IOT BASED PARENT CONTROLLED E-BIKE

Keerthi Kumar M, Renuka, Ruchithashree B S, Sahana G, Sahana Kashyap

Department of Electronics and Communication Engineering, GSSSIETW
Mysuru, Karnataka, India.
keethikumarm@gsss.edu.in

ABSTRACT

An Internet of Things-based parent-controlled e-bike system has been devised and put into operation by technological research. A variety of hardware components are included in the system, including the 20x4 LCD display for user input, the MPU6050 sensor for motion detection, the GPS Neo-6M module for location tracking, the GSM 900A for cellular communication, and the microcontroller ESP-WROOM-32. The Arduino IDE for microcontroller programming and the Blynk app for remote monitoring and control make up the software components. These parts work together to give parents the ability to monitor and control the e-bike from a distance, increasing the security and safety of younger riders. The research emphasizes how the Internet of Things (IoT) may improve user experience and security by describing the hardware configuration, software implementation, and functionality of the parent-controlled e-bike system.

Keywords— IoT, E-bike, Parent Control, Accident Prevention, ESP32, Blynk App

I. INTRODUCTION

The transportation industry has been integrating the Internet of Things (IoT) into its operations due to the rapid growth of technology. IoT technology is being used to improve safety, security, and user experience. Smart and connected solutions are becoming increasingly popular in transportation, and one example of this is the creation of smart two-wheelers, such as electric scooters and motorcycles. These vehicles are equipped with several IoT modules, including sensors, GPS tracking, and GSM connectivity, which allow for real-time monitoring and control.

However, concerns about safety and security have arisen with the rise in the use of smart twowheelers, especially among younger riders. To address this issue, an IoT-based parent-controlled e-bike system has been proposed. This system combines various IoT components, such as sensors, GPS tracking, and GSM connection, to provide real-time monitoring and control. The system enables parents to set speed limits, track the position of the two-wheeler, and receive emergency notifications, thus enhancing user experience and safety.

The proposed solution builds on previous studies on smart bike safety systems, IoT controllers for smart bikes, and electric bike monitoring and control systems. It offers parents a comprehensive solution to ensure their children's safety and security when riding a twowheeler by utilizing the possibilities of IoT technology.

II. RELATED WORKS

In this section, we will discuss the previous research that has been conducted on the architecture we have suggested. We will highlight some of the significant contributions made in these areas. Mohd Hakimi Bin Zohari et al. [3] proposed a GPS-based vehicle tracking system that uses Arduino MEGA. Although the system works well outside, it has signal loss issues indoors. Therefore, they recommend using a higher quality GPS module for increased accuracy. Hanif Hakimi Azlan et al [6] suggested using an MPU6050 sensor to automatically identify accidents. They also used GSM and GPS modules to transmit location-based notifications. The system improves motorcycle rider safety, but it may require large manufacturing. M. Ajay Kumar et al [7] proposed using an accelerometer to identify collisions and send rescue messages. The system sends messages over GSM and tracks location using GPS. Additionally, it can detect drunk driving accidents using sensors. Saad Ur Rehman et al [4] developed a motorcycle accident detection system with a 97.33% detection rate. The system uses tilt and MEMS accelerometer sensors and GSM to alert emergency contacts to the position of the wounded driver. Muhammad Ridwan Arif Cahyono et al [5] presented an electric bicycle IoT system that uses ESP32 and SIM800L for remote monitoring. The app monitors speed and tracks calories. Testing showed a 100% success rate with 8.82-second latency and 94.24% accuracy.VandanaSayila et al [8] developed a speed control system for Electric bikes based on an MPU 6050 and Arduino Uno. The system uses the steering angle as a basis for controlling the motor speed, which can be adjusted through an LCD and keyboard. The prototype offers improved security and control. Saima Siddique Tashfia et al [2] proposed a safety system for motorcycles that usesGSM/GPRSto send emergency notifications in the event of an accident. The system tracks the state of the bike and features an expert system for troubleshooting and maintenance information. Deepak K C et al [1] developed an IoT system that utilizes motion sensors to detect two-wheeler accidents. When an accident is detected, the system sends alerts and prevents incoming calls while the user is riding.

III. METHODOLOGY

To set up an E-bike, it is crucial to follow the instructions provided in the datasheets and pin layouts. Several components, including the ESP32, MPU6050, IR sensor, L298N motor driver, GSM module, and GPS module, must be attached. Creating an ESP32 development environment using the Arduino IDE and installing the necessary libraries to interface with GPS, GSM, MPU6050, and other essential features come next. Initializing sensors, setting up communication interfaces (UART, I2C), configuring GPS and GSM modules, and performing other initialization and configuration tasks are the next steps. The MPU6050 is an essential component used to identify abrupt shifts in orientation or acceleration, which could indicate an impending collision. If an accident occurs, it's essential to record its location, time, and severity. To determine the E-bike's speed, use the infrared sensor.
The IR sensor provides an RPM value, which the microcontroller will convert to speed using the formula:

Speed = Wheel Circumference* RPM (speed in m/s).

To convert the speed to km/h, use the formula: SpeedKmph = Speed * 3.6.

To control the speed of E-bikes, the ESP32 can be implanted to the L298N motor driver. For added safety, an intuitive control the Blynk app can be created to allow parents to operate and monitor the E-bike from a distance. This system should enable users to track the E-bike's location, receive notifications, and change speed limits. In case of any accidents or risky driving incidents, the GSM module can be integrated to send SMS alerts to designated contacts, such as parents or emergency services. To trace the exact co-ordinates of the E-bike in real-time, the GPS module can be used.

Systems can be set up to update the control system with location updates regularly, and the E-bike's location can be displayed using the Blynk app or any other tracking interface. Safety should always be a top priority, so it is important to take all necessary precautions to ensure the driver's safety.

A.Block diagram

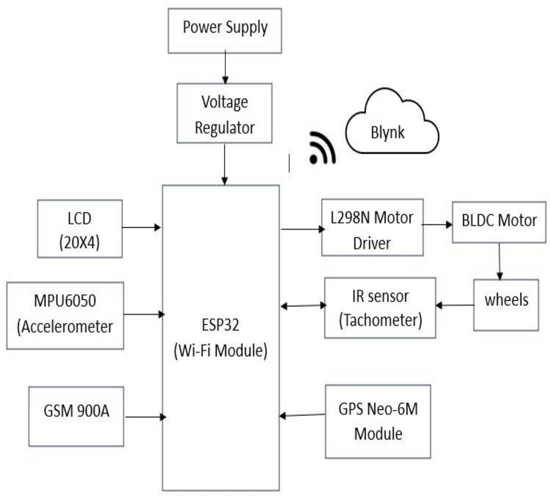


Figure 3.1 E-Bike Module

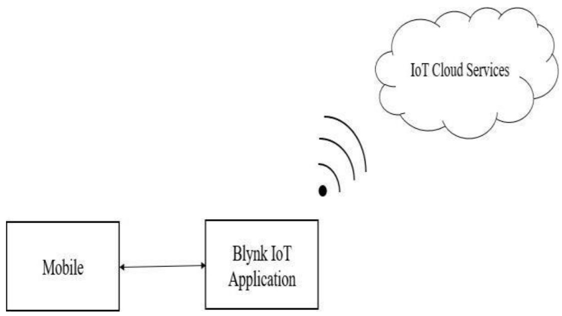


Figure 3.2 Parent Module

B.Hardware and Software requirements

Hardware Requirements:

- **ESP-WROOM-32**

It mainly consists of a 40 MHz crystal oscillator,4 MB Flash IC, and other passive components along with ESP32 SoC.
The ESP32 Board consists of the following:

- ESP-WROOM-32 Module
- 30 Input Output Pins

- CP2012 USB – UART Bridge IC
- micro–USB Connector (for power and programming)
- AMS1117 3.3V Regulator IC
- Enable Button (for Reset)
- Boot Button (for flashing)
- Some passive components
- An interesting point about the USB-to-UART IC is thatDTR and RTS pins, automatically set the ESP32 into programming mode (whenever required) and also rest the board after programming.

- **GPS Neo-6M Module**

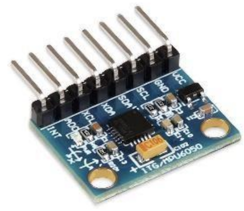
Thisdemonstrates the use of the popular, affordably priced, and extremely functional u-blox NEO-6M Global Positioning System (GPS) module. It is composed of an onboard memory chip, a backup battery, and a ceramic patch antenna. It is easily interoperable with a range of microcontrollers. This module features an integrated EEPROM and an external antenna. Interface: TTL RS232,Power source: 3V to 5V Baudrate by default is 9600 bps.

- **GSM 900A**

The smallest and least expensive GPRS/GSM communication module is the SIM900A GSM Module. In most embedded applications, it is usual to use Arduino and microcontrollers. For communication via a mobile sim, the module provides GPRS/GSM technology. SMS and mobile phone sending and receiving are supported, and it operates in the 900 and 1800 MHz frequency range. SIM900A module is a GPRS/GSM module, as far as we are aware. Certain functions of the module are device-dependent. It is the SIM that matters. Fully functional GPRS/GSM requires a connection between the SIM and the module. This is the module's entire sim interface:

SIM_VDD – Pin30 – Power Supply of the SIM
SIM_DATA – Pin31 – For data output
SIM_CLK – Pin32 – For clock pulse
SIM_RST – Pin33 – For reset
SIM_PRESENCE – Pin34 – To detect the SIM

- **MPU6050 Sensor**



A sensor that can determine a moving object's orientation is the IMU (Inertial Measurement Unit), plate number MPU-6050. It is made up of a three-axis accelerometer and a three-axis gyroscope that monitors temperature, rotational velocity, and gravitational acceleration. Also referred to as roll, pitch, and yaw, the gyroscope records changes in Angular Position versus time along the X, Y, and Z axes respectively. This enables us to ascertain an object's orientation. The accelerometer, on the other hand, tracks the rate at which an object's velocity changes due to both dynamic and static forces, such as movement or vibrations, as well as static forces like gravity. Acceleration is measured by the MPU-6050 in three dimensions: X, Y, and Z.

- **Infrared (IR) Sensor**

IR sensors comprise two primary components: an IR LED and a photodiode. The IR LED emits light within the infrared spectrum, making it invisible to the naked eye. On the other hand, the photodiode, also known as a light-dependent resistor, exhibits high resistance in the absence of light. When illuminated, the photodiode's resistance decreases proportionally to the intensity of the incident light. Operating in reverse bias, the photodiode, a semiconductor with a PN junction, conducts current in the reverse direction upon exposure to light.

- **L298N motor**

IJTRET "Voice of Innovative Minds"
International Journal of Trendy Research in Engineering and Technology
Volume 8 Proceedings of NCCDS-24
ISSN NO 2582-0958

The dual H-Bridge motor driver module L298N is intended to regulate the speed and direction of two DC motors or one stepper motor independently. It can handle up to 2A per channel continuously and operates in the voltage range of 5V to 35V for motors and 5V for logic control. In addition to features like temperature shutdown and current detection for increased safety, the module enables PWM control for speed adjustment. Because each motor has an enable pin that lets you operate it separately, it's a popular and adaptable option for robotics and motor control projects.

- **BLDC Motor**

An electric motor that operates via electronic commutation rather than mechanical brushes is known as a brushless DC (BLDC) motor, and it has various benefits over conventional brushed motors. Because there are no wear-and-tearcausing brushes, it has a longer lifespan, is highly efficient, and requires less maintenance. Because they can precisely manage both torque and speed, BLDC motors are perfect for a wide range of applications, including robotics, electric vehicles, drones, and HVAC systems. They often run more silently and generate less heat, which enhances performance and energy efficiency.

- **LCD 20x4 I2C Module**

The intended use of this LCD 20x4 I2C display module is with the Arduino microcontroller. It uses an I2C communication interface, so any Arduino-based project can display data with just two lines of I2C. It will leave at least four digital and analog pins free on the Arduino. All connectors are XH2.

Software Requirements:

- **Arduino IDE(IntegratedDevelopment Environment):**

The File, Edit, Sketch, Tools, and Help menus of the Arduino IDE provide access to a number of features. Because these menus are context-sensitive, they only show relevant alternatives in relation to the current job. Key operations include managing files, editing code, organizing sketches, utilizing tools, compiling, uploading, and integrating libraries. Additionally, features such as sketchbook, tabs, support for multiple files, and compilation and uploading processes further enhance the IDE's capabilities.

- **BLYNK Application**

Blynk is a mobile and web application for creating interfaces to control and monitor IoT devices. It provides a user-friendly platform for designing custom dashboards with widgets like buttons, sliders, and gauges, allowing real-time control and monitoring of devices. Blynk supports a wide range of microcontrollers and offers libraries for platforms like Arduino and Raspberry Pi.

It enables cloud connectivity and provides alerts and notifications based on device data. Users can easily set up projects by generating an authentication token and writing code using the Blynk library to connect their devices to the app.

International Journal of Trendy Research in Engineering and Technology
Volume 8 Proceedings of NCCDS-24
ISSN NO 2582-0958

IV. Flowchart

The Figure.3.3 represents the flowchart of the system.

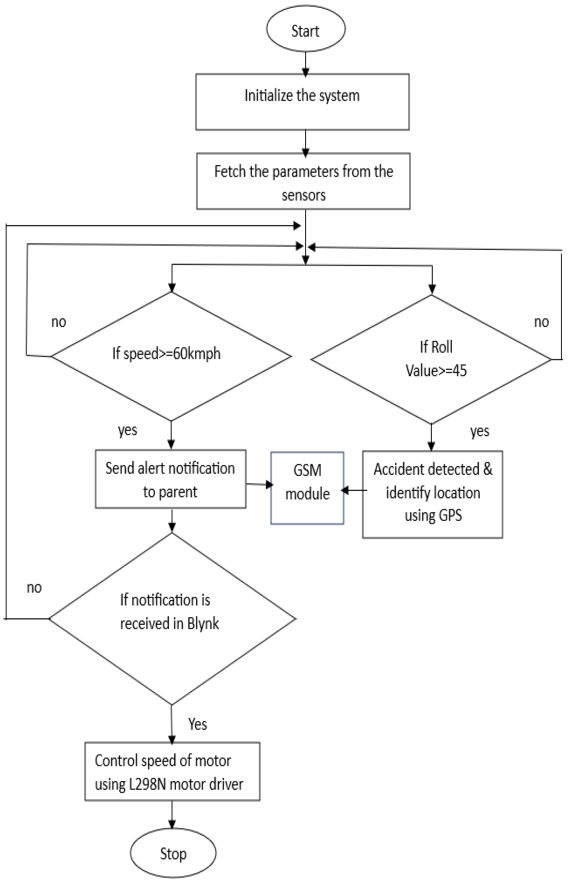


Figure 3.3: System Flowchart

V. RESULTS

In this section, we are going to discuss the results of the system developed as well as the required discussion.

1. *Sending Coordinates Using GSM/GPRS Module:*

GPS modules coupled to an ESP-32 are used in an Internet of Things -basedparent-controlled e-bike with location monitoring using GSM900A. While the GSM module uses a SIM card with an active data plan to transmit the data to a server, the GPS module gives exact position data, such as latitude and longitude. With a web or mobile app that gathers and shows the data on a map, parents may view the e-bike's current location.

Table 1: Coordinates of Different Locations

Sl.No	Latitude	Longitude
1	12.278447	76.714705
2	12.278438	76.714697

2. *Detecting Accident Using MPU6050 Sensor:*

Using the MPU6050 accelerometer,it is possible to identify accidents in an IoT-based parentcontrolled e-bike by keeping an eye out for abrupt, noticeable changes in the bike's acceleration. The system analyses accelerometer data in real time and compares it to preestablished thresholds to detect sudden changes in acceleration that might be signs of an accident.

Table 2: Lateral Right and Left Fall Detection

Sl. No.	Accelerometer Values			Roll & Pitch Value	Response
	AcX	AcY	AcZ		
1	127	127	127	0.00	No Fall
2	128	248	143	82.5	Right Fall
3	131	8	165	-72.1	Left Fall

3. *Speed Detection Using Infrared (IR) Sensor:*

The e-bike's speed can be detected using an infrared sensor as it travels between two locations, and the ESP32 can regulate a BLDC motor to change the speed if it above a certain limit. The Rotation Per Second (RPM) is converted to speed here.

Table 3: RPM Converted Speed Values

Sl.No.	Speed in Kmph	Response
1	59	Normal
2	40	Normal
3	60	Overspeed
5	71	Overspeed

4. *Speed Control Using L298N Motor Driver:*

BLDC motor's speed is managed by the L298N motor driver through the use of pulse width modulation (PWM) signals.The L298N driver's PWM signal inputs allow for variable speed control by altering the signal's duty cycle. The duty cycle fluctuates, changing the average voltage applied to the motor and subsequently the motor's speed. ing work.

5. Parent Control Using Blynk Application on Smartphone:

When an e-bike is equipped with the Blynk application, parents can use their smartphone to remotely monitor and change the bike's speed. To guarantee their child rides safely, they can establish and adjust speed limits. By limiting overspeeding and enabling parents to adjust the e-bike's speed in real time, this simple control improves safety.

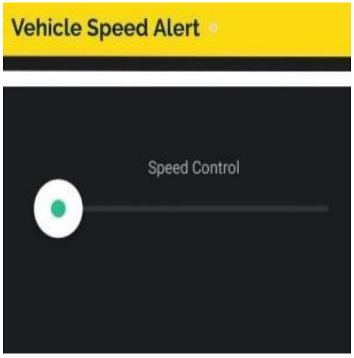


Figure 3.4: Template to Speed Control byParent

VI. CONCLUSION

A comprehensive strategy to guarantee the safety and security of young riders while giving parents peace of mind is embodied in the IoT-based parentcontrolled e-bike project. The combination of intelligent technology, including safety sensors, communication systems, and real-time GPS tracking, allows the e-bike to provide a complete remote monitoring and control system. This initiative shows the revolutionary potential of IoT technology in fostering safer and more connected family transportation alternatives by enabling parents to monitor their child's whereabouts and riding conditions while also improving the user experience. We are getting closer to a day where family well-being and efficiency are enhanced by personal mobility, which is also intrinsically safer and more innovative as we develop and improve these solutions.

REFERENCES

[1] Deepak K C, Rakesh B K, Faisal Ahmed, DR. Prabhanjan S(2019), "IoT Implementation for Preventing Two-Wheeler Accident Detection with call control", International Journal of Scientific Research and Engineering Development, Volume 2, Issue 3, May 2019.ISSN: 2581-7175.

[2] Saima Siddique Tashfia, Rahabul Islam, Sadee Ibn Sultan, Md. Wahidur Rahman, Md. Ahsan Habib, Lubna Yasmin Pinky (2020), "Intelligent Motorcycle Monitoring Scheme using IoT with Expert System in Bangladesh", IEEE,2020.

[3] Mohd Hakimi Bin Zohari, Mohd Fiqri Bin Mohd Nazri (2021), "GPS Based Vehicle Tracking System", International Journal of Scientific & Technology Research, Volume 10, Issue 04, April 2021, ISSN 2277-8616.

[4] Saad Ur Rehman, Shaheryar Ahmad Khan, Arshia Arif, Umar S. Khan (2021), "IoT-based Accident Detection and Emergency Alert System for Motorbikes", IEEE, September 2021.

[5] Muhammad Ridwan Arif Cahyono, Ita Mariza, Surya Wirawan (2022), "Electric Bike Monitoring and Controlling System Based on Internet of Things", Jurnal Nasional Teknik Elektro dan Teknologi Informasi, Vol. 11, No.1, February 2022, p-ISSN 2301 – 4156.

[6] Hanif Hakimi Azlan, Suriana Salimin(2023), "Vehicle Accident Detection System using Accelerometer", Evolution in Electrical and Electronic Engineering, Vol. 4 No. 1, January 2023, 195-20,e-ISSN 2756-8458.

[7] M. Ajay Kumar, R. Kapil Raja, S. Karthikeyan, Leen Vimal Roy, J. Kohila (2023), "Automatic Vehicle Accident Detection and Rescue System Using ESP 32", International Journal of Research Publication and Reviews, Vol 4, no 4, pp 3240-3248, April 2023, ISSN 2582-7421.

[8] Vandana Sayila, Soumya Kundeti, Venkata Srinivasa Rao Nimmagadda, Usha Oleti, Mahesh Babu Basam, Srinivasa Rao Gampa (2023), "Arduino Micro Controller and MPU 6050 Gyroscope based Automatic Speed Control System for Electric Bike at Tight Turns", International Journal of Engineering Research & Technology (IJERT), Vol. 12 Issue 06, June 2023, ISSN: 2278-0181.