

Child Safety System using RTLS

Priyanka Gaba¹, Gunjan Chugh²

^{1,2}Department of Information Technology, Northern India Engineering College
New Delhi, India

¹priyanka.gaba2202@gmail.com

²chugh.gunjan8917@gmail.com

Abstract— In present time due to increase in number of crimes, Parents always worry about their children while sending them out for schools, which no one can't avoid. In a world where dangerous crime in school is a legitimate concern, arming teachers is becoming a realistic strategy for some. At the same time, what else can be done to ensure schools are more secure, visitors can be trusted, and students and teachers can efficiently stop or quickly combat an emergency situation? This paper proposes a solution for their worry using the latest enhancement in technology. Radio Frequency Identification (RFID) is one of key technologies to implement IoT applications to keep an eye on child problems.

Keywords— IoT, RFID(Radio-Frequency Identification), RTLS (Real-Time Locating Systems), Wi-Fi, GSM

I. INTRODUCTION

A. Internet of Things

Internet of things refers to a new type of electronic technology or data network system based on the internet technology. Electronic product code is the basis of this electronic technology or network system which marks or identifies all entities in the world by using RFID identification technology so as to achieve dynamic monitoring of physical items [1].

The internet of things can be understood from two perspectives: firstly, in terms of function, it carries out data exchange, connects virtual space and actual objects through network digital model, and realizes super-space time control to objects through network system. It includes a digital calculation module and data calculation. Technically, the internet of things is about the things link structure of RFID technology, remote sensing technology, nanotechnology and intelligent identification technology.[2]

B. RFID

Radio-Frequency Identification (RFID) is the use of radio waves to read and capture information stored on a tag attached to an object. Information could be its unique identification and location. A tag can be read from up to several feet away and does not need to be within direct line-of-sight of the reader to be tracked. [3]. It can be used for identification of men, material, animal, vehicles, products etc. It consists of three parts: antenna, tag, reader.

RFID is a technology using radio waves of different frequencies for identifying objects. A typical RFID system comprises of a RFID tag and a RFID reader. A RFID tag is often formulated by a microchip which stores data and an integrated antenna serving as a transmitter. There are two types of RFID: the passive RFID and the active RFID where the former one has no power sources inside them but relies on the reader to supply power for wireless communication, and the latter has power sources installed inside.[4]

C. RTLS

Real-Time Locating Systems (RTLS) are used to automatically identify and track the location of objects or people in real time, usually within a building or other contained area. Wireless RTLS tags are attached to objects or worn by people, and in most RTLS, fixed reference points receive wireless signals from tags to determine their location. Examples of real-time locating systems include tracking automobiles through an assembly line, locating pallets of merchandise in a warehouse, or finding medical equipment in a hospital.

The physical layer of RTLS technology is usually some form of radio frequency (RF) communication, but some systems use optical (usually infrared) or acoustic (usually ultrasound) technology instead of or in addition to RF. Tags and fixed reference points can be transmitters, receivers, or both, resulting in numerous possible combinations of technology.

RTLS are generally used in indoor and/or confined areas, such as buildings, and do not provide global coverage like GPS. RTLS tags are affixed to mobile items to be tracked or managed. RTLS reference points, which can be either transmitters or receivers, are spaced throughout a building (or similar area of interest) to provide the desired tag coverage. In most cases, the more RTLS reference points that are installed, the better the location accuracy, until the technology limitations are reached. [5]

II. SCOPE AND OBJECTIVE

The developer Ford says "We wanted something we could put in the hands of every teacher—something they could access right away," rather than a panic button that might be mounted under a wall or at a doorway. That's the aim of this concept was not designed specifically for schools, but is used at a variety of workplaces, including hospitals which was not designed specifically for schools, but is used at a variety of workplaces, including hospitals. Currently showing its use in schools, to provide teachers with a means of summoning help from any location within the school, simply by pressing a button or pulling a switch on a badge.

III. SYSTEM ARCHITECTURE

A. System Engineering Requirements [6]

Our system is designed with the following engineering requirements:

- The system should recognize each child and detect the exact location of child in school.
- The system should have a database to store student's information.
- The system should be easy to re-configure.
- The communication should be reliable.



Fig. 1 Different variety of badges

B. The School unit consists of the following components:

As shown in fig. 1 for different purposes various devices are available in market. School unit requires these:



Fig. 2 Badges



Fig. 3 Ekahau IR beacons

- Badges (shown in fig. 2)
- Wi-Fi
- Ekahau IR beacons (shown in fig. 3)
- LCD
- GSM Modem

- Microcontroller Atmega 162
- Keypad
- GSM Modem
- RS 232
- PC

The complete system architecture of monitoring system for school is shown in fig. 4

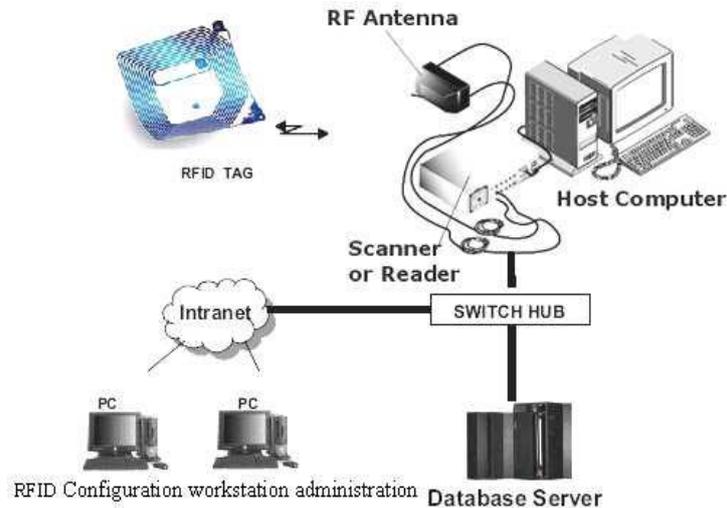


Fig. 4 System architecture of monitoring system

IV. DETAIL DESCRIPTION

Real-Time Locating System (RTLS) is one way campus administrators can keep a steady hand on the pulse of daily activities at schools.

The benefit of a dependable RTLS/RFID system is that visitors can be located in real-time throughout the facility. While the goal is not to make them feel like each of their steps is being 'tracked' in the building, it inevitably provides a tool to ensure all outsiders are indeed going where they say they're going.

Schools are wisely developing barriers to deter dangerous visitors from easily entering school grounds. But what if someone gets into the building unannounced or unapproved? RTLS/RFID systems allow staff members to wear a location-based badge with a button press that provides a silent alert to the computers or mobile devices of all pertinent individuals, inside or outside of the facility, if dangerous or emergency situations emerge. The individual receiving the alert knows who is asking for help along with their location. The benefit of these types of systems makes a difference in less severe, but still critical, instances as well. Location-based alerts are practical when, for example, teachers are dealing with a student that may be in immediate need due to injury or illness.

Although the school's existing Wi-Fi nodes were sufficient to read tags throughout the buildings as well as Ekahau IR beacons in various areas, to better pinpoint the tags' locations. Each battery-powered IR beacon sends its unique identifier to the tags, which read that ID number and transmit that beacon's ID to the Wi-Fi access points, along with their own number.[8]

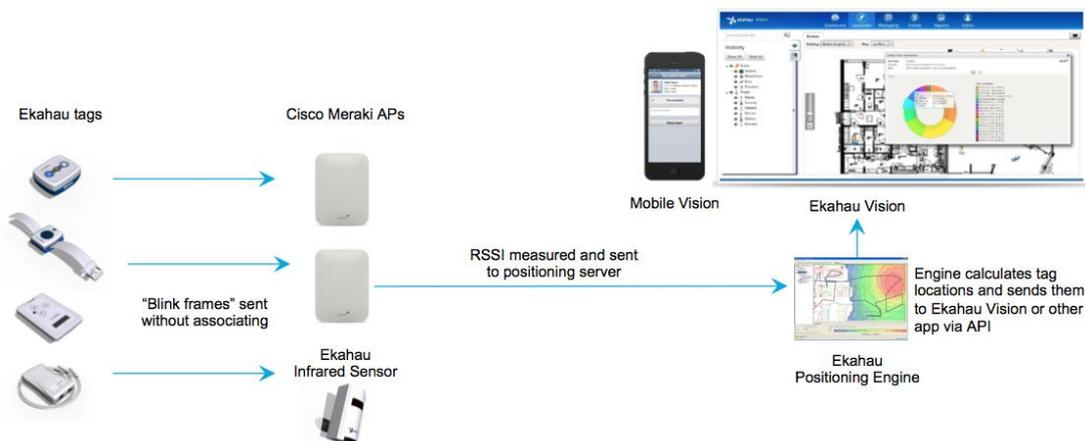


Fig 5 How message is communicated from badge to system

This system contains badge tags, which come with three independent alarm triggers:

- a pull-down safety switch, is intended to prompt a full "lockdown" of the school (issuing alerts to every employee, as well as to the police)
- Red Button: any miss happening
- Blue button signifies a health-related emergency. If someone pushes that button, the school nurses receive the alert, as well as the administrative staff general emergency.

In the event that any of the three options is triggered, software, residing on the school's back-end system, captures and interprets the data (based on the particular button pressed and the tag's location) as shown in fig 5. Within about four seconds, the software sends a message directly to the appropriate badges within the facility, thereby alerting personnel to the emergency's nature and location. Staff members can then view the text message on their badge's light-emitting diode (LED) screen and, if appropriate, report to a specific area. Ford can also rush to the scene and determine what step should be taken next, such as summoning an ambulance or calling a parent. During a "lockdown" alert, software can transmit the message directly to nearby police department.

The tags are not linked to individual staff members, but rather to the worker's role at the school, such as teacher, administrator or security personnel. The software links the tag's ID number to that individual's location, so that as a tag moves throughout the school, the software displays a color-coded icon moving around a map of the site, representing his or her role as shown in Fig 6. One employee has a unique color linked to the badge he uses, so that employees can always view his location within the two-building facility.



Fig 6 Color-coded icon moving around a map

V. FEATURES OF RTLS

A highly accurate, low-cost RTLS can be deployed using active RFID over an existing Wi-Fi infrastructure that does not require a lot of additional IT resources. RTLS can make an immediate impact on the security and safety of students, employees, and visitors.

A. Monitor the Location of Staff, Students and Visitors in Real Time

RTLS enables school security personnel to monitor students and teachers on the go without physically being in the same location. With RTLS, security and police can instantly see the location of any individual wearing a device such as a Wi-Fi badge tag. If students or visitors enter prohibited areas, an RTLS can identify and provide an alert to security, which can even work as a preventative for encroachment.

B. Provide an Instant, Silent Alarm for Emergencies

A good RTLS system can help protect staff and students from school violence by equipping them with wearable panic button devices that sound an alert and pinpoint the location of the incident to facilitate a rapid response. One of the most effective systems is a wearable badge tag attached to a lanyard that can be pulled down sharply to trigger the alarm. If a threat arises, the wearer can quickly summon help. If a fight breaks out, any student or teacher could pull their badge tag to alert other teachers close by as well as the school resource officer or security. If a teacher is threatened by a visitor or student, help can be summoned discreetly and quickly.

C. Reduce Response Times in Medical Emergencies

When help is needed, it's important to send the right person to assist. The right person is not only someone trained for the situation, but also someone who can get to the situation quickly. By the time first responders, police, and firemen locate the person reporting an emergency with manual map look-ups or calling, it could be too late. RTLS reduces emergency response times by allowing security staff and school resource officers to know the location of any student or teacher in distress or visitor in an unauthorized location, without having to perform any manual map look ups. In a life-threatening emergency where seconds and minutes count, it's vital to get the school nurse and other trained responders to the situation quickly with the right equipment, such as a rescue asthma inhaler or automated external defibrillator (AED). If a student or teacher has a medical emergency, RTLS helps the school

notify medical responders quickly, send the nurse to assist while waiting for outside help to arrive, and send the first responders to the right location, right away.

D. Guide Staff and Students to Safety

RTLS can also instantly and silently communicate with all staff and students wearing badges using text messaging capabilities. In the event of an emergency, integrate systems can allow security and police to lock down the school immediately and provide staff and students with directions—all without using the PA system. Police can communicate without dependence on cellular networks or VOIP based dialing. In the event of a student on a rampage or an active shooter situation, the police and school security can use the messaging feature to guide groups or teachers and students out of harm's way.

E. Improve Documentation and Reporting of Safety and Security Incidents

Careful tracking of all safety and security incidents helps schools document resolutions for continuous improvement and legal defence. RTLS software can help automate incident recording, noting the location and timestamp of safety incidents or security events. School security personnel can document who was involved and how the incident was resolved. These records can also enable security personnel to further identify students at risk of additional violent behaviour and to document their infractions.

VI. CONCLUSION AND FUTURE SCOPE

This system takes care of students problem with in the college vicinity by informing the school administrative staff from badge calling. System can be enhanced further to keep track of students problem outside the campus as well but that needs a huge network like phone network and messages could be sent to the parents in case of emergency and to the people who are nearby to that place as well as to the police to control. This system could be used for the safety of girls but this step must be taken by government for such a huge installation to make the city safe for everyone.

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