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PROPOSED BLE(BLUETOOTH LOW ENERGY)-BASED SAFETY SYSTEM FOR SCHOOL BUS NETWORK

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Abstract— **We are in a time when computational technology is being morphed, to address people's needs, into a form we have never been able to conceive especially with the advent of Internet of Things the opportunities are boundless. We propose a system to build a safety scheme for the school management and concerned parents regarding their respective children to ensure safe to-and-fro commute from home to school and back. The system will consist of three main units that are a bus unit, a school unit and parent unit. The bus unit which is a mobile device that acts as a central device that scans, connects to and reads a tag worn by child. The bus unit will be used to detect when a child boards or leaves the bus. These events trigger a notification message with relevant information communicated to the parent unit and school unit as and when the tag interacts with the bus unit. The system will have a mobile-based and web-based database-driven application that facilitates its management and provides useful information about the children to authorized personnel.**

Keywords—**BLE, Internet of Things, Eddystone, Transportation Safety System, System Architecture, Child Safety.**

I. INTRODUCTION

In this proposed system, we embed IoT (Internet of Things) network using BLE (Bluetooth Low Energy) powered by Google's Eddystone™ beacon technology. Eddystone™ is open source, so any beacon manufacturer can implement the standard in their hardware and distribute beacons with Eddystone™. We have used beacons powered by Radius Networks. Users that are part of this API can advertise their presence as a BLE peripheral. System is used to provide safety system to child by giving timely notifications to parents and school administrators about the location of children.Safety means making use of BLE giving real time updates about the location of the child to the parent. A bus here is treated as a system where every transaction equates to a student entering and exiting it. It is to be noted that each day is to be considered as a single work cycle where all operations take place between enter and exit events. While returning, a status indicator, which acts as a flag, will be deployed at the bus administrator's end that indicates a green/red signal corresponding to each child that entered the bus, when the day started, to receive cue to wait/leave to/from said station (school). This is done with the help of an Android application interface. Also error messages, regarding red signal indication, are shown according to respective situation(s). The parent is notified, along with bus identification as soon as a respective child is in the bus which is in the departed status. The end transaction takes place when a child exits bus for the day and a fresh cycle starts next day.

II. MOTIVATION

The idea is to develop a system that supports and influences the society directly. Emphasis is given on solving real world problems that have a direct impact on day-to-day living. Vision is to support the concerned parents that spend good part of their day worrying about the whereabouts of their children in transit to and from school. Attaining a way to provide this service that inculcates fundamentals with underlying concept that delivers with least overhead compared to other similar models. The objective is to build a safety

scheme for the school management, concerned parents and safety of their respective children to ensure safe to-and-fro commute from home to school and back.

III. RELATED WORK

This section reports the most related work to the problem. A system is proposed in [3] where a child is tracked using a child module that sends the notifications to the database and a mobile device. This system is not affordable being the deployment cost high and the module may not be convenient for children. A system is addressed in [4] where android terminals communicate among themselves to form a cluster using Bluetooth technology. These clusters transmit the relevant information using WLAN. Here the concern is that the system exposes a high deployment cost. A commercial solution [5] where school buses are fitted with RFID enabled tracker and children carrying RFID nametags that lets parents to know where his/her child/children are. Since, the deployment of this system will also need the deployment of RFID enabled trackers in the school buses. Other products such as Kidtrack [6], uses biometric features such as palm of the child. The entry and exit of the children into/from the bus is marked by scanning their palms across a palm reader. The scanned palm patterns are sent to a secured database to cross-reference against preregistered users' patterns. The school administrator can keep a watch on children status. The children are required to place palms on the scanner correctly which might lead to inaccurate data transmission leading to inaccurate results. In this system, is the entry and exit is not automatic and is to be triggered manually

IV. SYSTEM ARCHITECTURE

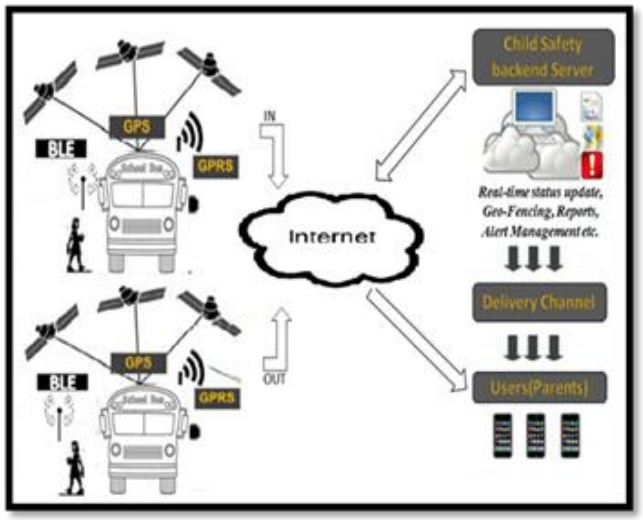

Figure 1 : System Architecture

V. UML DIAGRAM

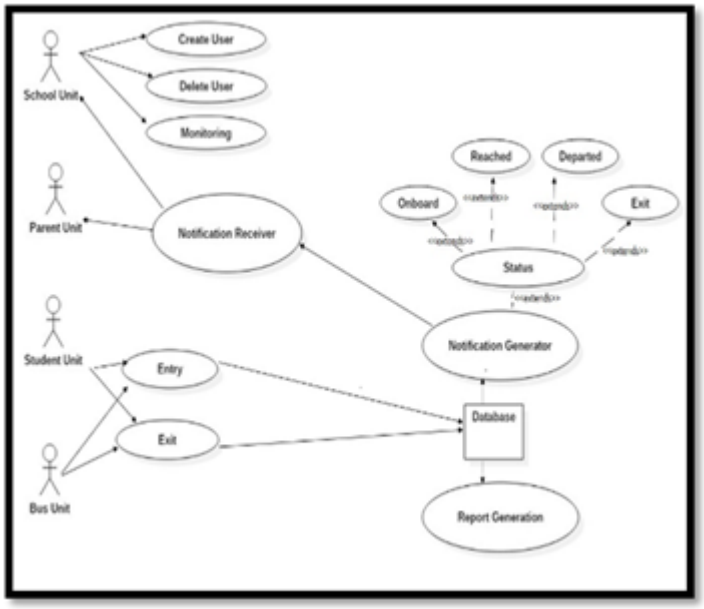

Figure 1: Use Case Diagram

VI. SYSTEM COMPONENTS

The system consists of three components i.e. administrative, user and web. The role of administrative and web components is administrator. The administrative component automatically marks the students In/Out status by reading a BLE tag and enables micro location engagement capabilities for students. The user component helps in checking real-time status of boarding of their loved ones. The user component will be used by Parents. The system allows the administrative staff to monitor students through web component. The administrative and user components run on an android powered device.

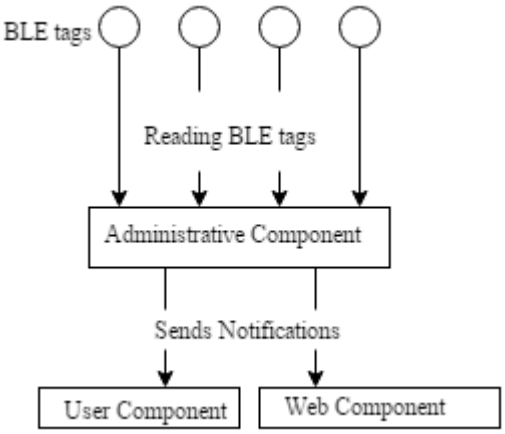

Figure 2 : Component Interaction

VII. ALGORITHM

1. Entry: Student enters along with tag that registers student to database resulting in **start transaction**. It will link student to said bus for a complete work cycle. A notification is sent to Parent with event Entry message.
2. This above event will change the status of student to On-Board.
3. The bus administrator monitors if bus has reached and changes status of bus to Reached; this will apply changes to status of each student linked to said bus to Reached.
4. Departed: To achieve departed status- A status indicator, which acts as a flag, will be deployed at the bus administrator's end that indicates a green/red signal corresponding to each student that entered the bus to receive cue to wait/leave to/from said station (school).
5. An android application interface is deployed on bus administrator's end in which error messages, regarding red signal indication, is shown according to respective situation(s).
6. Once Departed state is achieved: The parent is notified, along with BusID and/or location as soon as a respective student is in the bus which is in Departed status.
7. Exit: Bus terminal detects whether beacon is in/out of proximity and Exit event is switched. This results in end transaction.

Modules	Output/Outcome
Bus Unit	• Gateway. • Status Monitoring.
Student Unit	• Determines **start** and **end** transaction operation. • Sends frames to Bus Unit in proximity.
School Unit	• Database Administration Unit. • Report generation. • Record keeping.
Parent Unit	• User Module. • Notification Receiver. • Student Status checking ability in real time.

VIII. FUTURE SCOPE

Taking up such a project involving relatively new technology presented itself with challenges that we work with an unexplored territory of technology involving BLE. Google's Eddystone, being an open source platform, released by Google as early as July of 2015 is expected to keep evolving to provide a wide variety of applications. Geo-fencing to detect pre-programmed coordinates to cause action on assigned location. Data Mining techniques and algorithms can be performed on the data collected over time to satisfy management needs of institution. This system can be extended for full-time monitoring of children that will be of interest to concerned parents and guardians.

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