Keeping School Children Safe and Parents Informed

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Abstract:- An elementary, middle, or high school kid spends almost 8-10 hours per day away from home (either in transit to/from school or at school). In many cases, parents are not aware of the safety and whereabouts of their kids while at school. The school authority also frequently lacks insight about activities on the school campus, particularly during breaks or immediately after school. However, technology has evolved in today's world, providing "real-time" visibility into every aspect of an object's activity (e.g., After the online purchase, the e-commerce and logistics companies provide frequent insights into each milestone (shipment pick-up, shipment arrival time) until it has been delivered. This paper aims to present a novel application of technology to deliver a safe school environment as well as an insightful and comprehensive experience to students, parents, and school authorities.

Keywords:- IoT, School Safety, Bus Safety, MQTT, RFID, Data Pipeline, Real-Time Eventing.

I. INTRODUCTION

Every morning many parents drop their kids at the school bus stop. From the moment they drop off their child, parents live in constant low-level anxiety about their whereabouts until they return. When a child returns home, the first question that is being asked – "How was your day", "Did the bus reach the school on time", "Did you eat lunch at the cafeteria", "Did you go to the library? Etc."

On the other hand, most adults frequently shop online and receive continuous "real-time information" till the shipment is delivered – Is the item in stock, Where to find the item in the warehouse (zone), When it was picked up by the transportation company, or when it will be delivered, etc. If the shipment is lost, the companies know the last milestone that was crossed, so it's easy to find the item. A similar approach is adopted by airlines while transferring the baggage from departure to arrival city. Parents get Goosebumps thinking, "What if the driver of the bus goes rogue? How do I prove that my child was on the bus?"

If we can get up-to-date information about a shipment or baggage, why can't we have similar "real-time insights" about our kids from the time they get on the bus until they return home in the afternoon? Kids are the most precious "shipments" who depart the home (origin) in the morning and come back in the afternoon (destination) after spending a majority 50% of their entire day at the school. The kid's daily journey from origin to destination should be full of joy, providing happiness rather than anxiety to parents. This can be made possible only if the information is shared among key stakeholders (parents, school authorities) in "real-time".

This becomes more important in the event of danger or gun violence at the school or a bus accident. In the event of any gun violence, the school safety staff should have complete insight about students' whereabouts in each ward. Or if the bus doesn't return from school, they should know details of children who are in the bus.
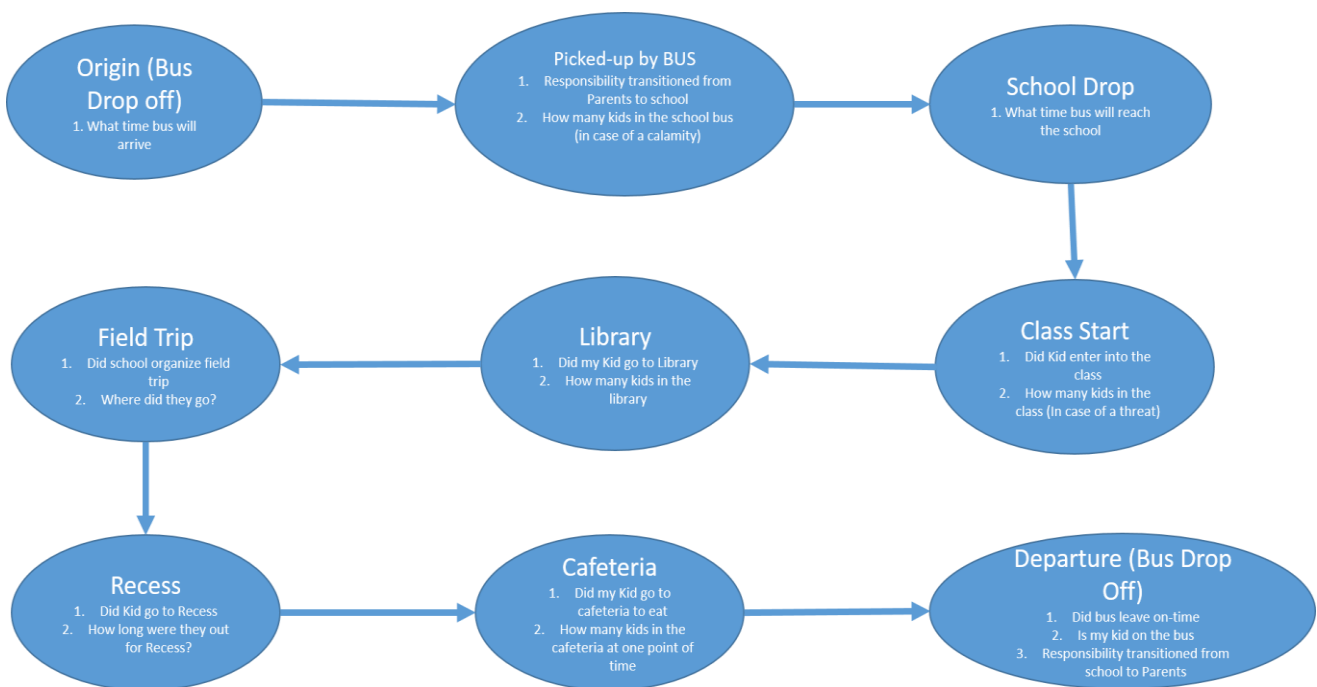

Fig. 1: daily student activities at school

II. CHALLENGES

Kids are the most important assets we have, but the entire value chain at school lacks modernization and cannot provide critical information about kids to their parents. Parents seek answers to essential questions about their child:

- What time the bus will arrive
- Can the school acknowledge as soon as the child has been on-boarded to the bus (The child's responsibility is now transitioned to the school authorities)
- What time did my child reach school?
- Did my child go to the cafeteria?
- Did my child go to the library?
- What time did the bus depart at the end of the day?
- Did my child go to an after-school activity?
- Can I Acknowledge as soon as the child has been off-boarded (The child's responsibility is now transitioned to the parents)?

- In the event of an unforeseen gun violence incident, there are additional questions:
  - How many students are on the school premises
  - How many students are in a specific area (library, cafeteria, etc.?)

III. SOLUTION: IOT BASED FRAMEWORK

A proposed Internet of Things (IoT) framework can provide real-time insights and information to parents and school authorities. The IoT enabled school management solution sensors will monitor key data points at each milestone that can be securely analysed before delivering critical information to parents and school authorities. The solution can be enabled via -

- Radio Frequency Identification (RFID)
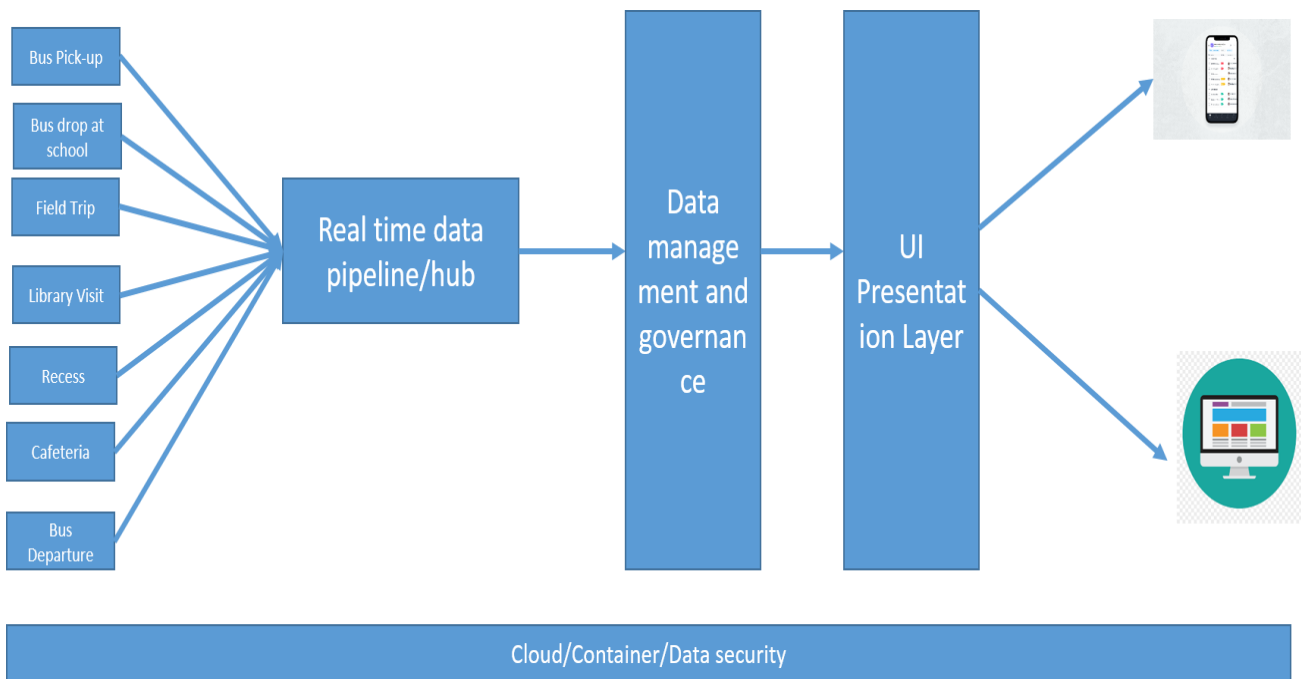- Global Positioning System (GPS)

Fig. 2: IoT Based Framework

An ultra-high frequency (UHF) tag provide longer read range and higher memory capabilities. The solution will include a passive tag with high degree of efficiency which can be given to students as a wrist band (similar to Disney's magic band).

A robust solution will comprise four key phases providing distinct visibility and insight into students' daily interactions and experiences while they embark on their educational journey daily.

- **Data Sensors:** The process starts with IoT data sensors (connected RFID devices that continuously process the data at each milestone – morning pick-up, bus drop off, school entrance, library entrance, school departure, etc.). The reader location can be customized based on school's specific requirement and milestone they want to capture. A kid will beprovided a sensor based bracelet similar to

what's available in Disneyland. They will wear it while in the school providing a sense of security and consistent experience.

Fig. 3: Magic Band from Disney

- **Data Pipeline**–The device will constantly communicate with sensors real-time, in order to provide safe environment at school. Once data from edge devices (Bracelet) is collected, it will be transferred to the cloud for real-time event updates. This can be done through MQTT or Kafka-based data pipeline.
- **Data Security and Governance** – Data storage, as well as governance and access, will be managed in this stage. This will ensure data security and quality are not compromised during the life cycle. PKI based model will secure the client-server connections between multiple networked devices.
- **Data Presentation/Delivery** – The data (events) can be displayed to parents and school authorities (depending on the access) through the web or mobile applications. The simplicity of application will determine easy information exchange, and a tableau based report will come handy.

IV. BENEFITS

- Real-time visibility to parents – In today's complex world, access to real-time data is the key. With this solution, parents can stay connected with their children while at school.
- Threat management – In the case of a code red scenario, the children can be easily found and brought to a safe location.
- Continuous improvement in service – The constant collection of events will help recommend improvements (Are there better routes for the school bus; is the cafeteria running at total capacity; what activities are most important to students, etc.).
- Teacher/school staff productivity – Improve productivity for teachers and efficiently manage school operations with access to real-time data.
- Students – Will be able to engage in quality conversations with the teacher, school staff, and parents instead of getting frustrated with logistical issues.
- Compliance - Gain insight and report about dangerous driving behaviour of bus drivers or driver fatigue to ensure children's safety is not compromised.

V. CONCLUSION

Kids, who are our most important assets, spend almost 8-10 hours daily at school. The technology has delivered enormous benefits to the e-commerce and logistics industry by providing continuous insights into the whereabouts of physical shipments. Similar benefits can be achieved at school with the technology, providing enormous benefits to parents and school authorities. The "real-time" information will provide a safe learning environment at school and will be helpful in the event of a life-threatening emergency. With the help of technology, parents and kids should embrace "Disneyland" kind of experience at School with data continuously moving from source to consumption, providing a sense of relief, happiness, and peace of mind.

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