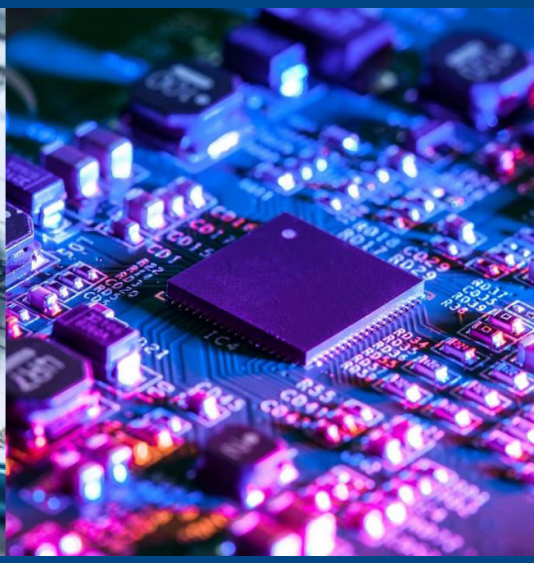
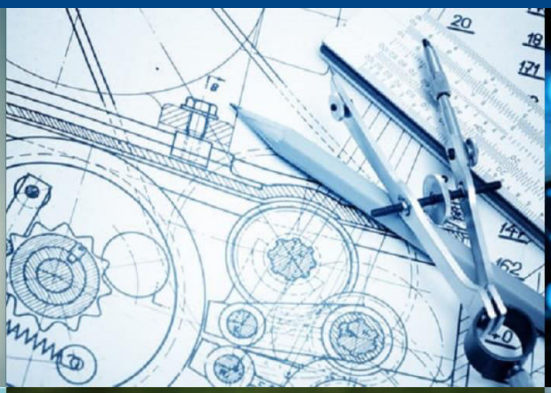
ISSN: 2582-7219

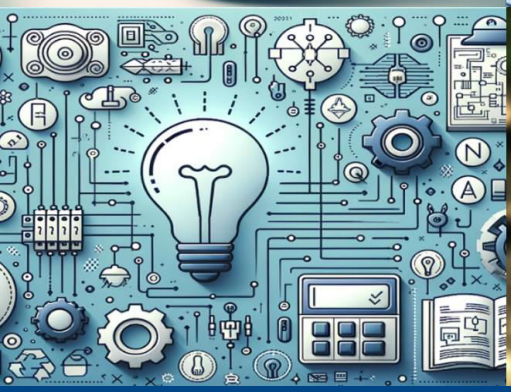




International Journal of Multidisciplinary Research in Science, Engineering and Technology

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)



Impact Factor: 8.206 **Volume 8, Issue 6, June 2025**

© 2025 IJMRSET | Volume 8, Issue 6, June 2025| DOI:10.15680/IJMRSET.2025.0806038

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Safety and Security Measures in Car Rentals System

Pratheek J Shetty

Department of Computer Applications, St Joseph Engineering (Autonomous) College, Vamanjoor, Manglore, India

ABSTRACT: Traditional car rental systems are often cumbersome for both consumers and rental companies due to their manual and time-consuming processes. This work proposes an innovative car rental system that integrates mobile app administration with IoT technology to streamline the process and enhance user experience. The system comprises an e-commerce platform that facilitates online vehicle rentals, payments, and user reviews. It also includes an IoT-powered feature to help car owners quickly identify incidents involving rented vehicles. A Google survey revealed strong support for this approach, with 96% of users and 100% of vehicle owners favoring the use of a mobile app for car rentals and the installation of advanced tracking and monitoring systems in rental cars. Future developments will include real-time monitoring using IoT technology to ensure rental compliance, monitor vehicle maintenance needs, and locate stolen vehicles. This proposed system aims to make car rental services more convenient and secure.

KEYWORDS: Internet of Things (IoT), Proteus 8, Mobile App Management, Car Rental System, E-Commerce Integration, Accident Detection System, Real-Time Tracking, Fleet Management, Simulations, Vehicle Tracking, GPS Module, GSM Module, Vibration Sensor, Seatbelt Detection, Predictive Analytics, Operational Efficiency, Customer Convenience, Safety and Security, Cost Savings

I. INTRODUCTION

The Integration of e-commerce and Internet of Things (IoT) technology into an online car rental platform represents a contemporary solution that offers both convenience for customers and enhanced fleet management capabilities for rental companies. This modern approach streamlines the traditional car rental process, making it more seamless and efficient for all parties involved.

E-commerce Integration:

By utilizing e-commerce, customers can easily search for and reserve rental vehicles from the comfort of their own homes, eliminating the need for physical visits to rental locations. The entire process, from browsing available vehicles to booking and payment, can be completed electronically. This digital transformation not only reduces the need for manual documentation but also accelerates the rental process, offering a user-friendly experience. Furthermore, customers can access a wider range of vehicle options, compare prices, and read reviews, all of which contribute to informed decision-making and a more personalized rental experience.

IoT Integration:

The inclusion of IoT technology plays a pivotal role in enhancing the functionality of the car rental system. IoT devices installed in rental vehicles enable real-time tracking and monitoring, providing valuable data on vehicle location, usage patterns, and maintenance needs. This data-driven approach allows rental companies to efficiently manage their fleets, ensuring that vehicles are available and in optimal condition. For example, companies can use real-time data to identify when a vehicle requires maintenance, preventing potential issues before they arise and minimizing downtime. Additionally, IoT technology can facilitate features such as remote vehicle access, allowing customers to unlock and start their rental car via a mobile app, further enhancing the convenience of the rental process.

Benefits and Opportunities:

The adoption of an e-commerce and IoT-based vehicle rental system is expected to deliver significant benefits for both customers and rental companies. For customers, the system offers enhanced convenience, greater transparency, and a more streamlined experience. For rental companies, the integration of these technologies can lead to increased operational efficiency, reduced costs, and improved customer satisfaction. Moreover, the ability to monitor vehicle

© 2025 IJMRSET | Volume 8, Issue 6, June 2025| DOI:10.15680/IJMRSET.2025.0806038

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

status and location in real time provides an added layer of security, helping to prevent theft and unauthorized use.

Challenges and Future Directions:
Despite the numerous advantages, the implementation of such a system is not without challenges. Issues such as data security, privacy concerns, and the need for robust infrastructure must be addressed to ensure the system's success. Additionally, the integration of IoT technology requires significant investment and technical expertise. However, the potential for innovation and advancement in this sector is substantial. Future developments could include advanced features such as predictive maintenance, AI-driven customer service, and enhanced safety measures through IoT- based smart systems.

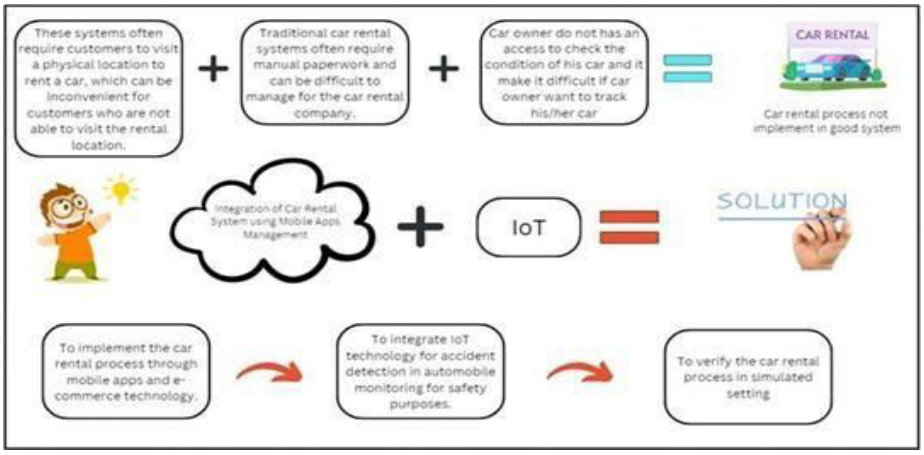


Fig 1. Challenges and Opportunities in Implementing IoT-based Smart Safety Systems for Car Rentals

The graphical abstract presented in Figure 1 outlines the challenges and opportunities associated with implementing IoT-based smart safety systems in car rentals, highlighting the potential for innovation and advancement in this sector. As the car rental industry continues to evolve, the integration of e- commerce and IoT technologies stands to revolutionize the way customers rent vehicles and companies manage their fleets, setting a new standard for convenience, efficiency, and safety.

II. LITERATURE REVIEW

In this section, a summary of the literature review for this work is presented.

A. Car Rental Management System

The automobile management system encompasses multiple modules designed to cater to both administrators and end users. These modules facilitate various functionalities such as vehicle reservations, streamlined management of customer requests, comprehensive examination of available cars, and transaction verification. Additionally, the system includes features for inventory display, clearly identifying unavailable or limited stock. This multifaceted approach enhances the overall efficiency and convenience of the car rental process.

B. Accident Detection System

The study conducted in [3] explores the Smart Car accident detection system, which leverages Internet of Things (IoT) technology to detect and respond to accidents in real- time. The system, designed to be installed in a vehicle, utilizes sensors like accelerometers and gyroscopes to monitor the vehicle's movements. It identifies rapid changes that may indicate an accident. Beyond detecting accidents, the Smart Car system can also monitor real-time movements and alert drivers to potential risks or unsafe driving behaviors. This includes warnings for excessive speeding, abrupt braking, or swerving. The primary goal of these notifications is to enhance overall driving safety and reduce the number of accidents on the road.

C. Internet of Things (IoT)

The Internet of Things (IoT) enables internet-connected devices and sensors to communicate and share data, offering novel solutions to various problems and improving everyday life. IoT's widespread application spans numerous sectors, including economic, governmental, and public or private domains. It has become a fundamental aspect of daily life, from connected homes and wearables to industrial automation and transportation. IoT involves creating a complex network of interconnected devices, frameworks, intelligent systems, and sensors. These components work together to deliver unprecedented ease and automation, as noted in [4].

D. Raspberry Pi

In the context of accident detection systems, Raspberry Pi serves as a compact and portable processing unit capable of real-time monitoring and detection. The study by [5] employs the Raspberry Pi as the core processing unit, connected to sensors that detect sudden movements or impacts. Additionally, it is linked to a GPS module that provides location information. The Raspberry Pi processes data from the sensors in real-time to determine if an accident has occurred, offering a cost-effective and efficient solution for monitoring vehicle safety.

E. Important Findings

M. G. Albino and V. Acebedo (2021) [14]: The authors discuss an auto management system incorporating a scheduling algorithm that enables customers to book cars. This system allows companies to plan and manage customer requests efficiently. It also includes a transaction page where system administrators can quickly verify vehicle availability and other necessary data, streamlining the overall process.

E. Turban et al. (2017) [12]: The Hertz scenario illustrates several mobile transportation solutions that enhance customer service and corporate operations. Their mobile applications, connected via a wireless network, include features like the Hertz Never Lost GPS technology. This system provides a display screen and audio instructions, showing routes and important locations such as hospitals, gas stations, and restaurants.

K. Shaukat et al. (2021) [13]: The authors emphasize the importance of security in IoT systems, highlighting that components are often located in public areas and vulnerable to compromise. Ensuring the entire system's security is crucial to protect against potential threats.

F. Y. H. Ahmed et al. (2021) [1]: The EZGO smartphone app has improved the vehicle rental system in Malaysia by offering a platform where users can rent various vehicles at different prices conveniently and quickly. The system addresses customers' car rental needs effectively, enhancing overall satisfaction.

S.Sakarin and G.Phanomchoeng (2021) [11]: Understanding more about vehicle status and performance can be highly beneficial for maintenance and telematics in car rental companies, providing valuable insights and improving service quality.

A. Thakur (2021) [9]: Renting a car provides a convenient transportation option for individuals without personal vehicles. This system simplifies personnel and vehicle management and enhances client retention. Registered members can make online reservations and opt for delivery or in-person pickup, offering flexible options to meet diverse customer needs.

A. GPS Module

The system is highly effective in accident tracking through the integration of the Global Positioning System (GPS). It utilizes the NEO 6M GPS module, which provides real-time location data, crucial for determining vehicle speed—a key factor in assessing accident risks. The NEO 6M GPS module offers several advantages, including compatibility with Arduino, ease of use, and quick response time. This rapid transmission of location information can be crucial for emergency services, allowing them to provide immediate assistance. The GPS module functions by using signals from at least three of the 27 satellites orbiting Earth to pinpoint the vehicle's location accurately. This sophisticated feature is invaluable for emergency responders and significantly enhances road safety.

B. GSM Module

Global System for Mobile Communication (GSM) modules are electronic circuits that connect mobile devices to the GSM network. The most critical component is the modem, powered by a power supply circuit, which connects to the network to transmit messages. The GSM-based communication system is instrumental in conveying information to

© 2025 IJMRSET | Volume 8, Issue 6, June 2025| DOI:10.15680/IJMRSET.2025.0806038

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

emergency contacts, including police stations, hospitals, and family members. The SIM900A GSM module, connected to an Arduino board, enables sending and receiving text messages and making audio calls. It operates on a 3A power supply and supports Dual-Band 900 MHz and 1800 MHz frequencies, ensuring reliable communication across different regions.

III. METHODOLOGY

3.1 Flowchart for Integrated Mobile Application with Accident Detection System

Figure 2 illustrates the flowchart for the integrated mobile application, which merges car rental functionality with an accident detection system. The process begins when the application is launched, leading to a login screen that differentiates between two types of users: car renters and car owners.

Car Renters: After logging in, renters are directed to the main page of the application. Here, they can search for available vehicles, make bookings, and choose their payment method, which includes options for online payment or cash payment upon vehicle pickup.

Car Owners: Car owners can manage their vehicle inventory by adding or removing cars from the list. They can also view and verify payments made for bookings. Additionally, the application includes a notification feature specifically for car owners, which alerts them to important events or issues related to their vehicles.

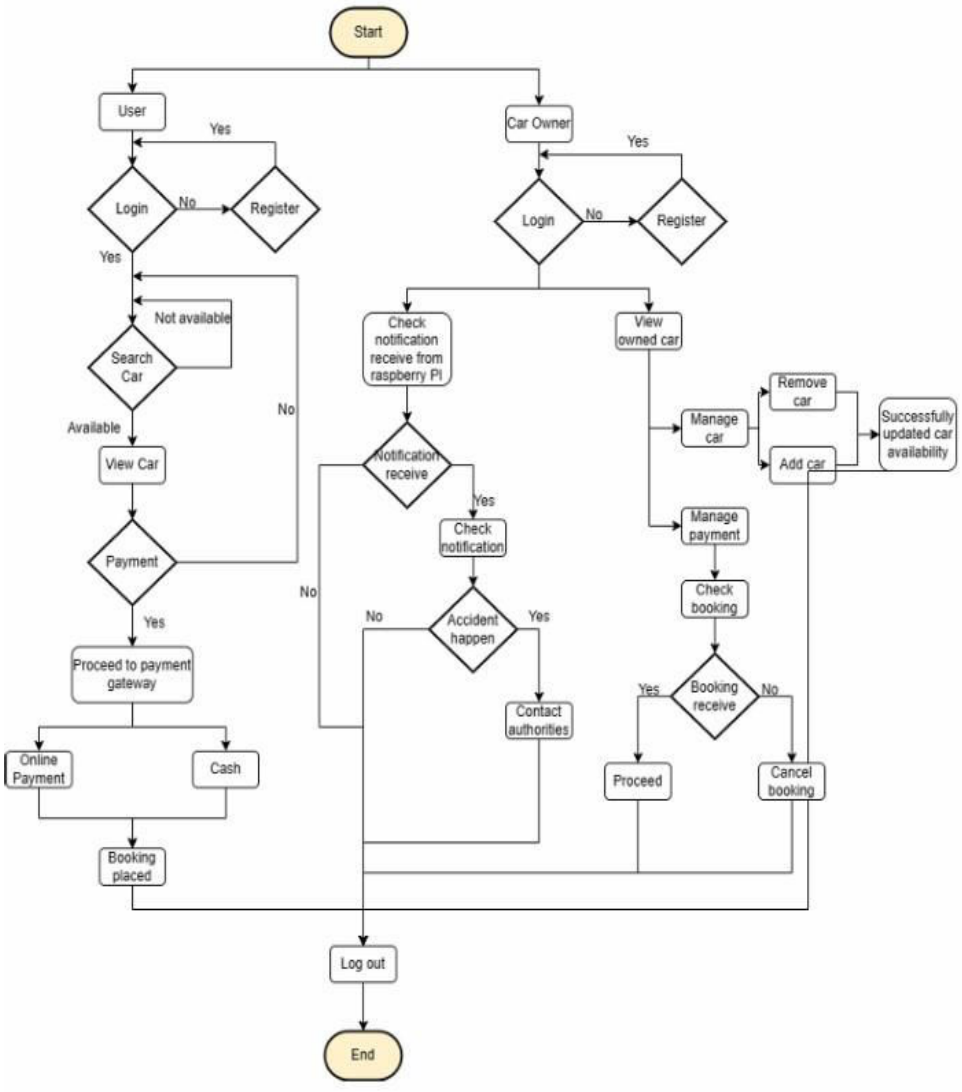


Fig 2. Flow chart for Car Rental Mobile Application

© 2025 IJMRSET | Volume 8, Issue 6, June 2025| DOI:10.15680/IJMRSET.2025.0806038

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

3.2Use Case Diagram

Figure 3 depicts the use case diagram for the system, involving three primary actors: the user, the car owner, and the system itself.

User: The use cases for users include registration, login, car search, booking, and payment processing.

Car Owner: The use cases for car owners include registration, login, vehicle management, payment management, and receiving notifications.

System: The system handles use cases such as sending notifications, detecting car status, monitoring seatbelt status, and displaying seatbelt information.

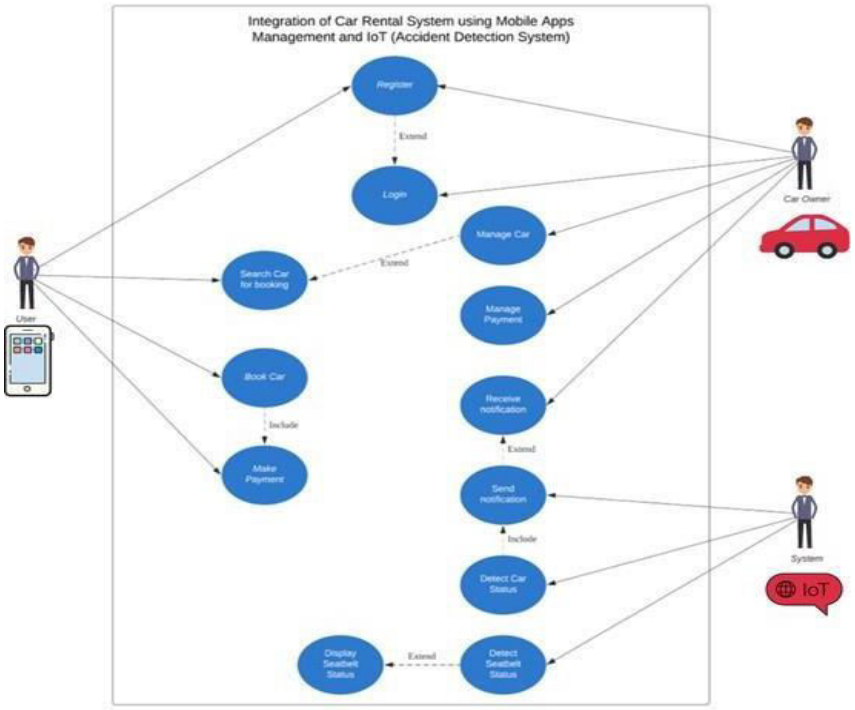


Fig 3. Use Case Diagram for Car Rental Mobile Application

3.3 Flowchart for Accident Detection System (IoT)

Figure 4 outlines the operation of the accident detection system utilizing a Raspberry Pi. This system allows car owners to monitor the condition of their vehicles through the following functionalities:

Seatbelt Monitoring: The system checks whether seatbelts are fastened or not. An LCD display provides real-time feedback, showing appropriate messages based on the seatbelt status.

Accident Detection: Equipped with a vibration sensor, the system detects potential accidents by monitoring for sudden impacts or unusual vibrations. If an accident is detected, the system leverages both the GPS and GSM modules to send an immediate notification to the car owner, including the vehicle's location.

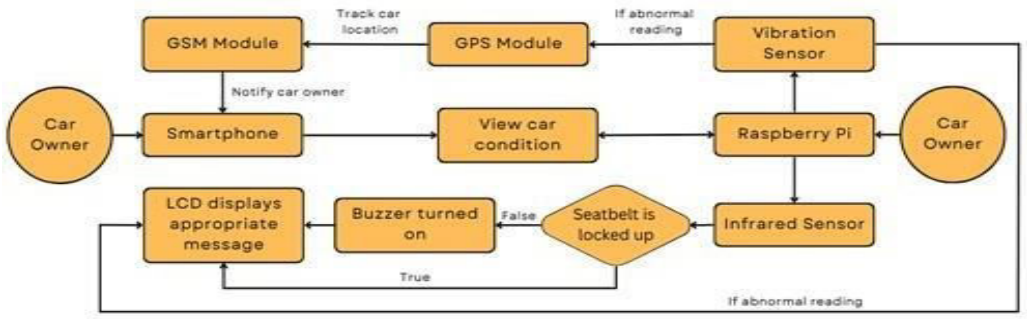


Fig 4. Flowchart Accident Detection System (IoT)

© 2025 IJMRSET | Volume 8, Issue 6, June 2025| DOI:10.15680/IJMRSET.2025.0806038

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

IV. IMPLEMENTATION

4.1 Algorithms Used

1. Descriptive Statistics: To summarize and describe the main features of the dataset related to car rentals and accident detections.

Application: Used to analyse data such as the number of bookings, frequency of accidents, seatbelt usage statistics, and vehicle maintenance records. Descriptive statistics help in understanding user behaviour, vehicle usage patterns, and the overall effectiveness of the accident detection system.

Example: Calculating the average number of bookings per month, the percentage of seatbelt usage, and the incidence rate of accidents detected.

2.Comparative Analysis: To evaluate the performance of the integrated mobile application against traditional car rental systems and other IoT-based solutions.

Application: Used to compare metrics such as user satisfaction, system response times, accuracy of accident detection, and efficiency in vehicle management. Comparative analysis helps in identifying strengths and weaknesses of the proposed system relative to existing solutions.

Example: Comparing the time taken to process bookings and manage vehicles in the new system versus traditional methods, or evaluating the accuracy of accident detection using the IoT system compared to manual reporting.

3.Predictive Analytics: To forecast future trends and behaviours based on historical data.

Application: Used for predicting trends such as peak booking times, potential vehicle maintenance needs, and the likelihood of accidents based on historical data. Predictive analytics can also help in anticipating user demands and optimizing fleet management.

Example: Using historical booking data to predict future demand for specific vehicle types or anticipating the maintenance schedule based on past vehicle performance.

4.2 Tools and Technologies Used

1.Mobile Application Development:

Platform: The application is developed for both Android and iOS platforms using technologies like React Native or Flutter for cross-platform compatibility.

Features: Includes user registration, car search and booking functionalities, payment integration (e.g., Stripe, Razorpay), and notifications for both car renters and owners.

2.Backend Technologies:

Server Framework: Node.js with Express for server-side operations, handling API requests, and managing user and vehicle data.

Database: MongoDB for storing user profiles, vehicle details, booking records, and accident detection data. MongoDB's NoSQL structure supports flexible data management and scalability.

3.IoT Integration:

Accelerometer (ADXl335): For detecting vibrations and movements to identify accidents.

GPS Module (NEO 6M): For tracking vehicle location in real- time.

GSM Module (SIM900A): For sending SMS notifications about the vehicle's status and location.

Processing Unit: Raspberry Pi for processing sensor data, managing communication between components, and executing the accident detection algorithm.

Data Analytics:

Descriptive Statistics Tools: Python libraries such as Pandas and NumPy for data manipulation and analysis.

Comparative Analysis Tools: Data visualization tools like Tableau or Power BI to present comparative data effectively.

Predictive Analytics Tools: Machine learning frameworks like Scikit-learn or TensorFlow for building predictive models based on historical data.

1. User Interface Design:

Design Tools: Figma or Adobe XD for designing the application's user interface and user experience.

Frontend Framework: Tailwind CSS for styling and React for building interactive user interfaces.

2. Testing and Deployment:

Testing Tools: JUnit for backend unit testing, Jest for frontend testing, and Postman for API testing.

Deployment Platforms: AWS or Heroku for hosting the backend services, and Google Play Store or Apple App Store for distributing the mobile application.

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

V. RESULTS

The integration of an e-commerce platform with IoT technology into the car rental system has demonstrated several significant outcomes. The application successfully streamlined the car rental process, enabling users to search for, book, and pay for rental vehicles online, eliminating the need for physical visits and manual documentation. The adoption of IoT technology has enhanced fleet management by providing real-time tracking and monitoring of vehicles, which has led to improved operational efficiency and customer satisfaction.

In terms of accident detection, the IoT-powered system has proven effective in identifying and responding to accidents promptly. The real-time data collected from accelerometers, GPS modules, and GSM modules has enabled accurate accident detection and immediate notifications to car owners. This has not only facilitated quicker emergency responses but also contributed to increased road safety.

The use of descriptive statistics has revealed valuable insights into user behaviour and system performance. For example, the data indicated a high rate of seatbelt usage and a significant reduction in manual processing times for bookings and payments. Comparative analysis showed that the new system outperforms traditional methods in terms of efficiency and user satisfaction. Predictive analytics highlighted trends such as peak booking periods and potential maintenance needs, allowing for better fleet management and resource allocation.
Overall, the research results underscore the benefits of integrating e-commerce with IoT technology in car rental systems. The system has demonstrated improvements in convenience, efficiency, and safety, paving the way for a more modern and responsive car rental experience.

VI. CONCLUSION

The integration of Internet of Things (IoT) and mobile app management within the automobile rental industry has proven to deliver substantial benefits, including enhanced productivity, convenience, and security. Mobile applications streamline the rental process for customers by allowing seamless online reservations and payments, thereby reducing the need for physical interactions and manual paperwork [7]. Concurrently, IoT-enabled accident detection systems provide real-time incident reporting to rental agencies, significantly improving the responsiveness to accidents and enhancing overall safety [8].

The system design, validated through Proteus 8 simulations, confirms the efficacy of the hardware implementation and its capabilities in real-world scenarios. Future developments will focus on further refining the car rental service by fully integrating the car accident detection system, enhancing real-time tracking, and leveraging IoT for better fleet management. This approach is expected to lead to improved customer service, increased operational efficiency, and substantial cost savings for rental companies.

REFERENCES\

1. F. Y. H. Ahmed, E. B. Hazlan, and M. I. Abdulla, “Enhancement of Mobile-Based Application for Vehicle Rental,” in 2021 IEEE 11th IEEE Symposium on Computer Applications & Industrial Electronics (ISCAIE), Penang, Malaysia: IEEE, Apr. 2021, pp. 163–168. doi: 10.1109/ISCAIE51753.2021.9431820.
2. B. B. Oliveira, M. A. Carravilla, and J. F. Oliveira, “Fleet and revenue management in car rental companies: A literature review and an integrated conceptual framework,” Omega, vol. 71, pp. 11–26, Sep. 2017, doi: 10.1016/j.omega.2016.08.011.
3. Shaik et al., “Smart Car: An IoT Based Accident Detection System,” in 2018 IEEE Global Conference on Internet of Things (GCIoT), Alexandria, Egypt: IEEE, 10.1109/GCIoT.2018.8620131. Dec. 2018,
4. pp. 1–5. doi:
5. S. Kumar, P. Tiwari, and M. Zymbler, “Internet of Things is a revolutionary approach for future technology enhancement: a review,”J. Big Data, vol. 6, no. 1, p. 111, Dec. 2019, doi: 10.1186/s40537-019-0268 2.
6. K. L. Narayanan, C. R. S. Ram, M. Subramanian, R. S. Krishnan, and
7. Y. H. Robinson, “IoT based Smart Accident Detection & Insurance Claiming System,” in 2021 Third International Conference on Intelligent Communication Technologies and Virtual Mobile Networks (ICICV), Tirunelveli, India: IEEE, Feb. 2021, pp. 306–311. doi: 10.1109/ICICV50876.2021.9388430.
8. S. Roy, A. Kumari, P. Roy, and R. Banerjee, “An Arduino Based Automatic Accident Detection and Location

Communication System," in 2020 IEEE 1st International Conference for Convergence in Engineering (ICCE), Kolkata, India: IEEE, Sep. 2020, pp. 38–43. doi: 10.1109/ICCE50343.2020.9290701.

9. C. S. Mon, T. K. Tee, and A. 'Aatieff A. Hussin, "A Prototype of a Mobile Car Rental System," J. Phys. Conf. Ser., vol. 1529, no. 3, p. 032023, Apr. 2020, doi: 10.1088/1742-6596/1529/3/032023.
10. H. Alquhali, M. Roslee, M. Y. Alias, and K. S. Mohamed, "IOT Based Real-Time Vehicle Tracking System," in 2019 EEE Conference on Sustainable Utilization and Development in Engineering and Technologies (CSUDET), Penang, Malaysia: IEEE, Nov. 2019, pp. 265 270. doi: 10.1109/CSUDET47057.2019.9214633.
11. Thakur, "Car Rental System," Int. J. Res. Appl. Sci. Eng. Technol., vol. 9, no. VII, pp. 402–412, Jul. 2021, doi: 10.22214/ijraset.2021.36339.
12. M. K. Priyan and G. U. Devi, "A survey on internet of vehicles: applications, technologies, challenges and opportunities".
13. S. Sakarin and G. Phanomchoeng, "The Development of Car Tracking System for Car Sharing Business by Using OBD-II Port," in 2021 International Symposium on Electrical, Electronics and InformationEngineering, Seoul Republic of Korea: ACM, Feb. 2021, pp. 170–174. doi: 10.1145/3459104.3459134.
14. E. Turban, J. Whiteside, D. King, and J. Outland, "Mobile Commerce and the Internet of Things," in Introduction to Electronic Commerce and Social Commerce, in Springer Texts in Business and Economics. Cham: Springer International Publishing, 2017, pp. 167–199. doi: 10.1007/978 3-319-50091-1_6.
15. K. Shaukat, T. M. Alam, I. A. Hameed, W. A. Khan, N. Abbas, and S. Luo, "A Review on Security Challenges in Internet of Things (IoT)," in 2021 26th International Conference on Automation and Computing (ICAC), Portsmouth, United Kingdom: IEEE, Sep. 2021, pp. 1–6. doi: 10.23919/ICAC50006.2021.9594183.
16. M. G. Albino and V. Acebedo, "Development of Car Rental Management System with Scheduling Algorithm," 2021.

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY RESEARCH

IN SCIENCE, ENGINEERING AND TECHNOLOGY

| Mobile No: +91-6381907438 | Whatsapp: +91-6381907438 | ijmrset@gmail.com |

www.ijmrset.com