, the system is working but nowadays our technology is developing day by day and moving to smart tech.

**A. In 1418 Italian physician and engineer, Giovanni Fontana** is build the First human power land vehicle in fifteenth century, it was four wheels. [4] One the others site, we have seen the Leonardo da Vinci Bicycle Hoax was sketches showing printing version of a bicycle in 1974. [5] Finally, in 1817 Karl Drais invented a running machine Variously called velciped, he followed by draisienne and dandy horse. This is the main appearance of the bike rule that is fundamental to cycling and motorcycling and limits moving opposition.

**B. The Bikestastik in 2007 [6] and ubiActive** in 2012 [7] they used android application in their projects. The Bike user installed to run this application their own phone and used only the inbuilt sensors on the mobile. The e-bike are moving to requires human power or battery power, and therefore this has a minimum requirement already have a battery – basically motors such as use in cars, lorries, boats or trains. On the other hand, bicycles are a demo of the moving object without battery and motor. Security is very important for everyone. Every people wants to live securely in his/her bike. We always themselves to keep safe our bike and secure everything.

**C. Souvik Paul and Soumi Mondal ‘GSM Based Smart Locker’ [8].** This GSM Based Smart Locker is a locking technology which will allow a user to unlock without using traditional key. We implement this technology in this e-bike with proper way. This locker controlling system is very easy. You can control very easily two ways over the smartphone android application and password lock in e-bike button system.

**D.** This paper is the main thing replacing human power to use electric power. One of the most sensible things about this bike, moving the while without human power using battery power. When turned on the power key will be on display and functions are available. Two types of functions are used, one of Mobile control another is a manual function in the display using the button. This is a microcontroller device all are the functions wrote in microcontroller chips. We attach some of the features, Auto-lock, location tracking, Bluetooth, and some of the sensors. Also barcode scanning systems. Our locks are worked in manually, mobile function and new function is *SMS/text sending lock/unlock system*. When you lose your e-bike you can track 24 hours e-bike locations using GPS modules. also given the updates GSM modules call and texts and lock/unlock system.

GPRS Tracker Sensor 24 hours tracking location and given the update, by use the cellular network. Speed Sensor is calculating all the history in your daily life travel distance in kilometer (KM), per day km, per hour km, current speed km, total travel in km. You can use more extra interesting new and useful feature our e-bike color display, traveling to 25-30 kilometers per hour speed. Cellphone controller, smart lock, first charging, 7 hours' battery backup, location tracking.

### 3. Description of the proposal

Bicycle is a manual machine. Here we try to convert the manual system to automated system. In this project we used some method for atomized. A motor is used to rotate the gear and the motor is driven by a DC battery. We used 2.4" display to monitor battery level, speed, time, security system etc. We used a GPS module for implement tracking system. A Bluetooth module used to connect phone to operate the security system by phone. A smart lock mechanism is setup in the front of wheel to improve the security level. The entire module is driven and monitored by an Arduino Mega and Arduino Nano. A method was used to find out voltage label which is voltage divider. The entire module and voltage driver made their voltage need from the same DC battery.

### 4. Block Diagram Connection

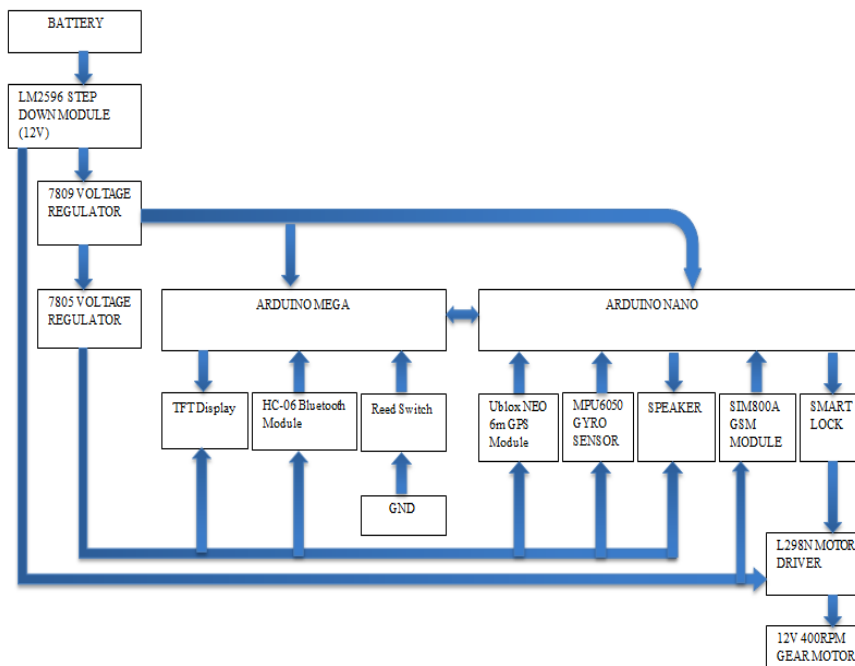


Fig. Block Diagram of the E-bike

## 5. Project Flow Chart

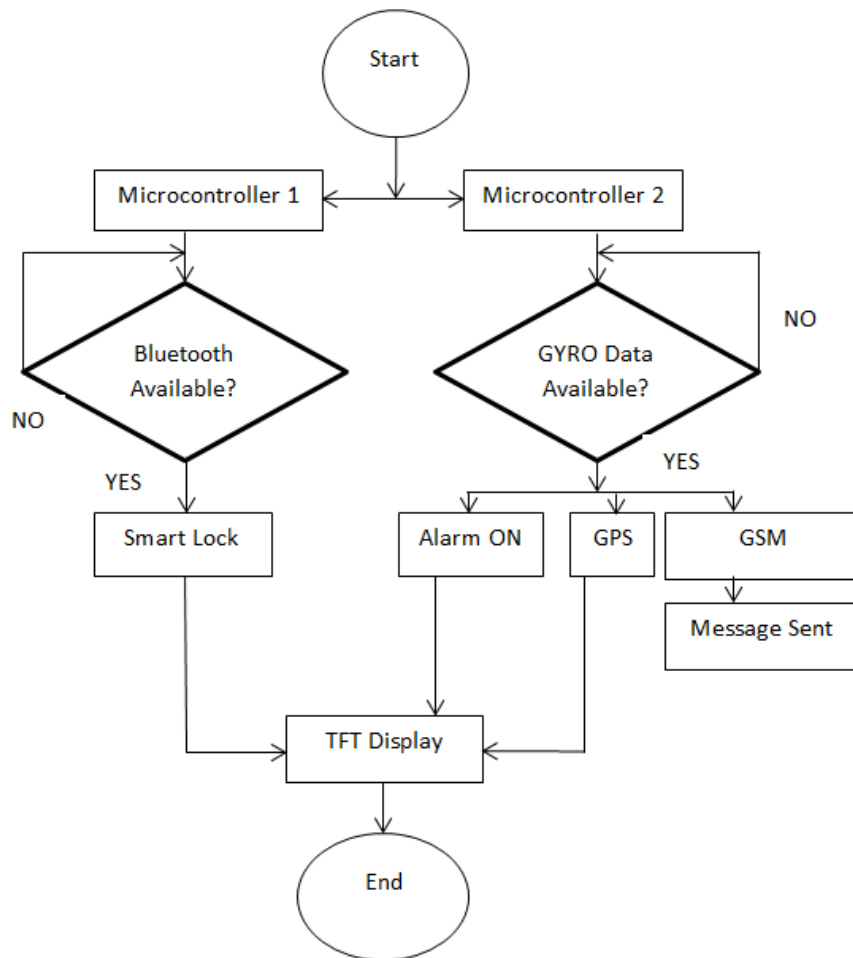


Fig. B-1. Main Flow Chart of the E-bike

## 6. Simulation

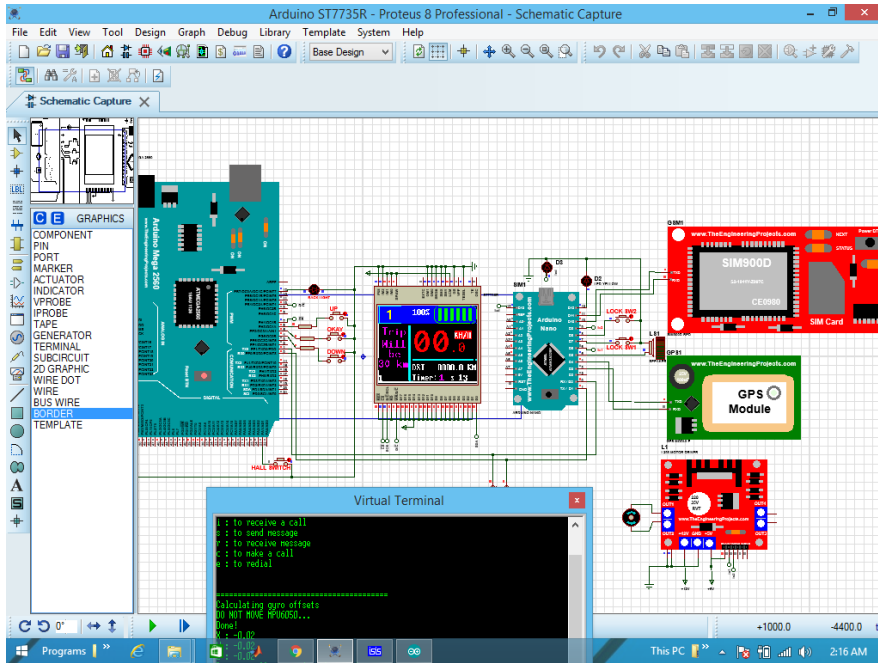


Fig. Simulation of E-bike

## 7. Mathematical Calculations & results

### 6.1 CALCULATIONS

The motor used in the E-bike is permanent magnet 24-volt DC Brushless Gear motor of 250 watt. Rated current 10.4 and during no load condition each motor consumes 1.6 ampere current. Motor can be reaching a peak current during starting equal to 13 amps. The motor has inbuilt gear to increase the torque, gear ratio 9.78.1. Rated torque 0.8-1N.m. These motors are used in electric Bicycles and cars they can work in any hostile terrains, like the mountains or the deserts and advantage of using this motor is that they require very less maintenance in comparison to other motors. To choose motors capable of producing enough torque to propel the vehicle.

$$P=2*3.14*N*T/60$$

$$250=2*3.14*300*T/60$$

$$=0.79 \text{ N m}=790\text{N-mm}$$

$$\text{Chain drive reduction}=20/9=2.22$$

$$\text{Wheel shaft torque} =T*R \text{ chain}=790*2.22=1753.8 \text{ N mm}$$

$$\text{Wheel shaft speed} =300/2.22=135.13 \text{ rpm}$$

$$\text{Electric energy} = V \times I \times T$$

(i)

**Table 1. Power requirements for various accelerations**

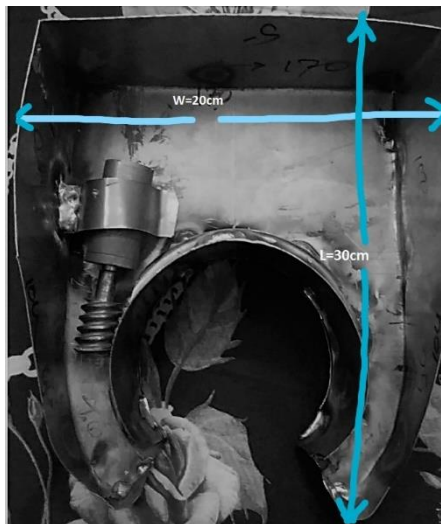
Time to Accelerate(s)	Velocity	Voltage Available (v)	Current Required (amps)	Power Consumed (watts)
20	25mph (11.2m/s)	24	10.5	
40	25mph (11.2m/s)	24	7.7	
60	25mph (11.2m/s)	24	5.5	

Another Motor used in locker to lock or unlock it's a 12v high torque electric motor dc gear motor.

Motor Rating no load 280rpm ,0.3A, torque 0.4 kg.cm

On Load 210rpm, 1.8A, torque 2kg.cm.

This motor used to run worm gear. worm gear size L=18cm, D=12cm and gear tooth 1.2mm. Also this worm gear run Flywheel ring gear which is locked the E-bike. Flywheel ring gear size D=12.5cm, gear tooth 1.8mm.



**Fig. 1. The smart lock body inner side.**



**Fig. 2. The smart lock body inner part.**

The structure of the Locker box is made of Stainless Steel Sheet. Different cutting, joining and shaping operations are performed through welding machine, lathe machine, shaper machine and drilling machine. Its size wide 20cm, Length 30cm and height 4cm. inside this locker box all are PCB board installed.

## 6.2 Results

In this section, we describe preliminary results of the proposed module in terms of the implement ability of the design in a functional and a qualitative analysis of the performance. After finished the project we run experiment on the e-bike. During the successfully experiment period we become a conclusion on e-bike. The project “E-bike “has been made for electric / smart lock with GPS tracking and alarming for unnecessary situation. The smart lock received the comment by scanning Q-R Code, text /SMS or manually and automatic successfully done his lock /unlock process. It takes near about 04 seconds take for lock or unlock process. The lock or unlock situation are showing on the digital color display which is attached with the E-bike. When e-bike is under lock position it alarmed the unnecessary shake. After consider a few amount of shake it send text /call to the driver. We also control the lock or unlock situation over server. When the e-bike is running position, the display has shown the speed of E-bike and indicates every turn or stop situation. Also the display has shown the time, battery level, charging situation. All of the work finished without any error.



The display will be showing the product of eBike range. There are many options in the eBike display function. It is color display and the display will be given time, google map, distance actual rate, show the speed of eBike, one of the most important is locked and unlocked by button with personal passcode in the display function and easily change the password using buttons and set time or text message to your phone.

## 8. Future work

**Calorie measurement:** Based on the readings from the accelerometer, gyroscope and user profile, the calorie measurements will be calculated and displayed to the user's mobile phone mounted on the handle. The user can set the target calories that he/she wants to burn in the manual mode. After the target is accomplished, the user can now shift to the electric mode.

**Biometric (Fingerprint locks detection system):** User can lock/unlock his bicycle using his fingerprints. The lock will operate on a separate mini rechargeable battery, such that even if the main battery is discharged, the bike can be



locked/unlocked. Multiple bikes with such a feature can be used for bicycle rental based on Adhaar Card credentials from select rental stations.

Business and Data Analytics: Biometric locking and GPS can provide a secure and reliable platform for cycle rental business. Bicycles can be reserved to be picked up from a particular location by an app and an Adhar card number. The billing and user statistics will be synced with this number only. Calorie measurement data bundled with the GPS coordinates from multiple places can help build a 'calorie road-network' in the city based on average calories burned per route. This information can be used to estimate the calories a user might burn on a certain selected route. This data can also be used to suggest routes for people with health problems. GPS coordinates along with time data can be used to estimate time to travel from one location to another.

- The device should be able to generate the calorie count.
- The device should lock and unlock with the fingerprint scan.
- The device should be able to talk to a remote server and send data.
- The device should be able to track its own location.
- The device should be able to calculate distance between itself and user.
- The device should be able to work over conventional power sources.
- The device should be judicious in power usage.
- The device should be able to calculate distance travelled and incline of road.

## 9. Conclusions

In today's modern world, new advances in technology have made people's lives easier and safer. Technologists around the World are trying to make life easier but they have to keep an eye on the huge global demand and its versatile use, so as not to create any adverse effects on the environment. With that in mind, we developed the E-bike with new technology and safety measures, which is very modern and eco-friendly. This e-bike is designed in such a way that it is powered by both peddle and batteries power. We add more new technology, security systems. It's mean it has anti-thief security system, App control automation locker, which is Arduino based. It can be locked by Mobile app and lock bar code. On Display have a program controller we can lock from display controller; GPS functions security system and we can see battery life.

### Abbreviations

E-bike	Electric Bicycle
GPS	Global Positioning System
AC	Alternating current
DC	Direct Current
GPRS	General Packet Radio Service
LED	Light Emitting Diodes
Li-ion	Lithium Ion
GSM	Global System for Mobile Communications
LCD	liquid-crystal display
TTL	Time to live
PCB	Printed Circuit Board
AFH	Adaptive frequency-hopping
CSR	Corporate social responsibility
WDM	Wavelength Division Multiplexed

### References

1. S. Matey, A. Prabhu, "Design and Fabrication of Electric Bike" International Journal of Mechanical Engineering and Technology- Vol. 8 Issue 3- March 2017
2. Archie O. Pachica, Dhava S. Barsalote, Jessy Mae P. Geraga, Jhestine M. Ong and Michael D. Sajulan, "Motorcycle Theft Prevention and Recovery Security System" International Journal of Applied Engineering Research ISSN 0973-4562 Volume 12, Number 11 (2017)
3. Chris Kiefer, Frauke Behrendt, "Smart e-bike monitoring system: real-time open source and open hardware GPS assistance and sensor data for electrically-assisted bicycles" IET Intelligent Transport Systems · August 2015.
4. Source: R. John Way, The Bicycle - A Guide and Manual.
5. <https://www.cyclepublishing.com/history/leonardo%20da%20vinci%20bicycle.html>

6. Reddy, S., Shilton, K., Denisov, G., et al.: 'Biketastic: sensing and mapping for better biking'. Proc. 28th Int. Conf. on Human Factors in Computing Systems, (CHI '10), ACM, New York, NY, USA, 2010, pp. 1817–1820
7. Fan, Y., Chen, Q., Douma, F., et al.: 'Smartphone-based travel experience sampling and behavior intervention among young adults'. Technical report, Intelligent Transportation Systems Institute, Minneapolis, 2012
8. Souvik Paul, Soumi Mondal 'GSM Based Smart Locker'International Journal of Computer Science and Information Technologies, Vol. 6 (6), 2015.