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| **PROJECT PROPOSAL FORMAT** | | |
| 1 | TITLE OF THE PROJECT | Railway Safety with LoRaWAN-based Collision Avoidance and Monitoring System |
| 2 | RESEARCH GAP | The system consists of RFID tags placed at specific points along the train's path and an RFID reader on the train. When the train approaches a tagged point, the reader scans the tag and sends the tag ID to a microcontroller. The microcontroller then identifies the status of the environment by retrieving the information from an internal database. Based on this information, the microcontroller adjusts the train's speed to ensure safe operation.  One research gap in this project is the use of a LoRa module to improve the communication range and reliability between the RFID reader on the train and the microcontroller. LoRa is a long-range, low-power wide-area network (LPWAN) technology that is well-suited for applications where communication range and reliability are more important than data rate.  A LoRa module could be used to replace the existing communication link between the RFID reader and the microcontroller. This would improve the communication range and reliability of the system, making it more suitable for use in large metro rail stations.  Another research gap is the integration of the RFID system with other train safety systems, such as the train protection and warning system (TPWS) and the automatic train control (ATC) system. This would allow the RFID system to provide information to other train safety systems, such as the TPWS system, to enable more effective accident prevention measures. |
| 3 | OBJECTIVE | The objective of the project "RailSafe" is to create an advanced, comprehensive, and highly effective railway safety system based on LoRaWAN technology. This system aims to significantly enhance safety across the entire railway network by providing real-time collision avoidance, train tracking, and monitoring capabilities. |
| 4 | METHODOLOGY | The methodology for the "RailSafe" project focuses on enhancing railway safety through the integration of RFID sensors and onboard LoRaWAN communication systems within trains. The process commences with the strategic deployment of RFID sensors along the railway tracks, positioned at key locations to accurately sense and identify track numbers.  As a train travels along the tracks, the onboard RFID reader within each train reads the RFID tag associated with the track number it is currently on. This track information is then transmitted via the onboard LoRaWAN communication system, which acts as a network node, facilitating communication between trains.  Inside each train, LoRaWAN transceivers receive and process RFID data from nearby trains, including their track numbers. A localized processing unit, equipped within each train, continuously monitors this data in real-time, cross-referencing the track information to identify potential collision scenarios.  When the system detects two trains on a collision course or occupying the same track, the onboard processing unit generates an immediate warning signal. This warning is relayed to the locomotive pilot, providing essential early alerting capabilities. The pilot can take prompt corrective actions, such as engaging brakes or initiating a change of course, thus preventing potential collisions and significantly enhancing railway safety.  Throughout the project's development, comprehensive testing and validation procedures will be conducted, including the simulation of various collision scenarios to assess the system's effectiveness and reliability. The system will be designed with scalability and adaptability in mind, allowing for expansion across the railway network as needed.  To promote public awareness, educational initiatives will be launched to inform train operators, maintenance teams, and passengers about the system's safety benefits. A well-established maintenance schedule will ensure the continual optimization and reliability of the system. With adherence to international railway safety standards and certifications, the "RailSafe" project aims to establish a new standard in railway safety, safeguarding passengers and railway personnel while ensuring the seamless operation of rail networks. |
| 5 | ABSTRACT | The "RailSafe" project introduces a groundbreaking approach to enhance railway safety through the integration of Radio-Frequency Identification (RFID) sensors and onboard LoRaWAN communication systems within trains. This innovative system is designed to mitigate collision risks and improve overall railway safety. The project commences with the strategic deployment of RFID sensors along railway tracks to accurately sense and identify track numbers. As trains traverse the tracks, onboard RFID readers within each train capture track information, which is then transmitted via the onboard LoRaWAN communication system. This system, acting as a network node, facilitates real-time communication between trains. A localized processing unit within each train continuously monitors this data, cross-referencing track information to identify potential collision scenarios. When two trains are on a collision course or share the same track, the system triggers immediate warnings to the locomotive pilot, enabling swift corrective actions. Rigorous testing, scalability considerations, public awareness initiatives, and adherence to international safety standards are pivotal aspects of this project. "RailSafe" aspires to set a new standard in railway safety, ensuring the welfare of passengers and railway personnel while promoting the seamless operation of rail networks. |
| 6 | TOTAL BUDGET | 10,000  ESP LoRa module\*2  RFID module\*2 |
| 7 | COLLOBORATION  DETAILS | NIL |