A SmartBike: IoT crowd sensing platform for monitoring the rider safety

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***Abstract*— The Smart Bike Monitoring System BMS) project combines several technologies, both software and hardware, to create a current solution for riders, allowing them to monitor their progress online via an android application. Some of the crucial parameters for a rider include the speed and power generated by the bike and the ability to observe where the bike is at all times using a GPS module. The hardware is in charge of storing, scaling, and sending data from sensors, while the software includes an Android application that displays and pops up notification data and collaboration between the bike and the rider. Finally, an Android app acts as a remote command for the bike's hardware module, allowing control of how and when the .ride is monitored**

Keywords— ESP32 Micro controller, Relay 4 channel Board, Sim800i, GSM module, Neo M6 GPS, Arduino ide, Android application, Firebase.

INTRODUCTION

Nowadays, technology has progressed to the point where numerous changes are being made. As a product of which we are introducing the SBMS based on IoT (internet of things), the purpose of working on this Application is to provide unique features to the rider through the Application been installed on the mobile phone which would control the bike and can track and alert the rider to every error he or she performs while on the road. With a smartphone application and an internet connection, the rider can also operate the system by beginning, stopping, or ending. The ride speed can also be managed, and it would be set on the appropriate level, which is acquired by the rider, and if the speed is increased than the prescribed speed, it will notify on the phone through a pop-up message.

The main feature quickly locates the bike's current location through the GPS tracking systems installed on the SBMS application. The purpose of SBMS is to make our bike automated, and It is essentially a combination of hardware and software that allows controlling the bike across all factors.

As it is predefined that cars are fully automated, which provides security, GPS locating system, and sensors providing basic functionalities and features to the driver. Which motivates us to develop an application that provides similar features and functionalities to a bike and its rider. Table 1 represents the relevant work and the solution. Considering the problems that the riders are facing, this kind of Application is not available.

Table1: Problems and its solution

S #	*Title*	*Purpose*	*Advantages/ Disadvantages*
1	Connect bike-smart IoT – base bicycle training solution	This paper provides a technical approach to addressing these problems by reading, sending, saving, and displaying data using sensors, microcontrollers, and microcomputers.	The system works with real-time data about bike location
2	Smart -e- bike monitoring system real-time open source and open hardware IoT – base system	According to studies, riding electric bicycles as a mode of transportation saves the commuter an average of 8.5 litres of fuel every 100 kilometres. However, pollution will be greatly decreased, making the electric bicycle a new mode of private transportation for individuals concerned about the environment.	Bike riders can see every location through the GPS
3	Mobility on smart electric bicycle	The research paper proposed is that make smart bike system act like car	The system doesn't work Without network data.
4	Smart Mobility in the Netherlands	More efficient use of existing infrastructure in urban cities and provinces is required. Smart Mobility is one proposed answer to the expanding mobility difficulties.	The system battery has a power bank because of all hardware connected with the battery.

Study of Objective

The project aims to provide the necessary functionalities to the rider. SBMS is based on IoT, which provides the latest features and techniques to control some of the essential parameters, more precisely, the speed, which can monitor online using an android application through a GPS module. The rider can also see his or her current location in real-time. Hardware and software components should be used to complete the procedure. Sensor data is collected, processed, converted, and sent from the device. On the software side, there is the server,

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which consists of the Back end and the Front-End of the Android App, which shows and manages bike and rider communication. The Android App functions as a remote command for the bike's hardware module, allowing the rider to control how and when the ride is monitored.

- Develop a mobile app for operating the (SBMS)
- Calculate the bike's speed and maximum speed output using the collected data.
- Real-time GPS tracking of the bike.
- To allow the user the monitoring system through a mobile android application
- Collecting data from sensors

Significance and Limitation

The project is to provide advanced functionalities and features to the rider through the Application. The project's outcome is an interactive (SBMS) IOT based system. After collecting the requirements will be done using sensors and hardware, including micro controller, relay four-channel board, GSM module, and GPS.

- Does not support the video feature.
- live location can be navigated through the GPS
- Collect the data through the sensors

LITERATURE REVIEW

This is a general literature review is conducted regarding electric bicycles and their different systems, the bike system components are discussed, and several control and energy management systems are reviewed. Finally, the concept of data fusion is detailed along with localization and positioning The IBISC laboratory (Informatics, Bio-Informatics and Complex Systems) is a Research laboratory of Paris-Saclay University and the University of Evry-Val-d'Assonne. It is a merge of two laboratories: lami (Laboratory of Computer Methods) and LSC (Complex Systems Laboratory). It is composed of four teams (AROB@S, COSMO, IRA2 SIAM), whose research is divided into two areas

ICT & SMART SYSTEM: activities in this area are focused on drones and Vehicles, with the aim of designing autonomous systems that interact with the environment, and that can make decisions to achieve a common goal.

— ICT & LIFE: The activities of this one are focused on personalized medicine and precision. Hey cover problems in biology at different scales (biological and biomedical data and signal analysis, systems modelling biological, surgical training and personal assistance)

Both electric and traditional bicycles appeared almost at the same time. Many patents were granted for e-bike engines in the 1890s, and in 1920, a German company called Heinz man began the mass production of electric motors for e-bikes. Nowadays, the use of e-bikes has become prevalent in large cities due to overcrowding and traffic jams. Thus, tens of millions of e-bikes are sold worldwide [3]. Globally, Over 40 million bikes have been sold. In 2015, China alone represented a share of 90%, 5% of those were sold in Europe versus only 0.7% in the USA Research is still lagging when it comes to electric bicycles, around 900 papers were published from 1973 to 2017 [4], prior to that no data were recorded. Research about e-bikes started increasing in 2003 and witnessed significant scientific production in 2008, figure 1 shows the distribution of scientific production by country for the year 2018. RYAN CITRON, "Bike sales have increased in major European markets, but the United States lags behind," 2018. [14].

Bike accidents frequently result in the death of bike users. Technology can help to protect such bike users. Smart bikes with sensing, computing, and communication capabilities and smartphones for riders have the potential to be integrated into such internet of things environment. Bike accidents frequently result in the death of bike users. Technology can help to protect such bike users. Smart bikes with sensing, computing, and communication capabilities and smartphones for riders have the potential to be integrated into such internet of things environment. To avoid bike-vehicle accidents and provide biker safety, minimal effects are produced on IoT integrated bikes. This IoT-integrated bike would create new and unique information and cyber security risks, which could make accident prevention solutions effective in realizing the potential of IoT, especially in biker safety. Biker safety management framework that combines a misbehaviour detection scheme (MDS) with a collision prediction and detection mechanism (CPD). The MDS Integrates in-vehicle driver behaviour monitoring to identify potential threats. A rider who are misbehaving. The MDS and CPD frameworks are based on an upgraded version of certain existing solutions. The framework's use cases highlight its potential in improving bike safety. Prediction and detection of accidents, ultrasonic sensor and speedometer.

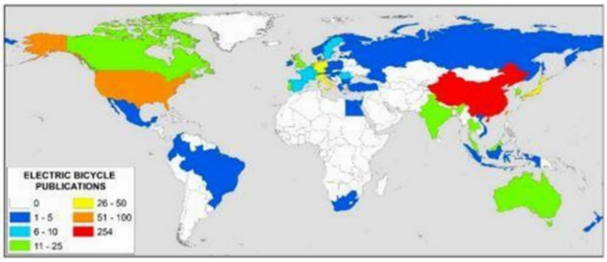

Fig 1. Distribution Of Scientific Production by Country for the Year 2018

METHODOLOGY

The Smart Bike Monitoring System (SBMS) offers a user-friendly and practical interface that is simple to use and understand. It is an internet-of-things (IoT) Application. Furthermore, it is an android application, so users can easily access it through network data with the help of GPS. The user has access to locate the bike and can be notified by a pop-up message if speeding the bike from the prescribed ith the help of a mobile phone application. An individual can enhance speed. The system integrates an Arduino, microcontroller in terms of hardware, Relay four channel model, GSM model, neo m6 GPS, Speedo meter, and software side. We have Arduino ide, android application and fire base.

CRISP Model

The CRISP Data mining model plays a vital role in planning, organizing, and implementing for our project. The main stages are shown in Figure 2, while the stages involved are discussed below.

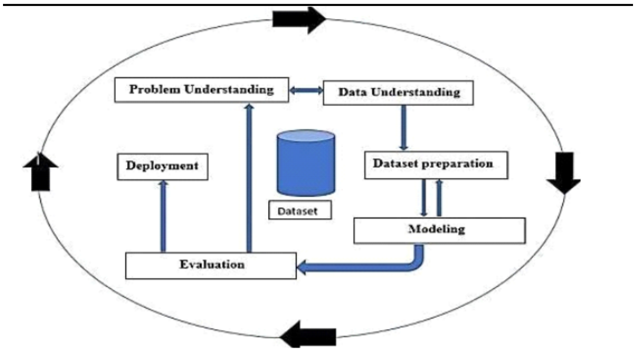

Fig. 2. CRISP-DM Model

Data Understanding

This step deals with the complete understanding of data quality relevant to our project.

Modeling

Our model is 2D based convolutional firebase data set sensor system, which is three layers one of the most influential innovations IoT based in computer vision & computer engineering.

Evaluation

This step deals with the validation of results, whether results are effective and accurate or not based on analysis and examination in which the filtration of data from multiple sources then associate them together to form report analysis.

Deployment

This step helps in the presentation of results in precise and beneficial way.

Prototype

The user interface of the smart bike monitoring system, which is an android Application, allows a user to control all kind of features and accurately and efficiently start the application and interact with only some simple steps, which are illustrated below.

Initial Graphical User Interface

This is our project's initial graphical user interface, which displays all the functionality through which users can go ahead to use the android application remotely. The Graphical User Interface is shown in Figure 3.

Fig 3. Initial Graphical User Interface

Start Application

Through this start, Figure 4 button user can quickly start the Application and display all the Application's features in front of the user.

Fig 4. Start Application

ON/OFF Button

Through the on/off push button you can starting the bike by using the mobile phone. The interface is presented in Figure 5.

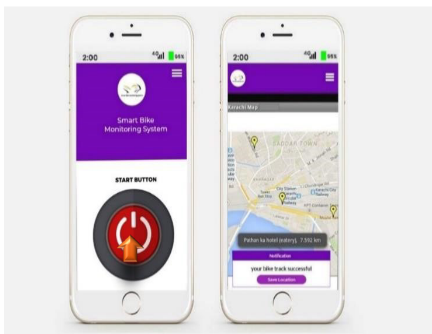

Fig 5. ON/OFF Button

Speed Button

Through the speed button user can manage the speed user wants to keep nothing more than 50km/hr user manage through the speed shown in Figure 6.

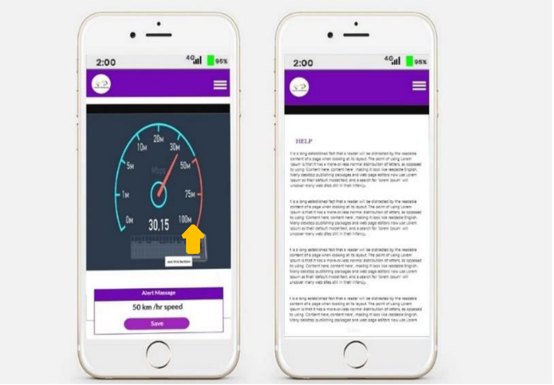

Fig 6. Speed Button

GPS Location Trace Button

There is giving the opportunity of user can locate the location through the Global Positioning System (GPS) button and user can every movement of bike location shown in Figure 7.

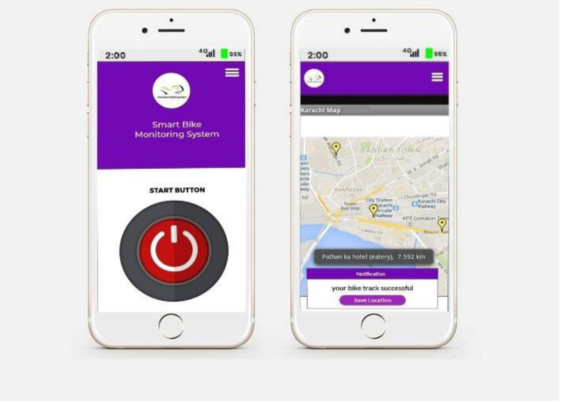

Fig 7. GPS Location Trace Button

System Architecture

The hardware consists of two modules, each of which has an Arduino and a microcontroller and a separate power supply or battery. And can communicate wireless with each other and are connected to a relay four-channel board that controls all modules. The microcontroller performs the following data. modification, it is converted to a byte array and sent to the Raspberry Pi algorithm, which reads the data from the GPS module and tracks the location using the mobile Application.

Network Layer

The speed and cadence are determined using an Arduino with two sensors in the module. The microcontroller wants to control the data before converting it to a byte array and transferring it to the Raspberry Pi through a USB port. The data is then converted back into binary format and combined with GPS module location data.

Application Layer

Three key components are responsible for the system's logic at the application level Determining how the Application will be processed, as well as how data will be stored and displayed. The first component is an Android app that controls the Raspberry Pi algorithm on the bike application, allowing it to perform various tasks. It is simple to keep control ride. The Raspberry Pi module is the second component, which is installed to the Raspberry Pi algorithm on a mobile Application that implements the system's logic in the form of a data structure, selecting to choose whether or not to begin receiving, processing, and sending data based on commands from the Android App The web application is the layer's third component. It allows users to connect, see data from rides, and monitor a ride in real-time.

Hardware Layer

Since hardware consists of two modules, each has an Arduino, and the microcontroller has a separate power battery that communicates wirelessly. The first module is based on an Arduino. This module reads data from the load data and transfers it through wireless communication to the other module. The data is then converted back to binary format and integrated with GPS module GPS location values. The final data format is JavaScript Object Notation (JSON), which is published to the server daily. The overall architecture of the system is presented in Figure 8.

USE CASE DIAGRAM

This fully dressed Use case diagrams model of SBMS defines the detailed functionality, and a deep understanding of Actors and use cases are part of our system. A set of actions, services, and functionalities that the system must perform is described as a use case.

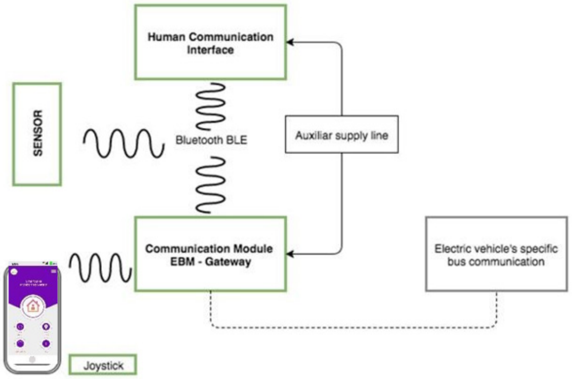

Fig 8. Proposed System Architecture

Within the system, the "actors" are people or organizations which perform specific tasks. For our project's better understanding, the fully dressed use case diagram is represented in Figure 9.

Flowchart

This flowchart of the smart bike monitoring system represents the workflow of our system employing geometrical shapes defining the step-by-step approach. For a better exemplification of our system, the flowchart is symbolized in Figure 10.

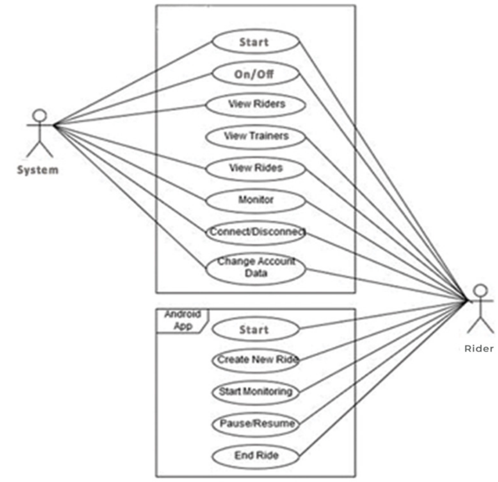

Fig 9. Fully Dressed Android Application Use Case Diagram

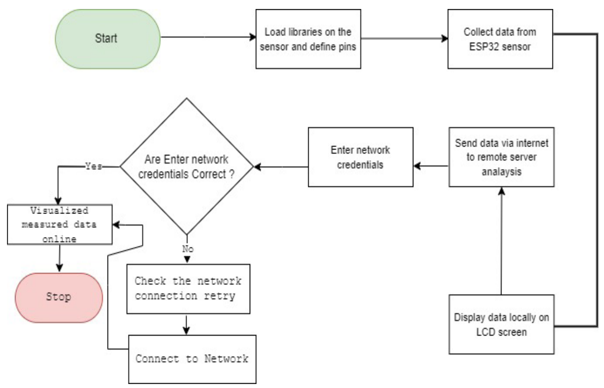

Fig 10. SBMS Working flowchart

CONCLUSION

Accidents are a major concern for everyone today. In this article, we intend to develop a system utilising IoT idea to detect the accident in a bike. Since accidents are increasing daily, we have minimized accidents by implementing some effective precautionary measures. In the Internet of Things, we use a microcontroller, an accelerometer, a position sensor, an Android app, and when an accident occurs, we can send a message to the hospital, family, and friends using GPS and GSM location. Smart bike monitoring system will help in saving human lives and also avoid robbing of vehicles. We used a wide range of technologies in order to design the Mobile Application. SBMS is a unique method of controlling speed and tracking the location of a bike using a mobile application while providing riders access to essential features. Furthermore, the future work includes the theft detection concept. If all monitored and managed operations through an Android application are terminated on purpose. So, an unauthorized individual enters the vehicle, it sends a round alarm to the bike's owners, and the owner can turn off the motor from anywhere using an Android application. The owner can also set up a geolocation boundary for the car, so that if it leaves the boundary, the owner will be notified.

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