TERMS OF REFERENCE FOR THE R&D PROJECT

1. **Title:** RFID based Tracking and Monitoring system for Children in School Bus.

2. **Background:**

2.1 The **RFID Application for Tracking and Monitoring of Children in School Bus** aims to enhance child safety during school bus transportation. By implementing RFID technology, we can achieve real-time tracking, efficient communication, and improved safety protocols.

2.2 School bus transportation is increasingly becoming an integral component of the overall transport system in most metropolitan cities—not only in India, but across the world. However, students in India face a significant risk of accidents each year while traveling by school buses, primarily due to the lack of adequate safety features in these vehicles. To address the issue of school bus safety, the installation and effective operation of dedicated safety features facilitate the secure boarding and alighting of schoolchildren. In many developed countries, the real-time movement of both buses and students is monitored by school administrations and parents through integrated security systems installed in school buses.

2.3 The RFID system plays a vital role in enhancing the safety of schoolchildren. To improve its effectiveness and coverage, additional features can be integrated with RFID technology. It is therefore essential to develop a comprehensive and reliable system for school buses that enables accurate tracking and monitoring of students through the application of RFID and camera surveillance. This system should be thoroughly developed, tested, and implemented in real-world conditions, ultimately paving the way for the standardization of RFID-based solutions for monitoring children commuting via school buses.

3. **Objective:**

3.1 The objective of this research is to develop an ITS-based school bus safety system for monitoring and tracking the boarding and alighting of schoolchildren during their commute between home and school. This system will be built on an IoT-based architecture and designed to comply with the performance requirements of RFID applications. Ultimately, the research aims to develop a set of standards for the use of ITS-based IoT devices in the operation of school buses.

3.2 While accomplishing the above said objectives, the following will be addressed as a part of the development of this system.

a) Assess the overall performance, reliability, and effectiveness of RFID applications in real-world school bus operations.

b) Identify potential risks and implementation challenges associated with RFID-based tracking and monitoring of school buses and students.

c) Provide recommendations for the optimal placement of RFID readers in school buses and tag allocation to students, aimed at enhancing system performance.

d) Leverage the capabilities of RFID systems in conjunction with functional components such as GPS-enabled GPRS modules, GSM communication, and IP-based camera systems.

4. Scope:

4.1 The scope of the proposed research is to develop a prototype RFID-based system aimed at ensuring the safety of schoolchildren commuting by bus—from designated residential bus stops to school and back. The following components of work will be undertaken in alignment with the objectives outlined above.

4.2 Study of the available literature, including national and international standards such as ASTM, JIS, EN, ISO, and IEC relevant to the subject, along with research papers, studies conducted by other organizations, and company brochures. Identify the grades, their chemical and mechanical properties, and any additional requirements that could be incorporated into the standards for RFID tags and readers.

a) Conduct a comprehensive literature review on the safety and performance of RFID applications in various transportation contexts.

b) Assess the technical specifications and capabilities of RFID hardware and software intended for school bus use.

c) Evaluate the effectiveness of RFID technology in monitoring schoolchildren during bus/van commutes through a live demonstration of the system.

d) Analyze the reliability and accuracy of RFID systems in tracking the presence of children, including their pick-up and drop-off activities.

e) Gather feedback from stakeholders—including parents, bus/van drivers, and school administrators—regarding their experience with RFID-based monitoring.

f) Propose a draft document for the standardization of RFID technology for school buses, tailored to Indian conditions.

5. Methodology:

5.1 To achieve the stated objectives, the proposed study adopts the following approach:

5.1.1 Carryout literature review as specified in item 4 above.

5.1.2 Conduct an on-site evaluation of RFID applications by installing developed RFID system in school buses.

5.1.3 Conduct interviews and surveys with relevant stakeholders, including parents, school teachers, and administrators, using discussions and structured questionnaires to gather qualitative data. Based on their feedback and suggestions, the system design for RFID application will be accomplished.

5.1.4 Utilize quantitative data, such as system accuracy and response times, to assess performance. Further prepare a comprehensive data analysis.

5.1.5 Visit to manufacturing facility to get the information about type of such devices available and their specification. Also to collect the data related to its performance, response time etc. in detail.

5.1.6 Conduct a practical trail/demonstration by installing the system in the school bus. Analyze the outcomes and make necessary improvements if required.

6. Deliverables:

6.1 An analytical report in soft and hard copy, covering all aspects mentioned in the scope, shall be submitted. The questionnaire, feedbacks from users, research findings, data collected, comparative analysis, literature review, shall be appended to the report.

As spelt out under this section, the following stages of deliverable in this context is being contemplated.

A. This will commence on right from the initial stage in terms of

i) designing a Performa for different types of stakeholders in consultation with BIS,

ii) survey to be conducted on a pilot basis initially in order to refine the survey Performa by addressing the shortcomings.

In the next stage, actual opinion survey with various stakeholders will be conducted so as to assess the nature and magnitude of the safety problems that would be used for final input to the design.

B. It is worth mentioning that during the period of conducting the opinion survey, every effort will be made to initiate the design of school bus/van tracking and monitoring systems. This process will begin with conceptual design and progress toward the development of a prototype, which will be demonstrated live on a small mini-van. This demonstration will serve as a foundation for further replication and commercial development.

7. Sampling Plan:

Based on the identification of manufacturing and testing facilities, the sampling plan will be submitted for approval from BIS, including provisions for visits to various stakeholders, if required

8. Timeline and Method of Progress Review: Project Timeline: 6 Months

A stage wise indicative timeline plan is provided below:

Project initiation (Month 1): Literature review of available National/International Standards, research papers or any other relevant document.

Data Collection (Months 2-3): Data collection from various stakeholders. Experimentation work with the development of total RFID system for school bus commuting.

Mid Term review (Month 4): Submission of Draft report for mid-term review to assess progress and adjust methodologies, if necessary.

Report Submission (Months 5-6): Collecting and processing expert review comments on the draft report and submission of the final project report.

9. Support from BIS:

BIS would provide the relevant Standards on request.

10. Nodal Point:

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