IoT based Smart Airbag Deployment System with Instant Emergency Alert and Hospital Integration for Enhanced Automotive Safety

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ABSTRACT—In pursuit of advanced automotive safety measures, this paper presents a new IoT-based Smart Airbag Deployment System (SADS) concept that aims to revolutionize the automotive safety system. The system involves the use of IoT technology to provide emergency alerts in the event of an accident and enable emergency services to respond quickly. Additionally, SADS integrates with hospital systems to help provide timely medical assistance to injured passengers. SADS uses real-time data analytics and machine learning algorithms to reduce the risk of injury by ensuring airbag deployment is optimized based on the severity and nature of the crash. A comprehensive introduction to vehicle safety not only improves occupant protection, but also helps reduce emergency response times and improve post-accident medical care. Through verification and simulation studies, the effectiveness and reliability of the proposed system demonstrate its ability to reduce the incidence of traffic accidents and improve the understanding of safety in driving.

INTRODUCTION

The advancement of Internet of Things (IoT) technology in recent years has led to hanges in the industry, including automotive safety. Due to increasing concerns about road accidents and the need to reduce their impact, a concerted effort is being made to develop intelligent systems that can improve vehicle safety measures. An important part of vehicle safety is the deployment of airbags, which are designed to reduce the severity of injuries to passengers in the event of an accident. However, traditional airbag delivery systems often lack the ability to send instant messages and integrate with emergency services, limiting their effectiveness in providing timely assistance to victims.

To address these limitations, this paper presents an IoT-based smart airbag deployment system (SADS) that aims to update the automotive safety system. Using IoT technology, SADS helps instantly communicate accident situations to emergency personnel, enabling rapid response and rescue. Additionally, the system connects to hospital networks to ensure that injured passengers receive timely treatment after the accident. The combination of IoT connectivity and hospital sharing represents a new way to improve post-accident care and improve overall outcomes for victims.

The development of SADS is driven by the urgent need to use new technologies to reduce the effects of traffic accidents and promote safe driving. Leveraging real-time data analytics and machine learning algorithms, SADS optimizes airbag deployment strategies based on the severity and dynamics of each crash to reduce occupant injuries. Through analysis of facts and simulation studies, this paper aims to demonstrate the effectiveness and reliability of the proposed system in improving traffic safety.

In summary, the IoT-based smart airbag deployment system proposed in this paper represents a significant advance in vehicle safety. Combining real-time emergency notification capabilities and seamless hospital integration, SADS has the ability to streamline incident management and reduce the impact of accidents on human lives.

ANALYSIS OF SMART AIRBAG SAFETY

Analysis of smart airbag safety systems shows their potential to change the design of vehicle safety. Unlike traditional deployment methods, these systems emonstrate the flexibility and functionality provided by IoT technology and real-time data analysis. The smart airbag system provides an effective way to protect passengers by constantly changing the situation according to the characteristics of the accident, such as the severity of the collision and the position of the passenger. This adaptability not only optimizes protection, but also reduces the risk of injury from over- or under-deployment of the airbag. Additionally, rapid communication with emergency

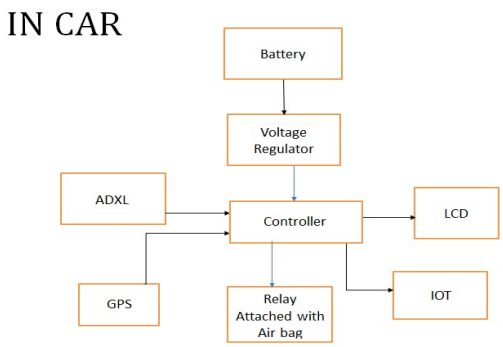

Figure 1 : Block Diagram

services, facilitating rapid response and potentially reducing rescue time. In addition, seamless integration with hospitals in hospitals leads to good coordination of timely medical assistance, demonstrating the safety of plastic bags, smart ways to reduce car accident cases. As research and development in this area progresses, smart airbag systems are expected to improve vehicle safety, potentially reduce injuries and save lives on the road.

SYSTEM DESCRIPTION

Smart Airbag Deployment System (SADS) is a safety solution designed to improve vehicle safety standards through the integration of crash and emergency response systems. The heart of the body is the electrical energy that provides all the necessary electrical equipment. These electronic devices will have a combination of batteries and electronic controllers to ensure stable and reliable operation even when power varies. The controller acts as the brain of the body by integrating the data flow of various sensors and actuators. It receives input from sensors such as ADXL (accelerometer) and GPS modules that detect collisions such as heavy collisions and vehicle positions.

The system uses multiple methods to alert residents and emergency responders in the event of an accident. The buzzer sounds an alarm to alert passengers, while the LCD screen shows important messages such as the severity of the accident and emergency instructions. Additionally, the system integrates IoT technology to facilitate instant collision detection for emergency services, enabling rapid response and intervention. In addition, relay mechanisms are connected to the airbags so that they can be deployed quickly if a collision is detected, providing significant protection to the passengers. This holistic system architecture is designed to improve passenger safety by coordinating with external stakeholders, using the most advanced technologies for instant collision detection, rapid response and uninterrupted communication.

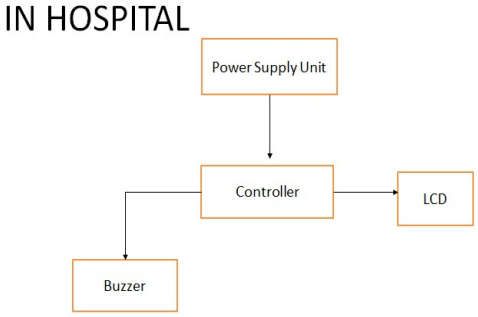

Figure 2: BLOCK DIAGRAM

CONCLUSION

In conclusion, the development of an IoT-based Smart Airbag Deployment System with Instant Emergency Alert and Hospital Integration marks a significant leap forward in automotive safety technology. By leveraging IoT capabilities, this system not only enhances the accuracy and efficiency of airbag deployment but also enables instant communication of collision events to emergency services, facilitating rapid intervention and potentially saving lives. Furthermore, the seamless integration with hospital networks ensures prompt medical assistance for injured occupants, significantly improving post-accident care and overall outcomes. As automotive safety continues to evolve, the integration of smart technologies like IoT into airbag systems represents a crucial step towards achieving comprehensive protection for vehicle occupants. With its proactive approach to collision detection, swift response mechanisms, and seamless coordination with emergency

services, the IoT-based Smart Airbag Deployment System sets a new standard for enhanced automotive safety in the modern era.

FUTURE SCOPE

Looking ahead, the approach of smart IoT-based airbag deployment systems with emergency alerts and hospital integration heralds a revolution in vehicle safety. Advances in technology are expected to improve crash detection capabilities, enabling more accurate and timely airbag deployment. Additionally, the integration of machine learning algorithms and AI-driven assessment promises to help detect collisions and enable preliminary measures to reduce the severity of accidents. This approach not only improves passenger safety, but also helps prevent and reduce accidents. Additionally, as IoT development continues to mature, integration of smart airbag technology with vehicle-to-vehicle (V2V) and vehicle-to-vehicle electronic (V2I) communications can be used to prevent crashes and improve overall safety.

Additionally, the future of smart airbag systems will have the ability to become an important part of autonomous vehicle technology. As driving capabilities improve, the smart airbag system must adapt to the unique challenges and opportunities presented by electric vehicles. This includes the development of powerful collision detection algorithms adapted to the vehicle's behavior and seamless integration with autonomous systems, ensuring emergency response coordination. Finally, the future of smart IoT-based airbag deployment systems with emergency alerts and hospital integration relates to advances in automotive technology that pave the way for safer and better transportation.

REFERENCES

[1] R. Paul, K. Deepa and M. Nithya, "Implementation of Airbags and IoT-based Safety and Alert Systems in Two-wheelers", IEEE 19th India Council International Conference (INDICON), pp. 1-7, 2022.

[2] A. Balaji, V. P. Srinivasan, J. Rangarajan, V. Nagaraju, B. Bharathi and S. Murugan, "Smart Technique to Prevent Flood Disaster due to High Rainfall in Coastal Areas using IoT", 2023 International Conference on Intelligent and Innovative Technologies in Computing Electrical and Electronics, pp. 1252-1256, 2023.

[3] A. K. Dar, M. A. Shah, H. Shahid and A. Naseem, "Fog computing based automated accident detection and emergency response system using android smartphone", 14th International Conference on Emerging Technologies (ICET), pp. 1-6, 2018.

[4] G. K. Sahoo, S. A. Patro, P. K. Pradhan, S. K. Das and P. Singh, "An IoT-Based Intimation and Path Tracing of a Vehicle Involved in Road Traffic Crashes", IEEE-HYDCON, pp. 1-5, 2020.

[5] P. Arul, M. Meenakumari, N. Revathi, S. Jayaprakash and S. Murugan, "Intelligent Power Control Models for the IOT Wearable Devices in BAN Networks", 2023 International Conference on Intelligent and Innovative Technologies in Computing Electrical and Electronics, pp. 820-824, 2023.

[6] S. Habib, Z. Afnan, S. A. Chowdhury and S. A. Chowdhury, "Design and development of IoT based comprehensive system for emergency assistance", Doctoral dissertation Brac University, 2020.

[7] A. R. Jangle, S. S. Girpunje and M. G. Thorat, "An IOT based vehicle accident detection and alert system", International Journal of Research in Engineering and Science (IJRES), vol. 9, no. 5, pp. 65-72, 2021.

[8] A. M. Kannan, P. Solainayagi, H. Azath, S. Murugan and C. Srinivasan, "Secure Communication in IoT-enabled Embedded Systems for Military Applications using Encryption", 2nd International Conference on Edge Computing and Applications, pp. 1385-1389, 2023.

[9] Mohideen, S. Shervin, T. Udara and M. Mushkeer, "IoT-Based Smart Helmet", International Research Journal of Innovations in Engineering and Technology, vol. 6, no. 12, pp. 46, 2022.

[10] S. Ur Rehman, S. A. Khan, A. Arif and U. S. Khan, "IoT-based Accident Detection and Emergency Alert System for Motorbikes", International Conference on Artificial Intelligence and Mechatronics Systems (AIMS), pp. 1-5, 2021.

[11] F. Bhatti, M. A. Shah, C. Maple and S. U. Islam, "A novel internet of things-enabled accident detection and reporting system for smart city environments", sensors, vol. 19, no. 9, pp. 2071, 2019.

[12] P. Karmokar, "A Novel IoT based Accident Detection and Rescue System", Third International Conference on Smart Systems and Inventive Technology (ICSSIT), pp. 322-327, 2020.

[13] S. Ghosal, "IoT-based Mobile Application for Road Accident Detection and Notification", International Conference on Advancement in Computation & Computer Technologies (InCACCT), pp. 1-6, 2023.

[14] S. Yuvarani, A. Gayathri, K. J. Velmurugan, V. Meenakshi, S. Sadhana and C. Srinivasan, "Quality of Service Factor based Unfailing Route Formation in Wireless Sensor Network", International Conference on Intelligent and Innovative Technologies in Computing Electrical and Electronics, pp. 617-622, 2023.

[15] S. Saha, "Crash Recovery and Accident Prediction Using a IoT Based Blackbox System", IEEE North Karnataka Subsection Flagship International Conference (NKCon), pp. 1-6, 2022.

[16] V. Vibin, P Sivraj and V Vanitha, "Implementation of In-Vehicle and V2V Communication with Basic Safety Message Format", International Conference on Inventive Research in Computing Applications (ICIRCA), 2018.

[17] Gorade Nishigandh et al., "Air Bag System in Two-Wheeler Vehicle System", National Conference on Recent Innovations in Engineering and Technology, 2019.

[18] Arnav Chaudhari et al., "Smart Accident Detection And Alert System", IEEE India Council International Subsections Conference, 2021.

[19] D. N. Kumar, "Collision Prevention in Cross Road Scenario in Vehicular Networks", 6th IEEE CONECCT, 2021.

[20] Rahul George, Srikumar Vaidyanathan, Amandeep Singh Rajput and K. Deepa, "LiFi for Vehicle to Vehicle Communication – A Review", INTERNATIONAL CONFERENCE ON RECENT TRENDS IN ADVANCED COMPUTING, 2020.

[21] C.Nagarajan and M.Madheswaran - 'Experimental verification and stability state space analysis of CLL-T Series Parallel Resonant Converter' - Journal of ELECTRICAL ENGINEERING, Vol.63 (6), pp.365-372, Dec.2012.

[22] C.Nagarajan and M.Madheswaran - 'Performance Analysis of LCL-T Resonant Converter with Fuzzy/PID Using State Space Analysis'- Springer, Electrical Engineering, Vol.93 (3), pp.167-178, September 2011.

[23] C.Nagarajan and M.Madheswaran - 'Stability Analysis of Series Parallel Resonant Converter with Fuzzy Logic Controller Using State Space Techniques'- Taylor & Francis, Electric Power Components and Systems, Vol.39 (8), pp.780-793, May 2011.

[24] C.Nagarajan and M.Madheswaran - 'Experimental Study and steady state stability analysis of CLL-T Series Parallel Resonant Converter with Fuzzy controller using State Space Analysis'- Iranian Journal of Electrical & Electronic Engineering, Vol.8 (3), pp.259-267, September 2012.
[25] Nagarajan C., Neelakrishnan G., Akila P., Fathima U., Sneha S. "Performance Analysis and Implementation of 89C51 Controller Based Solar Tracking System with Boost Converter" Journal of VLSI Design Tools & Technology. 2022; 12(2): 34–41p.
[26] C. Nagarajan, G.Neelakrishnan, R. Janani, S.Maithili, G. Ramya "Investigation on Fault Analysis for Power Transformers Using Adaptive Differential Relay" Asian Journal of Electrical Science, Vol.11 No.1, pp: 1-8, 2022.
[27] G.Neelakrishnan, K.Anandhakumar, A.Prathap, S.Prakash "Performance Estimation of cascaded h-bridge MLI for HEV using SVPWM" Suraj Punj Journal for Multidisciplinary Research, 2021, Volume 11, Issue 4, pp:750-756
[28] G.Neelakrishnan, S.N.Pruthika, P.T.Shalini, S.Soniya, "Perfromance Investigation of T-Source Inverter fed with Solar Cell" Suraj Punj Journal for Multidisciplinary Research, 2021, Volume 11, Issue 4, pp:744-749
[29] C.Nagarajan and M.Madheswaran, "Analysis and Simulation of LCL Series Resonant Full Bridge Converter Using PWM Technique with Load Independent Operation" has been presented in ICTES'08, a IEEE / IET International Conference organized by M.G.R.University, Chennai.Vol.no.1, pp.190-195, Dec.2007
[30] M Suganthi, N Ramesh, "Treatment of water using natural zeolite as membrane filter", Journal of Environmental Protection and Ecology, Volume 23, Issue 2, pp: 520-530,2022
[31] M Suganthi, N Ramesh, CT Sivakumar, K Vidhya, "Physiochemical Analysis of Ground Water used for Domestic needs in the Area of Perundurai in Erode District", International Research Journal of Multidisciplinary Technovation, pp: 630-635, 2019