

Systems Engineering Design Project (ENPM-643)
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Smart School ID System

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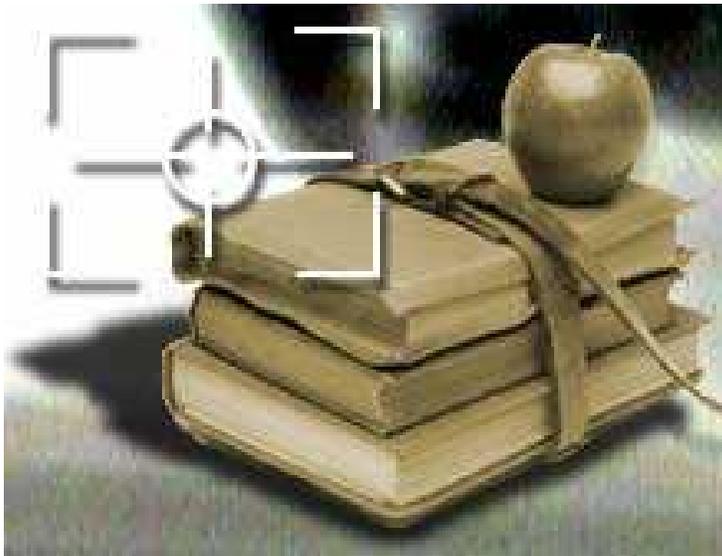


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1. PROBLEM STATEMENT

Security and student accountability is a major concern in schools these days. Nowadays, many schools in the US, UK, Japan and India are considering alternatives and solutions in order to incorporate access control and tracking mechanisms and also to automate attendance reconciliation. The purpose of this project is to apply the systems engineering principles to propose the Smart School ID System. The Smart School Id system is a presence detection and access control system designed to restrict any unauthorized access and allow tracking of students/staff and visitors inside the school. Our objective in this project is to use our knowledge of UML to analyze the system requirements, functions & specifications and use systems validation and verification strategies to put forward a robust test procedure.

1.1 INTRODUCTION

In recent years, automatic identification procedures have become very popular in many service industries, purchasing and distribution logistics, manufacturing companies, material flow systems and recently schools. The barcode labels that had triggered a revolution in identification systems some time ago are being found to be inadequate in an increasing number of cases. Barcodes might be extremely cheap, but they have a very low storage capacity and they cannot be reprogrammed. Optical character recognition was first used in the 1960s. Even though it supports a high density of information and a possibility of reading the data visually, OCR systems have failed to become universally applicable because of their high price and the complicated readers that they require. Biometric procedures (voice identification & Fingerprinting) are secure but are ideally used in High security, low traffic areas. Smart cards are ideal where undesired access and manipulation of data is a risk, but their flexibility can be enhanced by using contactless smart cards using the RFID technology.

Some of the advantages of RFID over Barcode

- Human intervention is required to scan a barcode, whereas in most applications an RFID tag can be detected "hands off."
- Barcodes must be visible on the outside of product packaging. RFID tags can be detected regardless of their orientation
- You must have "line of sight" to read a barcode. Line of sight is not required for RFID tagged objects
- The readability of barcodes can be impaired by dirt, moisture, abrasion, or packaging contours. RFID tags are not affected by those conditions.
- RFID tags have a longer read range than barcodes.
- RFID tags have read/write memory capability; barcodes do not.
- More data can be stored in an RFID tag than can be stored on a barcode.

In general terms, RFID (Radio Frequency Identification) is a means of identifying a person or object using a radio frequency transmission. It uses radio waves to automatically identify physical objects (either living beings or inanimate items). Therefore, the range of objects identifiable using virtually everything. Thus, RFID is an example of *automatic identification* (Auto-ID) technology by which a physical object can be identified automatically.

1.1.1 HOW RFID WORKS

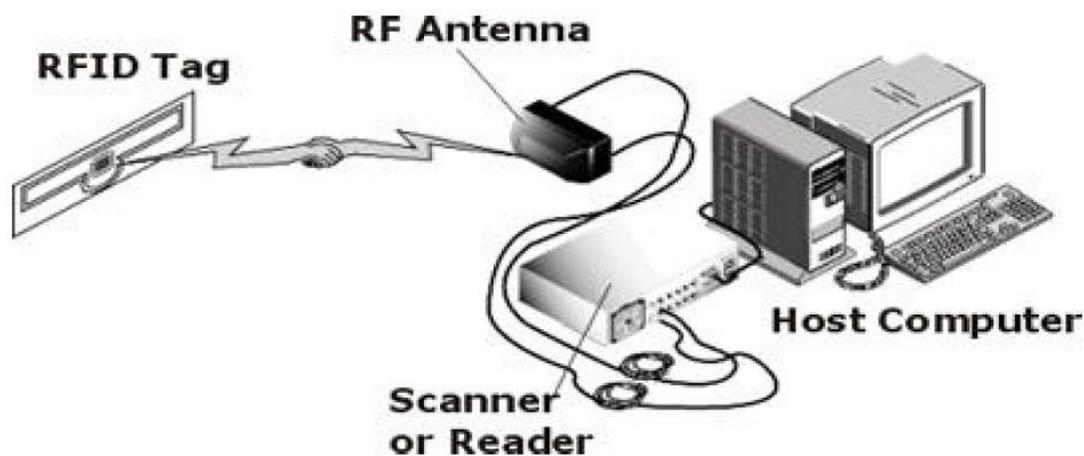
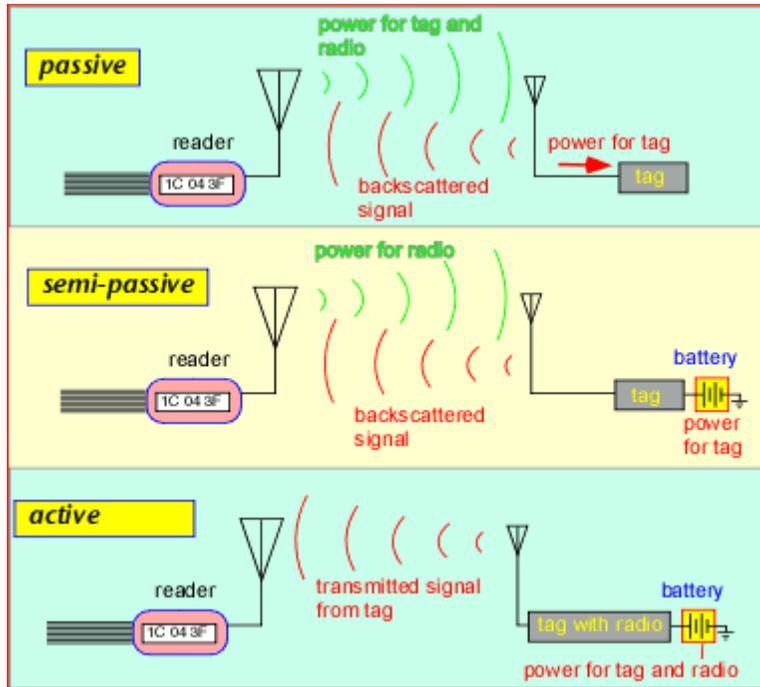


Figure 1. Typical RFID system

An *RFID system* is an integrated collection of components that implement an RFID solution.

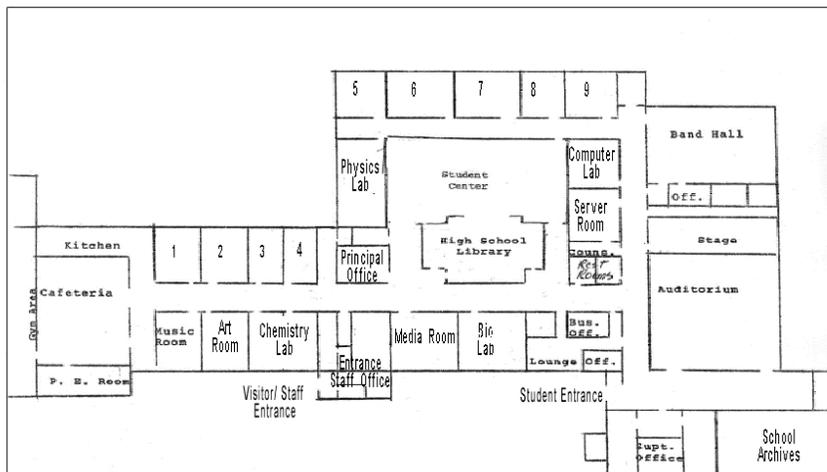
- Tag. This is a mandatory component of any RFID system.
- Reader. This is a mandatory component, too.
- Reader antenna. This is another mandatory component. Some current readers available today have built-in antennas
- Controller. This is a mandatory component. However, most of the new-generation readers have this component built in to them.
- Sensor, actuator, and annunciator. These optional components are needed for external input and output of the system.
- Host and software system. Theoretically, an RFID system can function independently without this component. Practically, an RFID system is close to worthless without this component.
- Communication infrastructure. This mandatory component is a collection of both wired and wireless network and serial connection infrastructure needed to connect the previously listed components together to effectively communicate with each other.

In a typical system tags are attached to objects that need to be identified. Each tag has a certain amount of internal memory (EEPROM) in which it stores information about the object, such as its unique ID (serial) number. When such a tagged object is presented in front of a suitable RFID reader, the tag transmits this data to the reader (via the reader antenna). The reader then reads the data and has the capability to forward it over suitable communication channels, such as a network or a serial connection, to a software application running on a computer. This application can then use this unique data to identify the object presented to the reader. It can then perform a variety of actions such as updating the location information of this object in the database, sending an alert to the floor personnel, or completely ignoring it (if a duplicate read, for example).

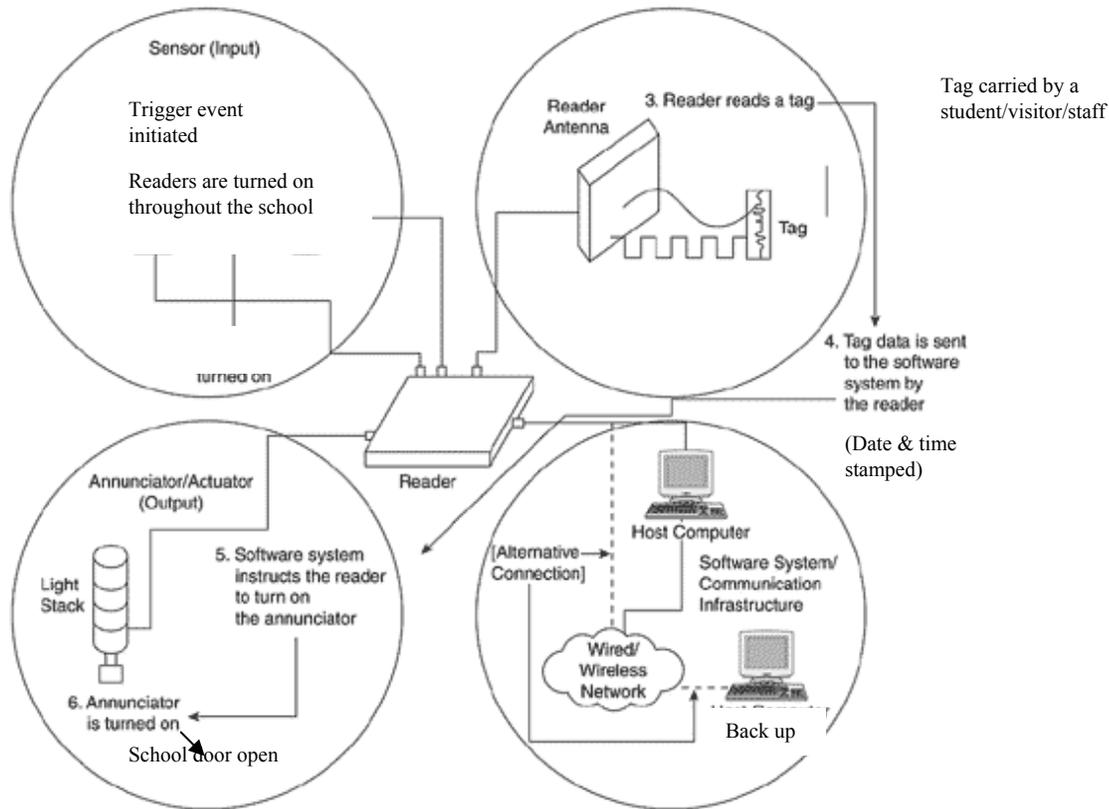


1.2 SYSTEM INTRODUCTION

The Smart School ID System makes student security possible and efficient. A typical school consists of 2 or 3 school entrances, student labs, student activity rooms, student gym/courts, administrative offices, media, archive rooms. The Smart School ID System incorporated in such a school, allows presence detection & access control in all areas inside the school. School entrances are generally restricted to two. The presence detection/access control function is comprised of a wired/wireless sensor network of readers that is installed in school buildings to detect presence of students with badges or tags. All students/staff are issued permanent access IDs on their recruitment into the school. Students/staff who have lost or forgotten their tags and Visitors are issued day access ids.



Layout Figure A: School Architectural Layout



The system consists of a photo ID card affixed to a lanyard and worn around the neck. Embedded in the card is an RFID chip that contains a 15-digit number assigned to each student. As students come near a doorway scanner on their way into school through the student entrance, the scanner verifies their information, gives the student access and records the number and sends it to a server in the school's office. The server translates the digits into names and uploads a list of present, absent and tardy (based on when they enter the classroom). The system sends this attendance list to the teacher's laptop, identifying all of the students who were given access into the school. This list is generated based on the student schedule for the day. The teacher then visually verifies that the names on the laptop list match the students in the classroom.



Figure above shows the doorway access for the entrance at the school, where RFID readers can be placed. This system also allows tracking inside the school under normal and special (emergency) situations. It provides notification services for the same and also automates

attendance reconciliation. To ensure data security, only Authorized users maintain the system database.

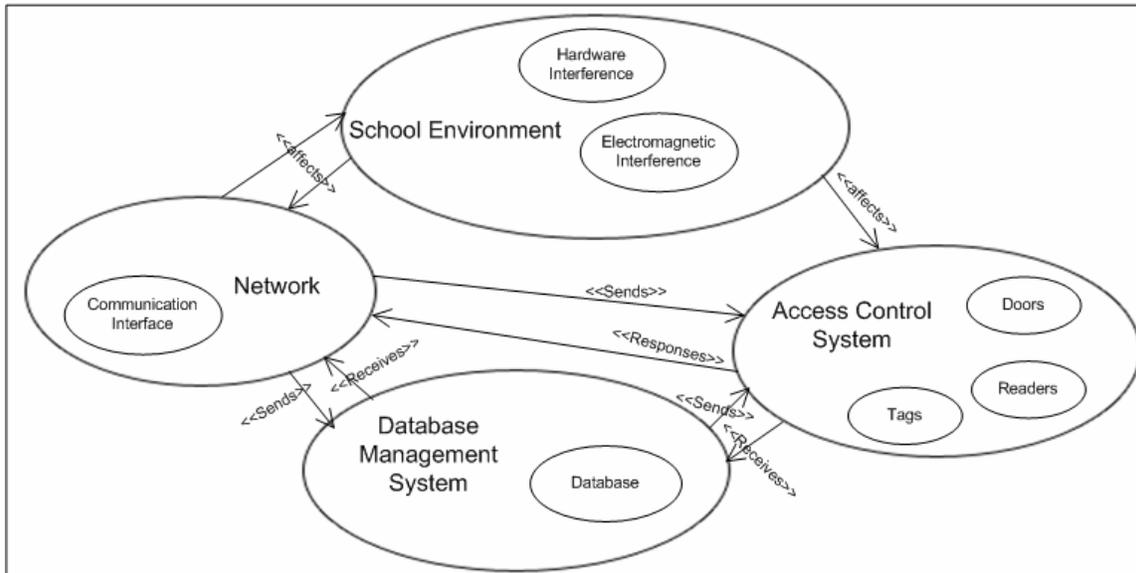
The Smart school ID system offers security advantages since administrators would immediately know if a student didn't show up for class and could notify parents quickly. School officials could also quickly identify anyone who didn't belong on campus if they weren't wearing an RFID badge. But the main draw is a more efficient and accurate way to track and verify attendance.

1.3 PROJECT OUTLINE

Initially use case analysis is done based on the customer/stakeholder requirements. From the use case analysis, high – level requirements are generated and are further synthesized and broken down into low level requirements. Component requirements and their design specifications are also identified. The system behavior models are also generated documenting the sequences of tasks making up activities governed by conditional logic and flows driven by internal processing. State chart diagrams are also specified describing all possible behaviors in a system element through its traversal of its different states and transition arcs.

1.4 SYSTEM FRAMEWORK & BOUNDARY

The Smart school system ID can be depicted as a framework of the following systems. This describes the system boundary.



2. GOALS, SCENARIOS and Use Cases

2.1 Goals and Scenarios

Goal 1: The system must be secure

- **Scenario 1.1** – The system should provide the school with a reliable tracking mechanism.
- **Scenario 1.2** – All updates to the database should be monitored by a system administrator
- **Scenario 1.3** – Emergency tracking and database updates require secure login to the system
- **Scenario 1.4** – Unauthorized person should not be allowed access.
- **Scenario 1.5** – The school should verify the visitor credentials before giving access Ids
- **Scenario 1.6** – In event of unauthorized access, the system should generate an alert and deny access.

Goal 2: The system must be efficient

- **Scenario 2.1** – The system should use a database management system which supports large number of students, staff and visitors.
- **Scenario 2.2** – The system should use readers which use anti-collision algorithms to manage reading and tracking of large number of tags.
- **Scenario 2.3** – Database accesses and updates made by the readers for tracking purposes should have minimum latency
- **Scenario 2.4** – Data validation and account authentication should be done with minimum latency

Goal 3: The system must be usable

- **Scenario 3.1** – The system should be easy to use.
- **Scenario 3.2** – The system should have easy to use graphical user interface for the entrance staff and authorized users to update or access the system.
- **Scenario 3.3** – The system should provide alerts wherever required.
- **Scenario 3.4** – The system should provide attendance reconciliation and print reports.
- **Scenario 3.5** – The system should be able to be used for tracking students/staff and visitors with tags.

Goal 4: The system must be reliable

- **Scenario 4.1** – The system and database should be available at all times.
- **Scenario 4.2** – The system readers should work whenever initiated.
- **Scenario 4.3** – The readers should correctly read the tag data and update the database accurately.
- **Scenario 4.4** - Back up Server ensures secure data storage

Goal 5: The system must be easy to maintain

- **Scenario 5.1** – The system database should be well protected from crashes.
- **Scenario 5.2** – Database should be easily accessible.

- **Scenario 5.3** - The entrance door should close after one revolution.

Goal 6: The system must track accurately and maintain data integrity

- **Scenario 6.1** – The system should make use of anti-collision algorithms to handle signal collision from different tags.
- **Scenario 6.2** – The system should allow database access and update by authorized users only.
- **Scenario 6.3** – The system should not allow more than two users to access the same record for update simultaneously.
- **Scenario 6.4** –The system should track students accurately and give the correct location of the student.

Goal 7: The system must provide authorized access

- **Scenario 7.1** – Every student/staff should have a permanent access id tag
- **Scenario 7.2** – Every visitor should get a day access id from the school entrance staff for access to the school
- **Scenario 7.3** – There should be two access controlled entrances: one for students and the other for visitors and staff
- **Scenario 7.4** A day access ID should be given Student/ staff who have forgotten their ID or lost it
- **Scenario 7.5** Entrance to the school should not be allowed from any other entrances from the outside
- **Scenario 7.6** The day access ID should be valid only for a day

2.2 USE CASE ANALYSIS

2.2.1 Actors

1. School Authority
2. System Administrator
3. School Staff
4. Entrance Staff
5. Authorized User
6. Student
7. Visitor
8. NT (No Tag) Staff
9. NT (No Tag) Student
10. Parents

2.2.2 Identify the roles of actors

- **School Authority:** Approves issuance of tags to the students/ staff or visitors.
- **System Administrator:** Issues tags to staff and student. Maintains the database, database recovery etc. Can trigger tracking under special situations. Creates accounts for authorized users (or staff) to provide them access the system, print/ generate reports, accesses the database for updating records.
- **School Staff:** User of the system

- Entrance Staff: Issues day ID tags to the visitors/students and staff, handle return of the tags, accesses the database for updating records.
- Authorized User: Accesses the database to update, delete or add records, print/generate reports
- Student: Accesses the system to enter the school, requests for a permanent tag, requests the access to a restricted area, returns the permanent tag
- Visitor: Accesses the system to enter the school, requests for a day ID tag, requests the access to a restricted area, returns the day id tag
- NT Staff: The staff who lost or forgot to get the tag to school
- NT Student: The student who lost or forgot to get the tag to school
- Parents: Requests initiation of tracking, visit school

2.3 Initial Use Case Modeling

The use cases represent system goals and system functions. A use case view focuses on the high-level system functionality, without revealing the details of the objects that will implement the behavior. It is an abstraction of a system response to external inputs and accomplishes a task that is important from a user's point of view.

The use cases have been packaged into six (6) packages. Below are the use case diagrams representing the Smart School ID System.

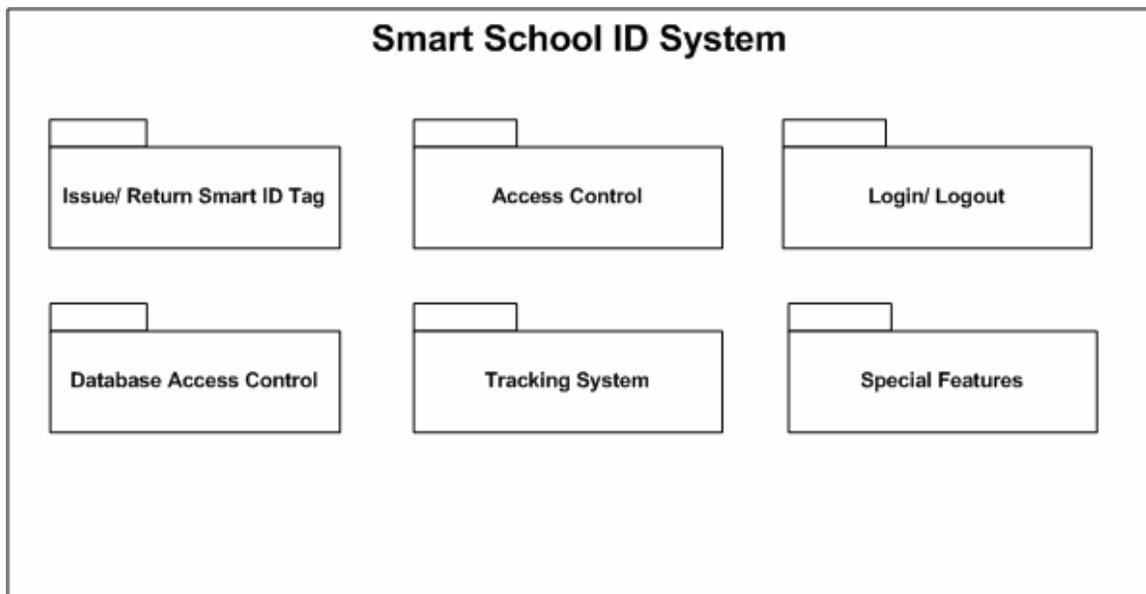


Figure 2: Initial Un-Partitioned use-case diagram of Smart School ID System

Issue/ Return Smart ID Tag Package

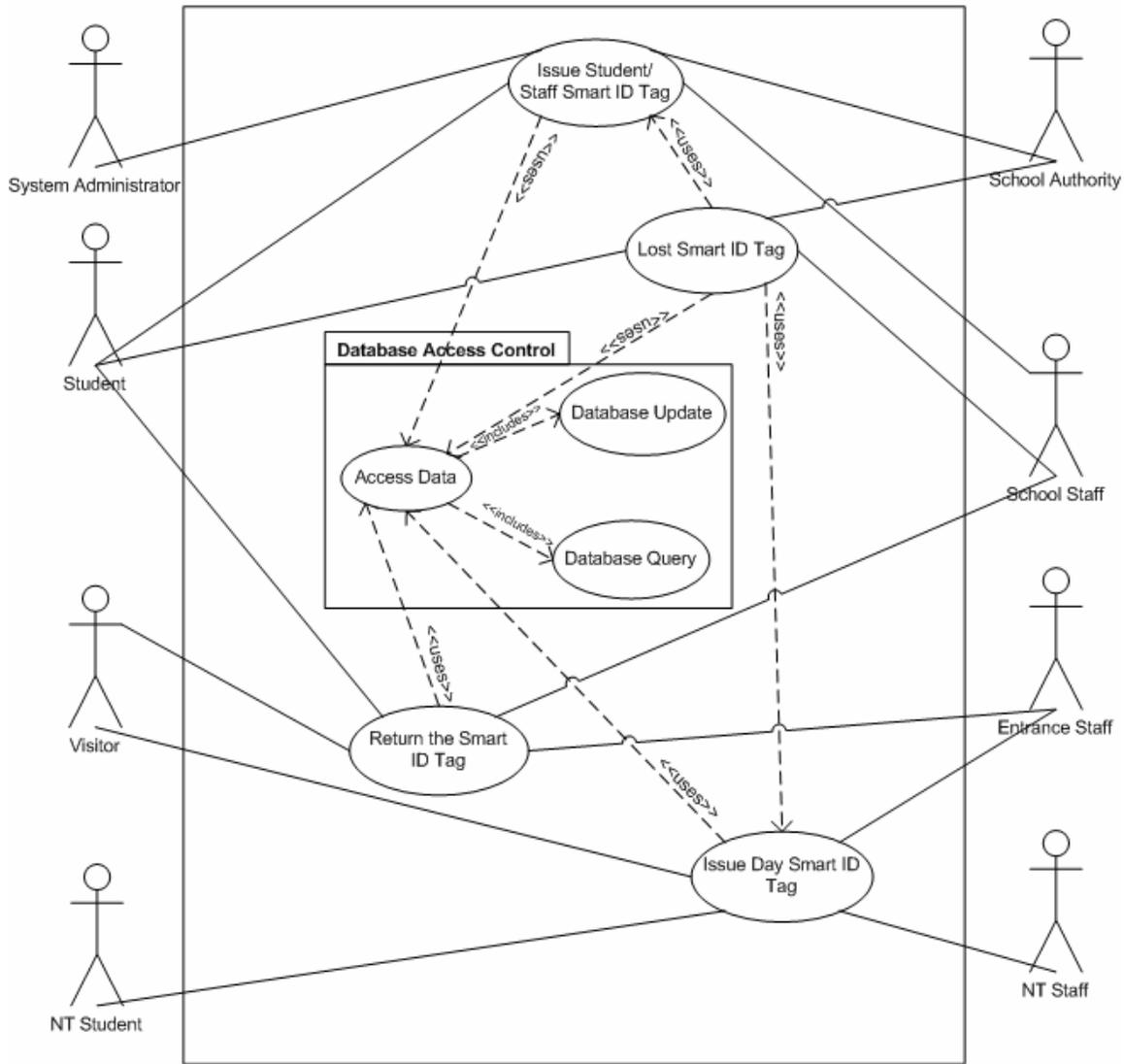


Figure 3: Issue/ Return Smart ID Tag Package - use-case diagram of Smart School ID System

Access Control Package

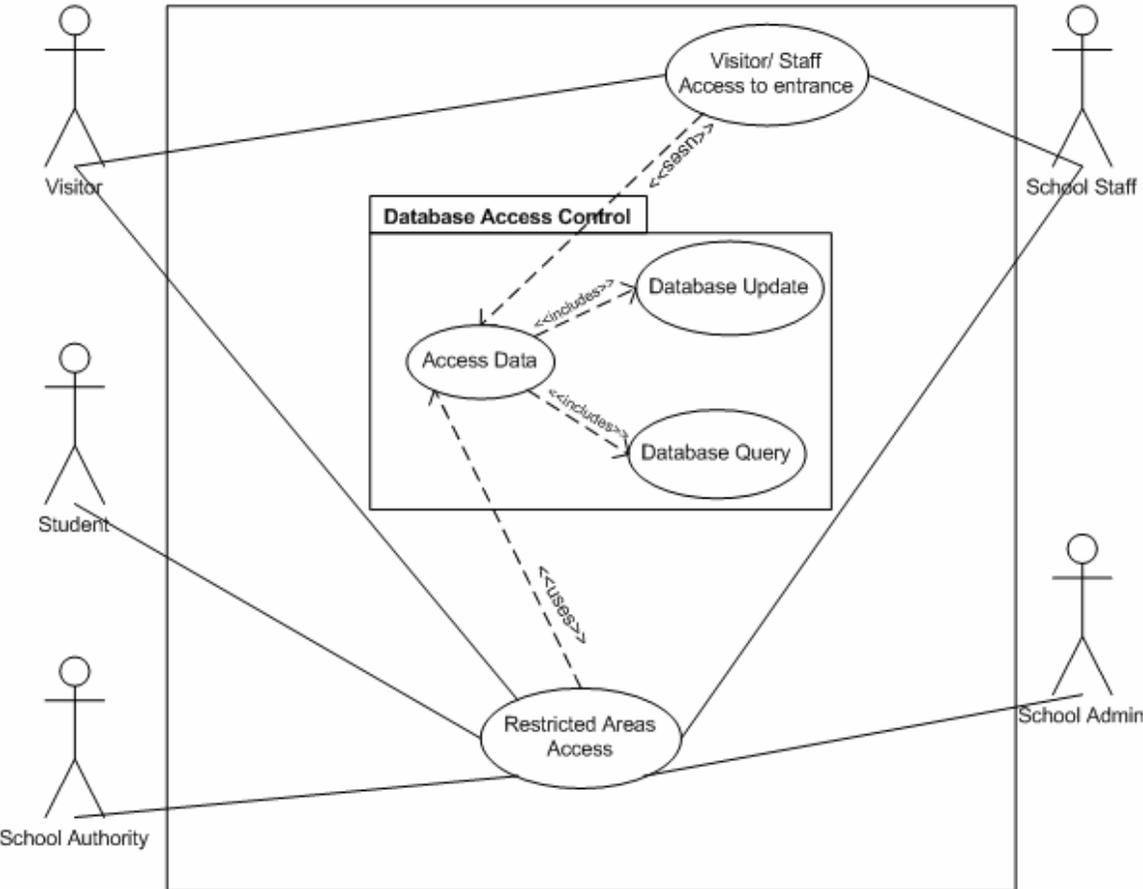


Figure 4: Access Control Package - use-case diagram of Smart School ID System

Database Access Control Package

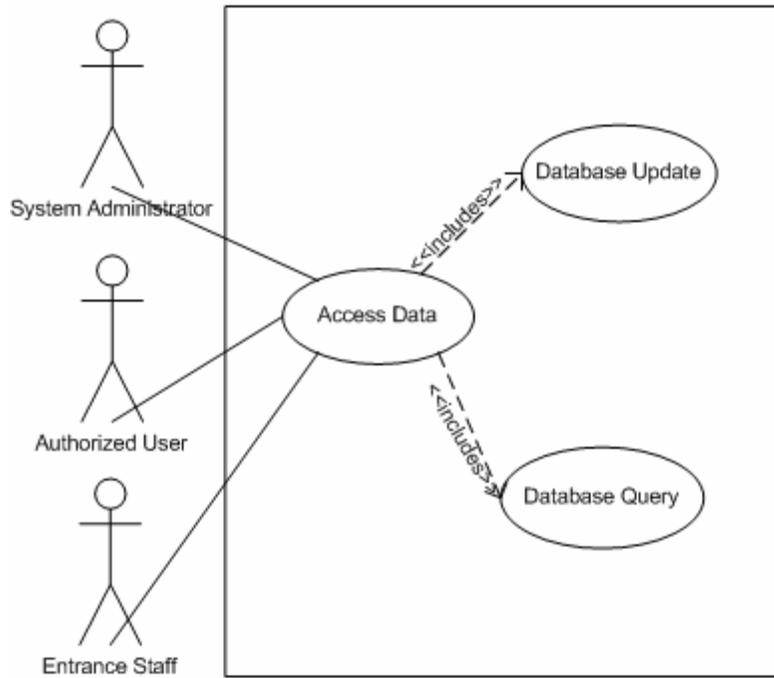


Figure 5: Database Access Control Package- use-case diagram of Smart School ID System

Login / Logout Package

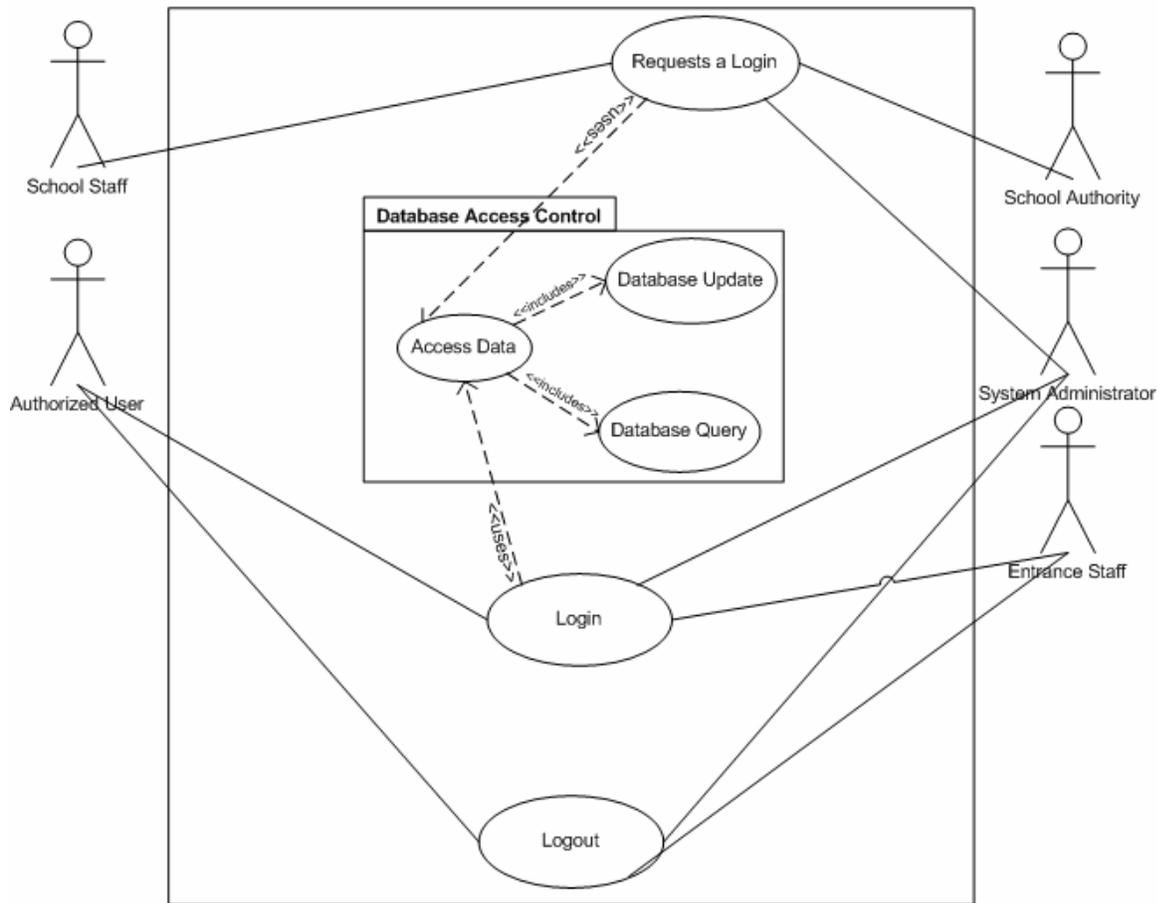


Figure 6: Login/ Logout Control Package- use-case diagram of Smart School ID System

Special Features Package



Figure 7: Special Features Package- use-case diagram of Smart School ID System

Tracking System Package

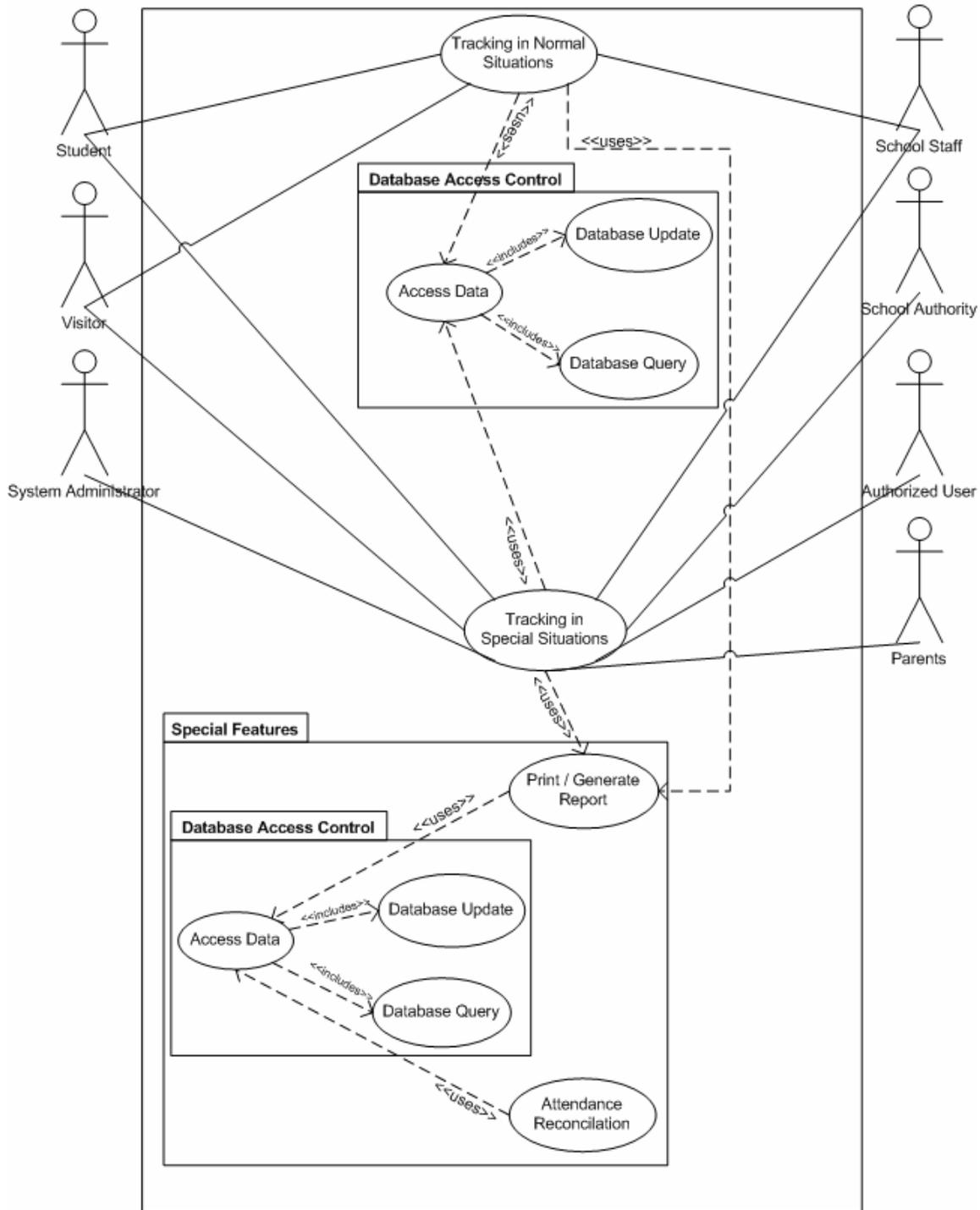


Figure 8: Tracking Package- use-case diagram of Smart School ID System

2.4 Use Case Narrative

USE CASE 1– ISSUE STUDENT/ STAFF SMART ID TAG

Brief Description

This use case narrative allows the school to issue permanent access Ids to newly recruited school staff and newly admitted students and also to school staff and students who have lost their permanent tags.

Actors

1. Student
2. School Staff
3. School Authority
4. System Administrator

Flow of Events:

1. Basic Flow:

- 1.1. The school authority collects all the information from the student or the staff member and gives to the system administrator
- 1.2. The system administrator logs in to the system
- 1.3. The system administrator gives the smart tag ID to the student or the staff member
- 1.4. The system administrator updates the database <include access data> with the name, information, tag id information (student Id number) and the access information.

Assumptions:

1. Student has been admitted to school Staff member has been recruited.
2. The student/staff who has lost the tag, has been issued a day access id once but now requires a permanent access tag for daily purposes.

Precondition:

1. The system should be up and running.
2. System administrator is logged in

Postcondition:

1. Student/Staff member have appropriate access.
2. The system administrator must log out after he is done with the updates<include use case logout>

USE CASE 2– ISSUE DAY SMART ID TAG

Brief Description

This use case narrative allows the visitor or NT student/staff to obtain access tags to enter the school building.

Actors

1. Visitor
2. Entrance Staff
3. NT Student
4. NT Staff

Flow of Events:

1. Basic Flow:

- 1.1 The visitor enters the school
- 1.2 The visitor enters his details in a form describing his name, address, photo, and the kind of access he requires and purpose of visit.
- 1.3 The entrance staff verifies and enters his information into the database.
- 1.4 The entrance staff determines what kind of access the visitor should get.
- 1.5 He updates the same in the database <Include access data>
- 1.6 The entrance staff supplies photo visitor id to the visitor.

2. Alternate Flow 1:

- 2.1 The visitor enters the school
- 2.2 The visitor enters his details in a form describing his name, address, photo, and the kind of access he requires and purpose of visit.
- 2.3 The entrance staff verifies and enters his information into the database.
- 2.4 The entrance staff rejects his request and decides not to allow him inside the school premises.
- 2.5 The entrance staff enters this information in the database for future reference <Include access data>

3. Alternate Flow 2:

- 3.1 A student/staff comes to school without his tag ID
- 3.2 If the student/staff has lost his ID, he reports it to the entrance staff.
- 3.3 The student/staff enters his details in a form describing his name, address, class and teacher.
- 3.4 The entrance staff verifies the kind of access that he requires.
- 3.5 The entrance staff verifies and enters his information into the database. <Include access data>
- 3.6 The entrance staff gives him the ID valid for a day

4. Alternate Flow 3:

- 4.1 A student/staff comes to school without his tag ID.
- 4.2 If the student/staff has lost his ID, he reports it to the entrance staff.
- 4.3 The student/staff enters his details in a form describing his name, address, class and teacher.
- 4.4 The entrance staff verifies and enters his information into the database.
<Include access data>
- 4.5 The staff rejects the request as it does not find any matching information.
- 4.6 The staff updates the database <include access data>

Assumptions:

1. The database is set up and entrance staff is the primary decision maker to approve or reject access request.
- 2.. Visitor tags/temporary student/staff Ids are valid only for a school day.

Precondition:

1. The visitor enters the school without an authorized smart ID tag
2. Entrance Staff is logged in to the system

Postcondition:

1. The visitor/ NT staff or NT student gets the appropriate ID and access.
2. The entrance must log out one the updates are complete

USE CASE 3– ATTENDANCE RECONCILIATION

Brief Description

This use case narrative allows student inside the school building and ensures that the student attendance is recorded.

Actors

1. Student

Flow of Events:

1. Basic Flow:

- 1.1 The student enters the school
- 1.2 The student swipes the tag on a controlled doorway with RFID reader at the main entrance
- 1.3 The RFID reader system recognizes the tag after verifying with the database<include access data>
- 1.4 They match, the door gives access to the student and the student can then enter

- 1.5 The server database gets updated with a time stamped entry. <Include access data>
- 1.6 The server translates the entries into student names and uploads a list of present, absent and tardy students
- 1.7 The teacher is provided with a list of students as a printout or through laptop connected in each class and she verifies it as she enters the class
- 1.8 The teacher finds all the students in the list present in the class

2. Alternate Flow 1:

- 2.1 The student enters the school
- 2.2 The student swipes the tag on the RFID reader at the main entrance
- 2.3 The RFID reader system fails to recognize the tag.
- 2.4 The student is denied access.
- 2.5 Student goes to the entrance staff.

3. Alternate flow 2:

- 3.1 The student enters the school
- 3.2 The student swipes the tag on a controlled doorway with RFID reader at the main entrance
- 3.3 The RFID reader system recognizes the tag after verifying with the database.<include access data>
- 3.4 They match, the door gives access to the student and the student passes successfully
- 3.5 The server database gets updated with a time stamped entry. <Include access data>
- 3.6 The server translates the entries into student names and uploads a list of present, absent and tardy students.
- 3.7 The teacher is provided with a list of students as a printout or through laptop connected in each class and she verifies it as she enters the class
- 3.8 The teacher finds one or more students in the list missing in the class. The teacher send out a alert and tracking is initiated<include tracking in special situations>

Assumptions:

1. There are two separate entrances for students and visitors.
2. Students are wearing their own tags
3. Entrance to the school should not be allowed from any other entrance from the outside.
4. The readers work at all times
5. The door will restrict access after one revolution

Precondition:

The RFID system is working properly.

Postcondition:

Access is allowed/ denied and the database is updated

USE CASE 4 – VISITOR /STAFF ACCESS TO ENTRANCE

Brief Description

This use case narrative allows access to the visitor/staff inside the main building.

Actors

1. Visitor
2. School staff

Flow of Events:

1. Basic Flow:

- 1.1 The visitor/school staff goes to the main access door of the school building
- 1.2 The visitor swipes the card on the reader
- 1.3 The reader at the door recognizes the tag used by the visitor
- 1.4 The database is updated with the visitor /school staff information and is time stamped<include access data>
- 1.5 The door opens for the visitor/staff

2. Alternate Flow:

- 2.1 The visitor/staff goes to the main access door of the school building
- 2.2 The reader at the door does not recognize the tag used by the visitor/staff
- 2.3 The door does not open for the visitor/staff
- 2.4 The visitor/staff goes back to the entrance staff

Assumptions:

1. Visitor/staff Door to the main entrance is access controlled. It opens only if the reader recognizes the tag.
2. The reader here works at all times
3. The door should restrict access after one revolution.

Precondition:

1. Visitor has taken access tag from the entrance staff.
2. School staff has IDs

Postcondition:

Visitor/ staff allowed or denied access into the building

USE CASE 5 – RESTRICTED AREAS ACCESS

Brief Description

This use case narrative allows access to some areas in the school is restricted according to individual requirement.

Actors

1. Student
2. Visitor
3. School staff
4. System Admin
5. School Authority

Flow of Events:

1. Basic Flow:

- 1.1 The student/school staff or visitor tries to access the restricted area entrance.
- 1.2 The reader recognizes the tag id.
- 1.3 The door opens and the student/school staff or visitor is given access to the area.
- 1.4 The database gets updated <include access data>

2. Alternate Flow 1:

- 2.1 The student/staff or visitor tries to access the restricted area
- 2.2 The reader fails to recognize the tag id
- 2.3 The door remains closed and the student/staff or visitor is not granted access to the restricted area.
- 2.4 The database is updated <include access data>
- 2.5 The student/staff/visitor goes to the system admin or school authorities to get the additional access.

Assumptions:

1. Access to the restricted area has been given to a visitor or student/ staff if he is required to enter the area.
2. Playground entrances, lab entrances, inventory and media centers all will have restricted access.
3. The readers here work all the time.

Precondition:

Students/staff/Visitors trying to enter a restricted area have a tag id.

Postcondition:

The student/staff/visitor are either allowed or denied access.

USE CASE 6 – REQUESTS A LOGIN

Brief Description

This use case narrative allows school staff to request the system administrator to provide login access to the system

Actors

1. School Staff
2. System Administrator
3. School Authority

Flow of Events:

1. Basic Flow:

- 1.1 A staff member authorized by the school requests system administrator for access to the system
- 1.2 The system administrator verifies the staff member's permission and information
- 1.3 The system administrator then issues a login id and an initial password to the requesting staff member
- 1.4 The user has the option to change the password to own choice
- 1.5 The database is updated with the login information <include access data>

2. Alternate Flow 1:

- 2.1 A staff member requests for access to the system
- 2.2 The system administrator verifies the staff member's permission and information
- 2.3 The system administrator finds that the staff member has not been authorized
- 2.4 The system administrator directs the user to the school authorities
- 2.5 The system administrator also reports the matter to the school authority
- 2.6 The system administrator updates the database<include access data>

Assumptions:

The system administrator has the power to create a new user account

Precondition:

The person requesting access belongs to the school staff

Postcondition:

Appropriate action is taken

USE CASE 7 – TRACKING IN NORMAL SITUATIONS

Brief Description

This use case narrative describes how students/ staff and visitors are tracked while they are inside the school premises

Actors

1. Student

2. Visitor
3. School Staff

Flow of Events:

1. Basic Flow:

- 1.1 A timed trigger initiates regular tracking of the students/school staff and visitors.
- 1.2 It initiates and activates the readers in classrooms, hallways, restrooms and inside restricted areas
- 1.3 The readers then recognize the tags present in their area of coverage
- 1.4 The data obtained is verified with the data available of the people present inside on that particular day
- 1.5 The reader is able to locate and track all students/school staff and visitors.<include access data>
- 1.6 A report is generated with location of each student/school staff and visitors.
- 1.7 <Include Print/Generate report use case. >

2. Alternate Flow 1:

- 2.1 A timed trigger initiates regular tracking of the students/school staff and visitors.
- 2.2 It initiates and activates the readers in classrooms, hallways, restrooms and inside restricted areas
- 2.3 The readers then recognize the tags present in their area of coverage
- 2.4 The data obtained is verified with the data available of the people present inside on that particular day and a report is generated of missing students/school staff
- 2.5 An alert is created if a student/visitor or school staff that is supposed to be inside the school is not found<include access data>
- 2.6 <Include Print/Generate report use case. >

Assumptions:

Timed trigger is set as per business needs but preferably at an hour's interval

Precondition:

Everybody inside the school has a tag ID

Postcondition:

A report is generated.

USE CASE 8 – TRACKING IN SPECIAL SITUATIONS

Brief Description

This use case narrative describes how students/school staff and visitors are tracked in special situations while they are inside the school premises.

Actors

1. Student
2. Visitor
3. System administrator
4. Authorized User
5. School Staff
6. Parents

Flow of Events:

1. Basic Flow:

- 1.1 A trigger is forced to make the RFID system track students/school staff and visitors. The system administrator on request from staff or parents generally initiates this trigger
- 1.2 This initiation activates the readers in classrooms, hallways, restrooms and inside restricted areas
- 1.3 The readers then recognize the tags present in their area of coverage
- 1.4 The data obtained is verified with the data available of the people present inside on that particular day<include access data>
- 1.5 The reader is able to track all students/school staff and visitors
- 1.6 A report is generated with location of each student/school staff and visitors.
- 1.7 <Include Print/Generate report use case >

2. Alternate Flow 1:

- 2.1 A trigger is forced to make the RFID system track a particular student/ school staff and visitors. The system administrator on request from staff or parents generally initiates this trigger.
- 2.2 This initiation activates the readers in classrooms, hallways, and restrooms and inside restricted areas.
- 2.3 The system administrator/authorized user enters the name of the student/ school staff and visitors to be searched for
- 2.4 It initiates and activates the readers in classrooms, hallways, restrooms and inside restricted areas.
- 2.5 The readers then recognize the tags present in their area of coverage.
- 2.6 The data obtained is verified with the Tag ID for the concerned student/ school staff and visitors
- 2.7 The readers then send an information if the student/school staff and visitors has been found or not. <Include access data>
- 2.8 A report is generated with the location of the student/school staff and visitors.
- 2.9 <Include Print/Generate report use case. >

3. Alternate Flow 2:

- 3.1 A trigger is forced to make the RFID system track students/school staff and visitors. The system administrator on request from staff or parents generally initiates this trigger.
- 3.2 It initiates and activates the readers in classrooms, hallways, and restrooms and inside restricted areas.
- 3.3 The readers then recognize the tags present in their area of coverage.

- 3.4 The data obtained is verified with the data available of the people present inside on that particular day and a report is generated of missing students/staff.
<Include access data>
- 3.5 An alert is created if a student/visitor or school staff that is supposed to be inside the school is not found.
- 3.6 <Include Print/generate report use case>
- 3.7 It initiates and activates the readers in classrooms, hallways, and restrooms and inside restricted areas.

Assumptions:

1. Forced trigger is initiated if requested by staff or parents or in case of emergency situations.
2. It can also be generated by a teacher if he does not find all the students in the attendance list physically present in the classroom

Precondition:

1. Everybody inside the school has a tag ID
2. System administrator or authorized user is logged in

Postcondition:

1. A report is generated.
2. The system administrator must log out after he is done with the updates<include use case logout>

USE CASE 9 – LOGIN

Brief Description

This use case narrative describes how the system administrator or authorized user can login to the system

Actors

1. System administrator
2. Authorized user
3. Entrance Staff

Flow of Events:

1. Basic Flow:

- 1.1. The user/system administrator enters into the login screen.
- 1.2. The user /system administrator enters the username and password
- 1.3. The password and username are verified with the entry in the database <include access data>
- 1.4. The password and username are accepted by the system and the user gains access to the system.

2. Alternate Flow 1:

- 2.1. The user enters into the login screen.
- 2.2. The user enters the username and password
- 2.3. The password and username is not accepted by the system. Either of them is incorrect.
- 2.4. The system prompts the user to correct his entry.
- 2.5. The system allows the user to have three trials.
- 2.6. If the user is not able to correct his entry in 3 trials, the username gets locked.
- 2.7. The user must contact the system administrator to reset the password.
- 2.8. <Include database update>

Assumptions:

The system administrator is a maintainer of all user accounts. He does not forget his password to any system

Precondition:

The user has an account

Postcondition:

The user is able to login

USE CASE 10 – ACCESS DATA

Brief Description

This use case narrative describes how an authorized user or system administrator can access the required data from the system

Actors

1. Authorized user
2. System administrator
3. Entrance Staff

Flow of Events:

1. Basic Flow:

- 1.1. The user connects to the database by providing the required information
- 1.2. He then updates or queries the database to acquire data

Assumptions:

The database should be robust enough to be able to hold records of all students/staff & visitors.

Precondition:

System administrator or authorized user is logged in

Postcondition:

1. A user accesses data
2. The user must logout after accessing the desired information<include use case logout>

USE CASE 11 – DATABASE QUERY**Brief Description**

This use case describes how the system administrator would generate a database query.

Actors

1. System administrator
2. Authorized User

Flow of Events:**1. Basic Flow:**

- 1.1. The system administrator in order to access data enters the appropriate search criteria.
- 1.2. The system administrator can search by name, tag ID, date.
- 1.3. The system accesses all records corresponding to the entered criteria.
- 1.4. The list of all such data is displayed to the system administrator.

Assumptions:

The search criteria name, tag ID and date are all that the system administrator might require doing a required search.

Precondition:

The system administrator is logged in

Postcondition:

1. The required data is presented.
2. The user must logout after accessing the desired information<include use case logout>

USE CASE 12– DATABASE UPDATE

Brief Description

This use case narrative describes how student and visitor data can be updated in the system.

Actors

1. Entrance Staff
2. System administrator
3. Authorized user

Flow of Events:

1. Basic Flow:

- 1.1. The system administrator decides to open / update or delete any existing record of a student.
- 1.2. To access the record, the system administrator enters the corresponding student name.
- 1.3. He then either views updates or deletes the record depending on the requirement.
- 1.4. If some other user is updating the same record, the user should get a message stating this. The updated record should open for this user only after the previous user is done with his updating.
- 1.5. The user must logout after accessing the desired information<include use case logout>
- 1.6. System back up of the data will be done to save the data from losing during system crash.

2. Alternate Flow:

- 1.1. The reader accesses the database, opens the record for a particular tag user and updates it with a time stamped value.
- 1.2. System back up of the data will be done to save the data from losing during system crash.

Assumptions:

1. Such a request can be either initiated by the concerned staff member or as a part of the data maintenance operations initiated by the system administrator.
2. The database should be robust enough to be able to hold records of all students/staff & visitors.

Precondition:

1. A request is initiated
2. The system administrator is logged in

Postcondition:

The required operation is performed and data is updated in the database.

USE CASE 13 – PRINT /GENERATE REPORT

Brief Description

This use case narrative allows the system administrator to print out /generate a report.

Actors

1. System administrator
2. Authorized user

Flow of Events:

1. Basic Flow:

- 1.1. The System administrator can generate and print a report from the system. This can be an attendance reconciliation report, a report of the monthly or yearly record of a particular list, a report of a time based location of a particular student or a report with just a list of students and their information, a day report.
- 1.2. The system administrator or authorized user selects the report type and views it
- 1.3. The System administrator initiates the print command for the desired report type and enters the required information.

Assumptions:

A staff member or parents can direct such a request to the system administrator.

Precondition:

1. The system has the capability to print and has a printer in network
2. The system administrator & authorized user are logged in.

Postcondition:

1. Desired report is printed.
2. The user must logout after accessing the desired information<include use case logout>

USE CASE 14 – RETURN THE SMART ID TAG

Brief Description

This use case narrative allows the student/school staff/visitor to return their Access ID. This can be either a day ID issued to a student /staff or visitor or can be a permanent tag being returned when a school staff or student is permanently leaving the school.

Actors

1. Student

2. Visitor
3. School Staff
4. Entrance Staff

Flow of Events:

1. Basic Flow:

- 1.1. Student/School Staff/Visitor returns the access ID after he comes out of the main building.
- 1.2. The staff collects the ID and updates the database. <Include access data>

Assumptions:

The visitor /temp student tag ids are not valid after a school day.

Precondition:

1. The student /visitor wishes to leave the school premises
2. Entrance staff is logged in to the system
3. Student/staff returning permanent tags are leaving the school permanently.

Postcondition:

1. The student/visitor returns the ID and leaves
2. The user must logout after accessing the desired information<include use case logout>

USE CASE 15 – LOST SMART ID TAG

Brief Description

This use case narrative describes what should be done incase a tag ID is lost. This is important to ensure security so that any unauthorized person does not use the tag to enter the school premises.

Actors

1. System administrator
2. Student
3. School Staff
4. School Authority
5. Visitor

Flow of Events:

1. Basic Flow:

- 1.1. The student/staff/visitor has lost his tag
- 1.2. The system administrator tries to track the ID to see if it is present in the school premises. <Include tracking in emergency situations>

- 1.3. The system tracks the ID and it is returned to the user.
- 1.4. The database is updated to reflect the carelessness of the tag user. <Include access data>

2. Alternate Flow:

- 1.1. The student/staff/visitor has lost his tag
- 1.2. The system administrator tries to track the ID to see if it is present in the school premises. <Include tracking in emergency situations>
- 1.3. The system fails to locate the ID.
- 1.4. The system administrator decides to delete or deactivate the lost Tag from the system by deleting the ID number code from the system.
- 1.5. <Include Database query>
- 1.6. Delete the ID Number code of the tag. This ensures that any user with that tag is not allowed inside the building. <Include access data>
- 1.7. A new tag is issued to the student/staff. <Include use case issue student/staff smart id tag>
- 1.8. A new tag is issued to the visitor if required <include use case issue day smart id tag>

Assumptions:

None

Precondition:

1. The tag user has lost the ID.
2. The System Administrator must be logged in
3. The student/staff/visitor has reported the lost ID

Postcondition:

1. The tag is found and restored to the user or the entry is deleted.
2. The user must logout after accessing the desired information<include use case logout>

USE CASE 16 – LOGOUT

Brief Description

This use case narrative describes how an authorized user must logout from the system to protect his account.

Actors

1. System administrator
2. Authorized User
3. Entrance Staff

Flow of Events:

1. Basic Flow:

- 1.1. The system administrator/authorized decides to logout by selecting the appropriate screen command.
- 1.2. The system prompts him to save any unsaved information.
- 1.3. The System confirms the logout with the user.
- 1.4. The user is successfully logged out.

Assumptions:

None

Precondition:

The user is logged into the system.

Postcondition:

The user is logged out and has to login again to access the system database.

3. Generation of Requirements from Use Cases

3.1 High Level Requirements from Use Cases

The following are the high level system requirements generated from the use case analysis.

LEVEL 1 REQUIREMENTS	
Requirement #	Description
1	The system must provide only authorized access inside the school building and restrict unauthorized access
2	The system should be able to track students under normal and emergency situations as well
3	The system should be able to automatically record attendance of the students as they enter the school building
4	The system must track accurately and maintain data integrity
5	The system must be secure
6	The system must be reliable
7	The system must be usable
8	The system must be easy to maintain
9	The system must be efficient
10	The system must maintain a record of tracking and access related information

3.2 Synthesis and break down of high level requirements

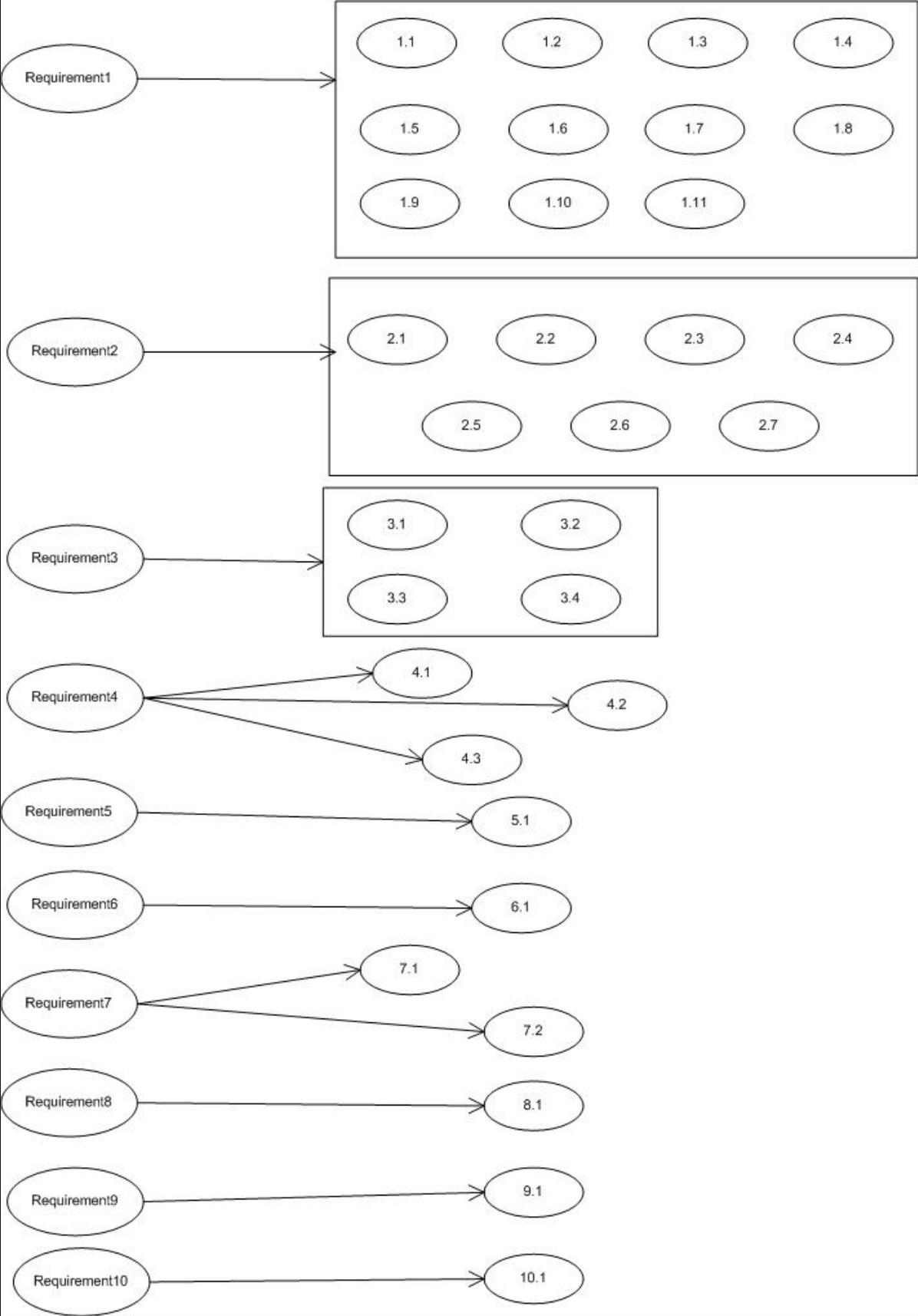
The high level requirements are further synthesized and broken down into low-level requirements as listed in the table below.

LEVEL 2 REQUIREMENTS	
Requirement #	Description
FR1.1	Every student/staff shall have a permanent access id tag
FR1.2	Every visitor shall get a day access id from the school entrance staff for access to the school
FR1.3	Permanent Id tags shall have the person's name, photo, ID number (student/staff ID number) and School name
FR1.4	Day Id tags shall have the school name, person's name and the student/staff/visitor ID number
FR1.5	There shall be two access controlled entrances: one for students and the other for visitors and staff
FR1.6	A day access ID shall be given Student/ staff who have forgotten their ID or lost it
FR1.7	The entrance door shall close after one revolution. The door needs to be one as shown in the picture. (Refer appendix)
FR1.8	The day access ID shall be valid only for a day
FR1.9	Entrance to the school shall not be allowed from any other entrances from the outside
FR1.10	A student shall be able to get additional access to a restricted area upon verification of the permission by the system administrator
FR1.11	The student shall swipe the RFID tag near the reader to open the entrance door
FR2.1	To get a day access Id, the student/staff/visitor needs to fill a form. The visitor form shall have the name, address, purpose, kind of access required, staff reference name, phone number .The student form shall have the student name, ID number, teacher name, reason for the need for day ID tag, address, grade. The staff form shall have the name, address, class, reason for the need for day ID tag
FR2.2	In event of loss of the permanent ID tag, concerned student/ staff shall report it to the school authority, and get the day access id tag. The system admin shall try to track the id if lost in school. If found, it shall be returned to the user or else a permanent id shall be issued for daily access. The student/ staff needs to fill a form for this: name, address, student id, class, and teacher name, day he lost the id
FR2.3	The student/visitors/staff shall return their day access ids at the entrance to the entrance staff .In case the student/staff is permanently leaving the school, they can return their access IDs to the entrance staff.
FR2.4	The authorized user to the database shall be able to update, add, delete a record
FR2.5	The system database user shall need to logout of the database whenever done. The system shall prompt to save any unsaved information
FR2.6	Access to the GUI and the database shall be accessible only via a secure login provided by the systems administrator to the authorized users
FR2.7	The login id shall get locked if a user tries to enter a wrong username/ password more than thrice. In such a case only a systems administrator can reset the user password

FR3.1	When access is granted to a student, attendance for that student shall be recorded in the database and the entry shall be time stamped
FR3.2	For the first time login, the systems administrator shall provide a default password which the user shall need to change and update to a personalized one
FR3.3	The authorized user shall also have the ability to choose and print any report or record from the database
FR3.4	There shall be 4 kinds of reports that are generated: student/visitor/staff report, attendance report, tracking report, day report
FR4.1	The attendance report generated by the system shall be available to the teachers either as a printout or through a laptop connected in each classroom. The teacher can then verify the students in the list for her class with those physically present in the class. This is done for each class
FR4.2	The system shall create an attendance report based on the student schedule for the day
FR4.3	The system shall also upload a list of present, absent and tardy students
FR5.1	All information concerned with the person entering the school shall be recorded in the database and his entry and exit shall be time stamped
FR6.1	Database shall be robust enough to be able to hold records of all students/staff and visitors
FR7.1	System shall be able to track students/ staff/ visitors on a timely basis. A timed trigger shall initiate turning on of all the readers and gathering information about all students present in the reader coverage. If student not found, an alert is generated
FR7.2	Forced trigger shall be initiated when requested by a staff/parent/authority to track a particular student, a lost id or to track all students in case of an emergency
FR8.1	RFID readers shall be placed at the entrance and through out the school. The readers at the entrance and entrance of restricted areas will always be on whereas the readers on other locations inside school will be turned on only by the trigger initiation. This can be done by a system administrator or authorized user
FR9.1	Readers shall be able to read data from multiple tags at a time
FR10.1	System shall be able to recover from unexpected crashes

3.4 Requirements arranged in a Tree Format

The above synthesized requirements are arranged in a tree format based on the level of the requirements as shown in the figure. Level 1 requirement represent the system level requirements, sub system level requirements are stored at level 2 and component level requirements are stored at level 3 and 4.



3.5 Requirements Traceability

Requirements Traceability Matrix		
Requirement #	Associated Use Case #	Associated Activity diagram
FR1.1	Use Case 1	AD2
FR1.2	Use Case 2	AD2
FR1.3	Use Case 1	AD2
FR1.4	Use Case 2	AD2
FR1.5	Use Case 3	AD3
FR1.6	Use Case 2	AD2
FR1.7	Use Case 3, Use Case 4	AD3
FR1.8	Use Case 2	AD2
FR1.9	Use Case 3	AD3
FR1.10	Use Case 5	AD3
FR1.11	Use Case 3	AD3
FR2.1	Use Case 2	AD2
FR2.2	Use Case 2, Use Case 1, Use Case 15	AD2, AD4
FR2.3	Use Case 14	AD3
FR2.4	Use Case 10, Use Case 11, Use Case 12	AD5
FR2.5	Use Case 16	AD1
FR2.6	Use Case 9	AD1
FR2.7	Use Case 9	AD1
FR3.1	Use Case 3	AD3
FR3.2	Use Case 6	AD1
FR3.3	Use Case 13	AD5
FR3.4	Use Case 13	AD5
FR4.1	Use Case 3	AD3
FR4.2	Use Case 3	AD3
FR4.3	Use Case 3	AD3
FR5.1	Use Case 3, Use Case 4	AD3
FR6.1	Use Case 10, Use Case 11, Use Case 12	AD5
FR7.1	Use Case 7	AD4
FR7.2	Use Case 8	AD4
FR8.1	Use Case 7, Use Case 8	AD4
FR9.1	Use Case 7, Use Case 8	AD4
FR10.1	Use Case 12	AD5

4. High Level System Modeling and Analysis

The simplified models of system behavior using activity diagrams and state chart diagrams are created.

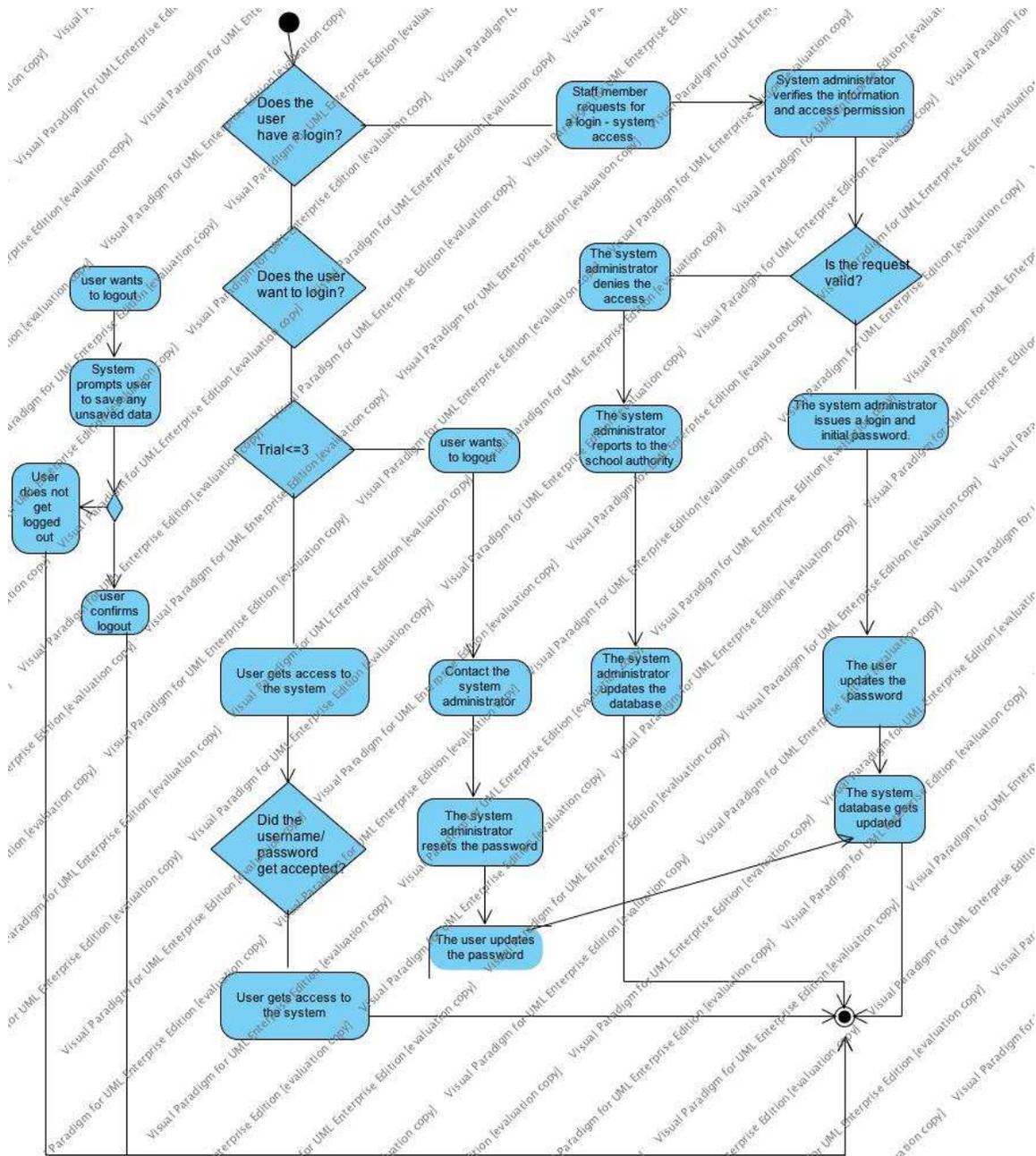
4.1 System Behavior Diagram

The system behavior is the different states of a system element and the sequences of tasks making up activities governed by conditional logic and flows driven by internal processing. System behavior for the Smart school Id System has been modeled using Activity and State Chart Diagrams.

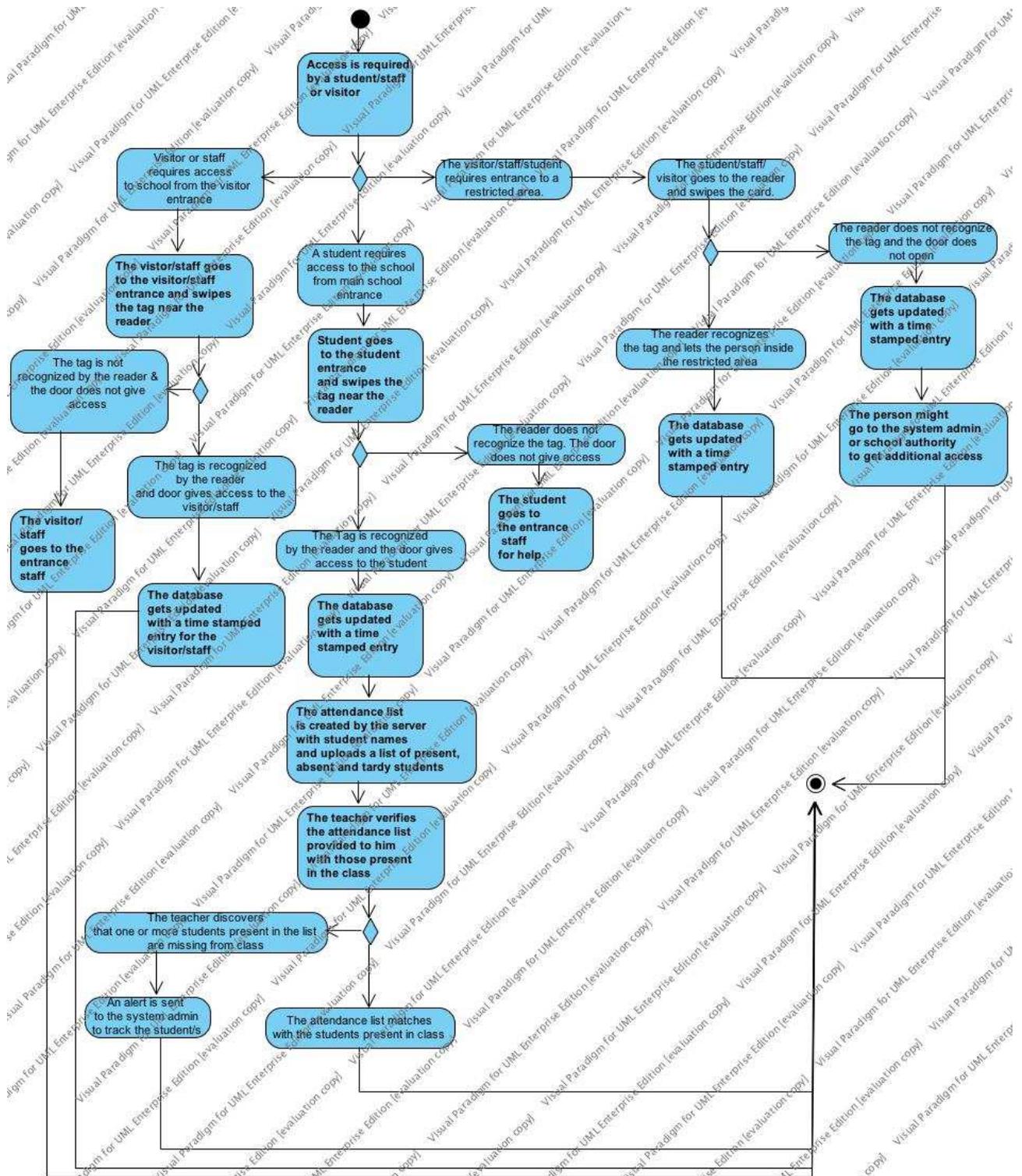
4.1.1 Activity Diagrams:

The purpose of the activity diagram is to model the procedural flow of actions that are part of a larger activity. Activity diagrams can also be used independently of use cases for modeling a business-level or system – level function representing multiple use cases in one activity diagram.

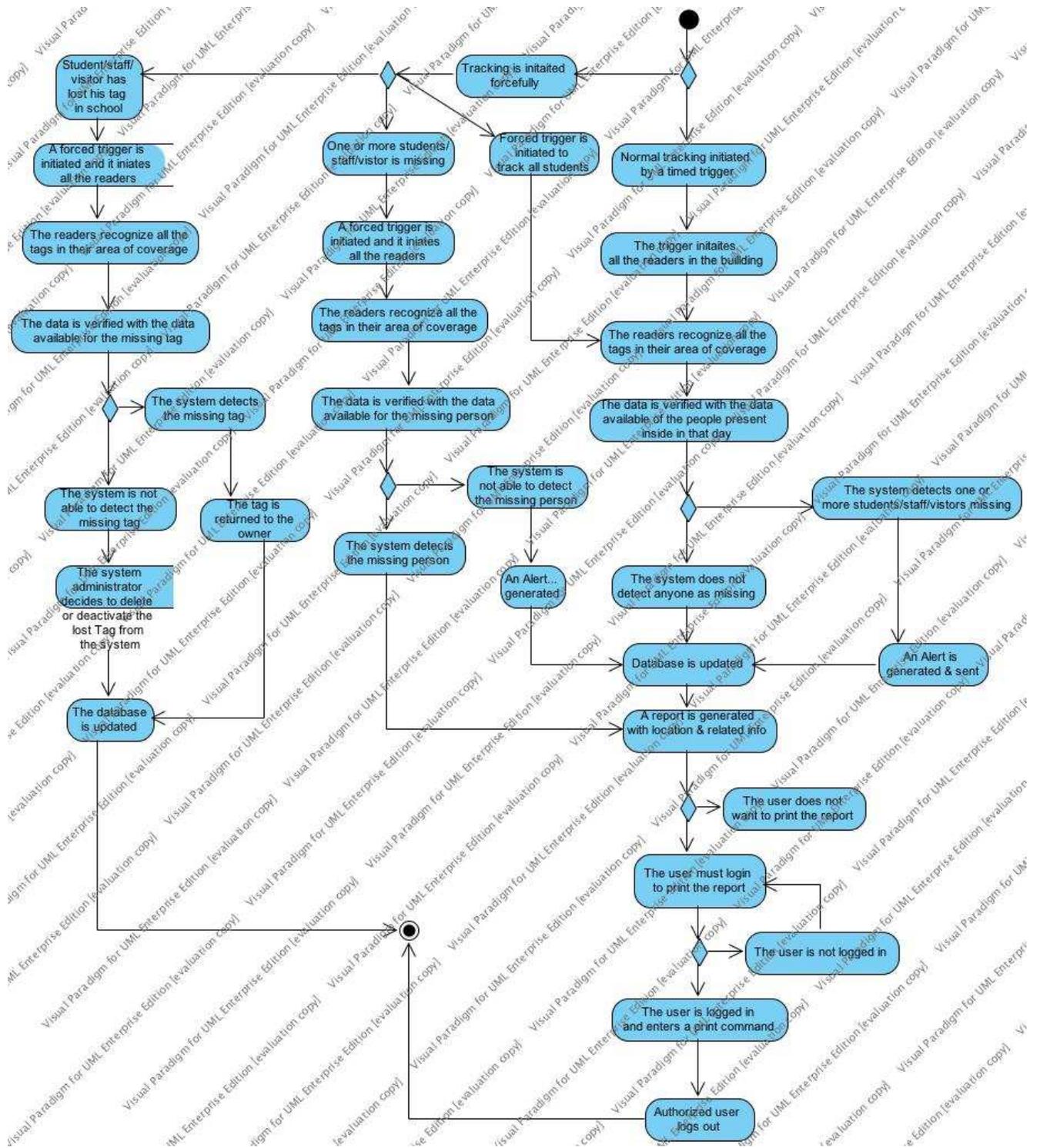
The Following 5 Activity Diagrams were identified for the Smart School ID system.



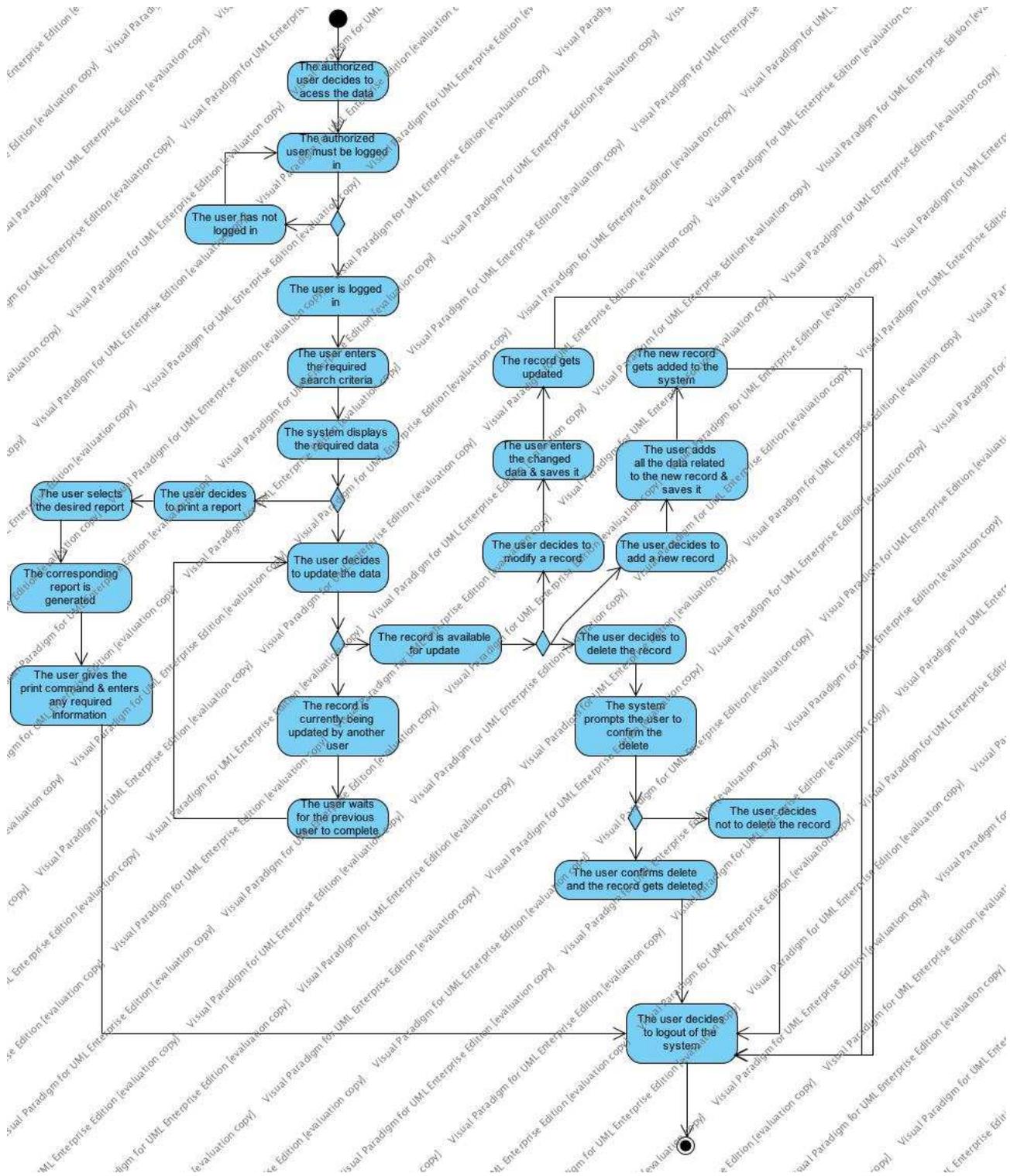
Activity Diagram 1 Login, request a login & logout



Activity Diagram 3: Student Attendance Reconciliation, Visitor /staff access to entrance.



Activity Diagram 4: Tracking in normal and special situations

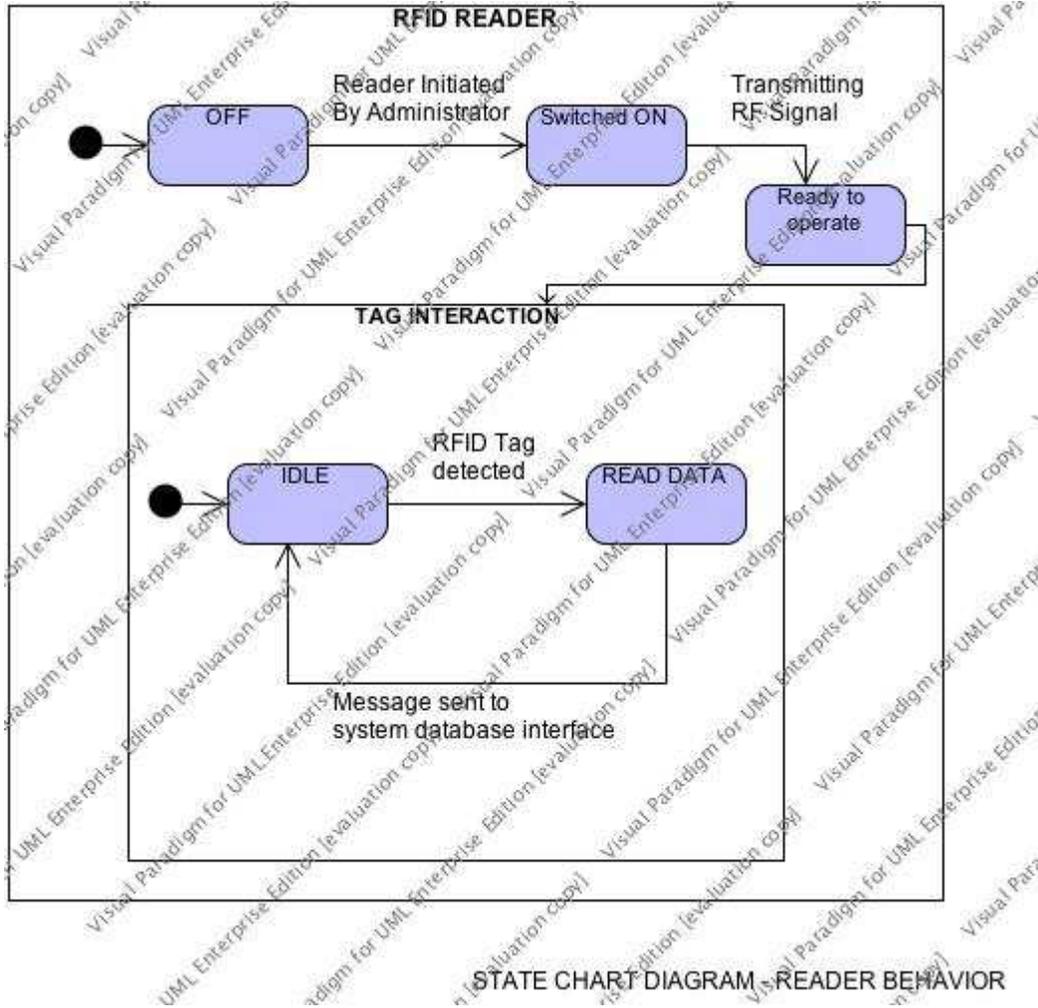


Activity Diagram 5: Database Access, update and print/generate report

4.1.2 State Chart Diagrams

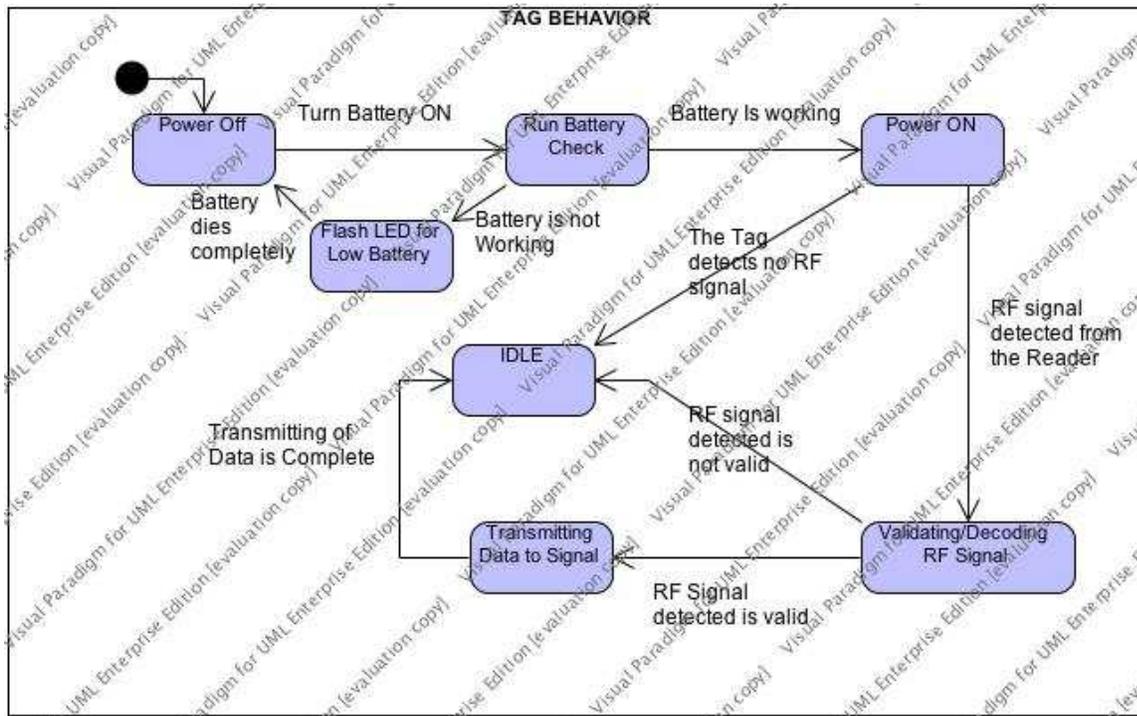
Existence of system elements can be described as flowing from state to state. A state chart diagram is therefore used to graphically represent finite states of the system elements. Following are the state chart diagrams for the reader, tag and door. These show the different states of these system elements and the transitions between them.

State Chart Diagram for the Reader



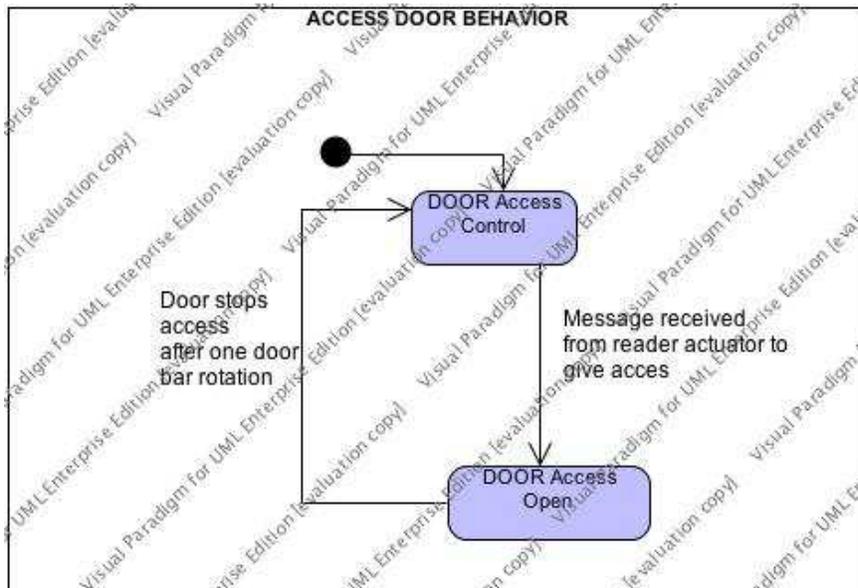
STATE CHART DIAGRAM - READER BEHAVIOR

State Chart Diagram for the Tag



STATE CHART DIAGRAM - TAG BEHAVIOR

State Chart Diagram for the Door



STATE CHART DIAGRAM - ACCESS DOOR BEHAVIOR

5. System Specifications

The above specified requirements are realized in qualitative and quantitative terms known as specifications. They are shown below in the table.

COMPONENT REQUIREMENTS		SPECIFICATIONS	
Requirement #	Description	Attribute	Function/Performance
Tag			
CR1	Those Rfid tags should be used which would be capable of wireless mid range(atleast 10-30 feet) radio-frequency communications	Tags	Semi-Passive
CR2	The tag RF signal bandwidth shall be less that or equal to 500 KHz	RF Signal Bandwidth	500Khz
CR3	The tag should be able to communicate with the reader placed at a minimum distance of 15 feet	Carrier Frequency	13.56MHZ (UHF)
CR4	The background noise of the transmission medium should not interfere with the transmitted signal	S/N Ratio	13.5db
CR5	The tag shall be capable of modulating/demodulating RF signals.	Signal Processing	using PSK 4 (4 state phase shift keying)
CR6	The tag shall be capable of being programmed with a unique ID number	Microcontroller memory	1Mb and 512KB RAM
CR7	The tags shall be programmed only once with the student Id number and always be read for access control and tracking purposes	Read/write	WORM tags
CR8	The clock frequency of the microcontroller shall be compatible with RF transponders signal processing speed	Microcontroller memory	
CR9	The tag shall atleast have a life span of 5 years	power consumption	<=35mW
CR10	The microcontroller shall trigger a flash LED indicating a low battery voltage insufficient to operate the Tag.	Battery	Output voltage 4.6 and 5 V(regulated)
CR11	The tag should be light weight and small in size	Weight Size	<3oz 2.1"X3.4"X1"
CR12	The tag should be able to handle the interference caused by various factors (electromagnetic interference, lab equipment, mud snow, metal) inside the school	Operating Frequency	UHF(about ~902-928Mhz)

CR13	The antenna design shall be capable of sending and receiving RF signals in a hemispherical pattern	Coverage area	Hemispherical
CR14	The antenna shall be small enough to fit in the Tag enclosure	Size	0.3 inch
Reader			
CR15	The reader should indicate a low voltage supply	Reader Power Indicator	Unregulated 12V DC
CR16	The tag reader should read the data from the tag regardless of its orientation	Antenna	4 port (Circular or linear polarization)
CR17	Tag reader should be able to detect and read data from a tag which is about 5 m away from the reader	Operating Frequency	UHF(about ~902-928Mhz)
CR18	The readers should be able to get connected wirelessly or using cables to form a network	Connection to Network	Ethernet, 802.11G or 802.3 wired
CR19	The readers should perform well under extreme temperatures	Operating Temperature	:-32F to 122F
CR20	Tag reader should be robust ,splash proof and rugged	Protection Type	IP 54, IP 67
CR21	The reader installed at the entrances of the restricted areas and main school entrance should read the tags only close to it and not outside the door	Tag type and special enclosure	Portal readers work in conjunction with presence detectors and an RF reflector surface such as metal mesh. The metal mesh which surrounds the doorway prevents the transmission from adjoining doors being read in error. Reader Type: IF5 Anti-collision Algorithm
CR22	The reader must be able to read multiple tags at the same time, maintaining data integrity and accuracy	Read Accuracy	
CR23	The reader should read the data accurately	Read Accuracy	No False Reads
CR24	The reader shall handle any kind of hardware interference	Read Accuracy	reader collision also using TDMA
CR25	The reader should be compatible with the windows OS	Reader Compatibility with OS	Windows OS
DB			
CR26	The DBMS should be robust and record data with minimum latency	response time	45 sec
CR27	There should be no duplicate data in the records	Data	Duplication Theorem
CR28	The readers should identify the accurate location when tracking	Location	Distance Calculator

6. Component-System Testing, Verification and Validation

Developed procedures of system test, verification and validation. The system was tested for a sample school layout that has been introduced as ***Layout Figure A*** in the system introduction section.

6.1 Primary Verification and Validation Plan

After requirements have been developed, one or more verification requirements should be developed for each requirement. Verification requirements determine whether or not a requirement has been achieved. The test procedures are listed below.

TEST CASE NUMBER	"Project" Test Case			<input type="radio"/> PASS <input type="radio"/> FAIL
	REQUIREMENT NUMBER	TESTER	DATE	
1.1	1.1			
DESCRIPTION To check that every student/staff in the school has a permanent access id tag. This is a functional test.				
TEST PROCEDURE Resources Required: Student list and student with tag list. 1. Obtain the list of total students/staff currently enrolled/recruited at the school. 2. Obtain the list of students/staff who have been issued a permanent access id. 3. Compare the two lists. 4. The lists should match to show that all the students/staff have been issued a permanent access Id.				
EXPECTED RESULTS				
ACTUAL RESULTS				

TEST CASE NUMBER	"Project" Test Case			<input type="radio"/> PASS <input type="radio"/> FAIL
	REQUIREMENT NUMBER	TESTER	DATE	
1.2	1.2,1.6,2.2			
DESCRIPTION <p>To check that every visitor wishing access to the school has been issued a day access id. The visitor will not be able to get past the visitor/staff entrance without a day access ID. A day access ID is required for entry if a student/staff who has forgotten their ID or lost it. This is a functional</p>				
TEST PROCEDURE <p>Resources Required: readers, School entrances</p> <ol style="list-style-type: none"> 1. Go to the visitor/staff and student entrance without an access id or with a false ID. 2. Try to get through the door. 3. The door should not give access. 4. Test again by taking a valid day access id. 5. The door should give access to the visitor. 				
EXPECTED RESULTS				
ACTUAL RESULTS				

TEST CASE NUMBER	"Project" Test Case			<input type="radio"/> PASS <input type="radio"/> FAIL
	REQUIREMENT NUMBER	TESTER	DATE	
1.3	1.3, 1.4			
DESCRIPTION To check that permanent /Day access ids have the right information on them.				
TEST PROCEDURE Resources Required: Permanent and day access ID. <ol style="list-style-type: none"> 1. Create a sample Permanent and Day access ID. 2. Verify that the permanent access id has the name, photo, ID number and school name. 3. Verify that the Day access ID has the name, school name and Id number. 				
EXPECTED RESULTS				
ACTUAL RESULTS				

TEST CASE NUMBER	"Project" Test Case			<input type="radio"/> PASS <input type="radio"/> FAIL
	REQUIREMENT NUMBER	TESTER	DATE	
1.4	1.5, 1.9			
DESCRIPTION To check that the school has two outside entrances: student entrance and visitor/staff entrance. This is a field test.				
TEST PROCEDURE Resources Required: school premises <ol style="list-style-type: none"> 1. Go to school location. 2. Verify that the school has just two entrances from the outside. 3. One entrance should be for student access control to the school. 4. The other entrance should be a visitor/staff access control. 				
EXPECTED RESULTS				
ACTUAL RESULTS				

TEST CASE NUMBER	"Project" Test Case			<input type="radio"/> PASS <input type="radio"/> FAIL
	REQUIREMENT NUMBER	TESTER	DATE	
1.5	1.7			
DESCRIPTION To check that the school student and visitor/staff entrances restricts access after one revolution of the door. This is a functional test at the school.				
TEST PROCEDURE Resources Required: Access tag, revolution door, reader <ol style="list-style-type: none"> 1. Bring the tag closer to the entrance door. 2. The reader recognizes the tag and the door gives access. 3. The door opens the revolution door for one person to pass. 4. The person behind should try to follow. 5. The door should get locked after one revolution. 				
EXPECTED RESULTS				
ACTUAL RESULTS				

TEST CASE NUMBER	"Project" Test Case			<input type="radio"/> PASS <input type="radio"/> FAIL
	REQUIREMENT NUMBER	TESTER	DATE	
1.6	1.8			
DESCRIPTION To check that the day access ID is valid only for a day and access with a previous day does not provide access to the visitor/student or staff. This is a functional test.				
TEST PROCEDURE Resources Required: Access tag, readers. <ol style="list-style-type: none"> 1. Bring the previous day Access tag near the reader at both the entrances one by one 2. The doors at the two entrances should not allow access to anyone with an access ID that was valid only for a previous day. 				
EXPECTED RESULTS				
ACTUAL RESULTS				

TEST CASE NUMBER	"Project" Test Case			<input type="radio"/> PASS <input type="radio"/> FAIL
	REQUIREMENT NUMBER	TESTER	DATE	
1.7	1.10			
DESCRIPTION To check that the school student should be able to additional access to a restricted access after the permission has been verified by the systems administrator. This is a functional test.				
TEST PROCEDURE Resources Required: Access tag, readers, system software, database, computer <ol style="list-style-type: none"> 1. Test the access tag at the entrance of the restricted area. 2. If the reader does not recognize & give access to the tag holder, acquire permission and ask the systems administrator to give access for the area. 3. With the added access, test the tag again at the entrance of the restricted area. 4. With the given access, the reader should now recognize the tag and give access to the tag holder. 				
EXPECTED RESULTS				
ACTUAL RESULTS				

TEST CASE NUMBER	"Project" Test Case			<input type="radio"/> PASS <input type="radio"/> FAIL
	REQUIREMENT NUMBER	TESTER	DATE	
1.8	1.11			
DESCRIPTION <p>To check that the entrance to the restricted area should not open the door lock unless the tag is brought very close to the reader at the door of the restricted area. This is a functional test.</p>				
TEST PROCEDURE <p>Resources Required: Access tag, readers, system software, and computer</p> <ol style="list-style-type: none"> 1. The access tag is brought near the reader at the entrance of the restricted area. The door consists of portal readers that work in conjunction with presence detectors and an RF reflector surface such as metal mesh. 2. The RF reader should now give access to the tag holder. 3. Now bring the tag a little far from the door entrance. 4. The reader now should not unlock the door now. 				
EXPECTED RESULTS				
ACTUAL RESULTS				

TEST CASE NUMBER	"Project" Test Case			<input type="radio"/> PASS <input type="radio"/> FAIL
	REQUIREMENT NUMBER	TESTER	DATE	
1.9	2.1, 2.2			
DESCRIPTION To check that the day access id forms for the student/staff and visitors contain all the required information.				
TEST PROCEDURE Resources Required: Student/visitor/staff forms <ol style="list-style-type: none"> 1. Check the forms to be used in the school for distributing of access ids. 2. The visitor form should have the name, address, purpose, kind of access required, staff reference name, phone number. 3. The student form should have the student name, ID number, teacher name, reason for the need for day ID tag, address, grade. 4. The staff form should have the name, address, class, reason for the need for day ID tag. 				
EXPECTED RESULTS				
ACTUAL RESULTS				

TEST CASE NUMBER	"Project" Test Case			<input type="radio"/> PASS <input type="radio"/> FAIL
	REQUIREMENT NUMBER	TESTER	DATE	
1.10	2.2			
DESCRIPTION To check that the day access id forms for the student/staff and visitors contain all the required information.				
TEST PROCEDURE Resources Required: tag ID, readers, distance calculator, computer, and system software 1. Assume that an ID is lost in the school premises. Put the ID at some location within school. 2. Try to track the ID using RFID readers installed at the various locations inside school. 3. The RFID reader & distance calculator should be able to tell us the exact location for the particular ID that is being looked for.				
EXPECTED RESULTS				
ACTUAL RESULTS				

TEST CASE NUMBER	"Project" Test Case			<input type="radio"/> PASS <input type="radio"/> FAIL
	REQUIREMENT NUMBER	TESTER	DATE	
1.11	2.3			
DESCRIPTION To check that a tag is deactivated when a access ID tag is returned to the entrance staff.				
TEST PROCEDURE Resources Required: Test Tag, system software, computer 1. Test deactivating a tag incase of return of an access ID. 2. The record entry in the database corresponding to the tag should be updated. 3. Test the tag at the school entrance after deactivation.				
EXPECTED RESULTS				
ACTUAL RESULTS				

TEST CASE NUMBER	"Project" Test Case			<input type="radio"/> PASS <input type="radio"/> FAIL
	REQUIREMENT NUMBER	TESTER	DATE	
1.12	2.4			
DESCRIPTION To check that an authorized user can access the database to update, add, view or delete a record.				
TEST PROCEDURE Resources Required: System database, computer <ol style="list-style-type: none"> 1. Create sample test data and enter records in the database. 2. Test the database by opening records, adding a new record, deleting and updating an existing record. 3. All these changes should be reflected in the database. 4. The database should maintain these changes till they are overwritten by further updates. That is the database data should not be lost after some time. 				
EXPECTED RESULTS				
ACTUAL RESULTS				

TEST CASE NUMBER	"Project" Test Case			<input type="radio"/> PASS <input type="radio"/> FAIL
	REQUIREMENT NUMBER	TESTER	DATE	
1.13	2.5			
DESCRIPTION To check if the user gets a message to save unsaved data when he tries to logout of the school database system.				
TEST PROCEDURE Resources Required: System software, login access, computer 1. Create a test login to the database. 2. Switch on the computer & go to the system software. 3. Access & make changes to the database. 4. Choose to logout of the system. 5. The system should give a prompt to save unsaved data before the user gets logged out. 6. Choose yes to save, no to not save and cancel to cancel the logout request				
EXPECTED RESULTS				
ACTUAL RESULTS				

TEST CASE NUMBER	"Project" Test Case			<input type="radio"/> PASS <input type="radio"/> FAIL
	REQUIREMENT NUMBER	TESTER	DATE	
1.14	2.6			
DESCRIPTION To check if the access to the GUI and database is provided to a user only through a secure login.				
TEST PROCEDURE Resources Required: Computer, system software, login access <ol style="list-style-type: none"> 1. Switch on the computer 2. Go to the system software 3. Enter the username and password on the system login screen. 4. If the username and password are correct, the system software gives access else the software prompts the user to enter the login information again. 				
EXPECTED RESULTS				
ACTUAL RESULTS				

TEST CASE NUMBER	"Project" Test Case			<input type="radio"/> PASS <input type="radio"/> FAIL
	REQUIREMENT NUMBER	TESTER	DATE	
1.15	2.7			
DESCRIPTION To check if the login gets locked if a user tries to enter a wrong username and password more than thrice.				
TEST PROCEDURE Resources Required: Computer, system software, login access <ol style="list-style-type: none"> 1. Switch on the computer 2. Go to the system software 3. Enter a wrong username. 4. The system prompts you to try again 5. Enter a wrong password. 6. The system prompts you to try again 7. Enter a wrong username again. 8. The system software shows up a message saying that the system login has got locked for the user. 9. After the systems administrator has reset the password, try logging in again with the correct username and password. 10. The system gives access. 				
EXPECTED RESULTS				
ACTUAL RESULTS				

TEST CASE NUMBER	"Project" Test Case			<input type="radio"/> PASS <input type="radio"/> FAIL
	REQUIREMENT NUMBER	TESTER	DATE	
1.16	3.1, 5.1			
DESCRIPTION To check if the entry recorded in the database for the student attendance & student/visitor /staff entry and exit are time stamped.				
TEST PROCEDURE Resources Required: Student, Visitor, staff tag, readers, system software. <ol style="list-style-type: none"> 1. Pass a sample student tag through the visitor entrance. 2. The access is not given to the student. 3. Pass the same tag at the student entrance 4. The reader recognizes the tag and gives access. 5. Now, login to the system database and check the student record and attendance list. 6. A time stamped entry should be recorded for the record and it should also be recorded in the attendance list. 7. Pass a visitor/student/staff tag in and after some time out through the visitor/staff & student entrance/exit. 8. Check the corresponding record to see if a right time stamped entry of entry and exit of that tag has been recorded. 				
EXPECTED RESULTS				
ACTUAL RESULTS				

TEST CASE NUMBER	"Project" Test Case			<input type="radio"/> PASS <input type="radio"/> FAIL
	REQUIREMENT NUMBER	TESTER	DATE	
1.17	3.2			
DESCRIPTION To check if the authorized user is able to change the default password provided by the systems administrator				
TEST PROCEDURE Resources Required: System Software, computer, login access. <ol style="list-style-type: none"> 1. Switch on the computer. 2. Go to the system software. 3. Login to the software using username and the default password provided by the systems administrator 4. The screen should prompt you to change the password. 5. Change the password. 6. Now logout and try logging in again with the username and the changed password. 7. The system software should give access. 				
EXPECTED RESULTS				
ACTUAL RESULTS				

TEST CASE NUMBER	"Project" Test Case			<input type="radio"/> PASS <input type="radio"/> FAIL
	REQUIREMENT NUMBER	TESTER	DATE	
1.18	3.3			
DESCRIPTION To check if the authorized user has the ability to print any report from the database.				
TEST PROCEDURE Resources Required: Computer, system software, login access, printer, tags, readers 1. Switch on the computer. 2. Go to the system software. 3. Login to the software using username and password. 4. Create a sample database with a few test records and move some tags in through the main student access door and keep them randomly on the school campus. 5. Go to the reports section. 6. Select a report type and click print. 7. Select a printer and hit print. 8. The report should get printed. 9. Also go to any record in the database and click on the print in the file drop down. 10. Select a printer and hit print.				
EXPECTED RESULTS				
ACTUAL RESULTS				

TEST CASE NUMBER	"Project" Test Case			<input type="radio"/> PASS <input type="radio"/> FAIL
	REQUIREMENT NUMBER	TESTER	DATE	
1.19	3.4			
DESCRIPTION <p>To check if there are four kinds of reports generated by the system software. The data in the reports should be correct and valid.</p>				
TEST PROCEDURE <p>Resources Required: Computer, system software, login access, and data.</p> <ol style="list-style-type: none"> 1. Switch on the computer. 2. Go to the system software. 3. Login to the software using username and password. 4. Create a sample database with a few test records and move some tags in through the main student access door & keep them randomly on some location on school campus. 5. Go to the reports section. 6. Select the student report and enter the student name. 7. Validate the generated report information with actual data. 8. The information should be correct. 9. Now open the other two reports: attendance, day report and tracking report. 10. Validate their information with the actual data. 				
EXPECTED RESULTS				
ACTUAL RESULTS				

TEST CASE NUMBER	"Project" Test Case			<input type="radio"/> PASS <input type="radio"/> FAIL
	REQUIREMENT NUMBER	TESTER	DATE	
1.20	4.1			
DESCRIPTION To check if you are able to print the attendance report that is being generated by the system. Also test if the attendance report is being sent to all the teacher laptops for each classroom. Also Check for data consistency between the two.				
TEST PROCEDURE Resources Required: System Software, computer, Login access, Teacher laptops, printer 1. Switch on the computer. 2. Go to the system software. 3. Login to the software using username and password. 4. Create a sample database with a few test records and move some tags in through the main student access door. 5. Go to the reports section. 6. Select the attendance report and select print. 7. Now verify teacher's laptop to see if the attendance report has been sent to all of them. 8. Verify each attendance report sent with the actual attendance report generated and check for data consistency.				
EXPECTED RESULTS				
ACTUAL RESULTS				

TEST CASE NUMBER	“Project” Test Case			<input type="radio"/> PASS
	REQUIREMENT NUMBER	TESTER	DATE	<input type="radio"/> FAIL
1.21	4.2			
DESCRIPTION To check if the attendance report being generated is based on the student schedule for the day.				
TEST PROCEDURE Resources Required: System software, login access, tags, readers, and computer 1. Switch on the computer. 2. Go to the system software. 3. Login to the software using username and password. 4. Create a sample database with a few test records and move some tags in through the main student access door. 5. Go to the reports section. 6. Select the attendance report. 7. After the attendance report opens, verify the student split up according to his/her class schedule for that day.				
EXPECTED RESULTS				
ACTUAL RESULTS				

TEST CASE NUMBER	"Project" Test Case			<input type="radio"/> PASS <input type="radio"/> FAIL
	REQUIREMENT NUMBER	TESTER	DATE	
1.22	4.3			
DESCRIPTION To check if a list of present, absent and tardy students is generated at the end of the day.				
TEST PROCEDURE Resources Required: System software, login access, tags, readers installed in school. <ol style="list-style-type: none"> 1. Switch on the computer. 2. Go to the system software. 3. Login to the software using username and password. 4. Create a sample database with a few test records and move some tags in through the main student access door at different times of the day. 5. Go to the reports section. 6. Select the day report. 7. After the day report opens, verify the list of present, absent and tardy students generated with the actual data. 				
EXPECTED RESULTS				
ACTUAL RESULTS				

TEST CASE NUMBER	"Project" Test Case			<input type="radio"/> PASS <input type="radio"/> FAIL
	REQUIREMENT NUMBER	TESTER	DATE	
1.23	6.1			
DESCRIPTION To check if the database is robust enough to hold a large number of records.				
TEST PROCEDURE Resources Required: System database, login access <ol style="list-style-type: none"> 1. Switch on the computer. 2. Go to the system software. 3. Login to the software using username and password. 4. Create a sample database with a large number of test records. 5. Check if you are able to open student records, print reports and open other useful applications. 6. If the database access speed and efficiency do not seem to be effected, increase the number of test records. 7. If the system hangs, it means that the system is not able to handle such large number of records. 8. Otherwise continue testing to check the largest number of records the database can handle without affecting the efficiency. 				
EXPECTED RESULTS				
ACTUAL RESULTS				

TEST CASE NUMBER	"Project" Test Case			<input type="radio"/> PASS <input type="radio"/> FAIL
	REQUIREMENT NUMBER	TESTER	DATE	
1.24	7.1			
DESCRIPTION To check if the timed tracking function is performed correctly.				
TEST PROCEDURE Resources Required: Readers, Tags, system software & database, system access, distance calculator. <ol style="list-style-type: none"> 1. Switch on the computer. 2. Go to the system software. 3. Login to the software using username and password. 4. Create a sample database with a large number of test records & put some tags at random location in the school. 5. Set a timed trigger at an interval of one hour. 6. Check if the tracking is initiated at that time and all readers in the school campus are turned on. 7. Check if the tracking report information generated is correct. 8. Check if an alert is generated if a tag is not found in the school campus. 9. Now change the time interval of the trigger and repeat steps 6 to 8. 				
EXPECTED RESULTS				
ACTUAL RESULTS				

TEST CASE NUMBER	"Project" Test Case			<input type="radio"/> PASS <input type="radio"/> FAIL
	REQUIREMENT NUMBER	TESTER	DATE	
1.25	7.2			
DESCRIPTION To check if the forced tracking function is performed correctly.				
TEST PROCEDURE Resources Required: Readers, tags, system software, system access, and system database. <ol style="list-style-type: none"> 1. Switch on the computer. 2. Go to the system software. 3. Login to the software using username and password. 4. Create a sample database with a large number of test records & put some tags at random location in the school. 5. Force a trigger on the system. 6. Check if the tracking is initiated at that time due to the forced trigger and if all readers in the school campus are turned on. 7. Check if the tracking report information generated is correct. 8. Check if an alert is generated if a tag is not found in the school campus. 9. Now enter information for a particular student/tag to be tracked and repeat steps 6 to 8. 				
EXPECTED RESULTS				
ACTUAL RESULTS				

TEST CASE NUMBER	"Project" Test Case			<input type="radio"/> PASS <input type="radio"/> FAIL
	REQUIREMENT NUMBER	TESTER	DATE	
1.26	8.1			
DESCRIPTION To check if the readers can be stopped and initiated at any time by the systems administrator.				
TEST PROCEDURE Resources Required: Readers, system software, computers, systems administrator access, Dedicated Testing team for manual checking. <ol style="list-style-type: none"> 1. Switch on the computer. 2. Go to the system software. 3. Login to the software as a systems administrator. 4. Turn on some (5) readers in the school campus. 5. If the readers turn on, turn on 5 more readers 6. Now turn off the earlier 5 readers. 7. Note the effect of these initiations. 8. Now check if the readers at the school and restricted area entrances are always turned on. 9. Check this on the system administrator display and by going to all the school and restricted area entrances in the school at regular intervals of time. 				
EXPECTED RESULTS				
ACTUAL RESULTS				

TEST CASE NUMBER	"Project" Test Case			<input type="radio"/> PASS <input type="radio"/> FAIL
	REQUIREMENT NUMBER	TESTER	DATE	
1.27	10.1			
DESCRIPTION To check if a back up database has been created to ensure that data does not lose on a system crash.				
TEST PROCEDURE Resources Required: System database access, System back up database access, Computers 1. Login to the server computer. 2. Go to the system database. 3. Login to the system database. 4. Pull up records information. (SD) 5. Go to the back up server database. 6. Login to the back up server database. 7. Pull up the records information. (SBD) 8. Verify that SD and SBD are same. That is the system back up database has all the information stored in the system database till date.				
EXPECTED RESULTS				
ACTUAL RESULTS				

TEST CASE NUMBER	"Project" Test Case			<input type="radio"/> PASS <input type="radio"/> FAIL
	REQUIREMENT NUMBER	TESTER	DATE	
1	RC6, RC7			
DESCRIPTION To check the tags be programmed only once with the student Id number and always be read for access control and tracking				
TEST PROCEDURE Resources Needed: RFID Tag, RFID Reader, Smart ID software, PC <ol style="list-style-type: none"> 1. Enter Student ID in the Smart ID software and send data to the tag. Verify that tag acknowledges that it had received the data. Response time should not be more than 2 seconds. 2. Use Smart Id software to read the tag data. Data queried from the tag must appear in 2 seconds. Verify that the tag data and the queried data match. 3. Repeat 1 and verify that the tag cannot be written twice 4. Also verify from the manufacturer's data sheet for the tag, that the RAM is 256 KB 				
EXPECTED RESULTS				
ACTUAL RESULTS				

TEST CASE NUMBER	"Project" Test Case			<input type="radio"/> PASS <input type="radio"/> FAIL
	REQUIREMENT NUMBER	TESTER	DATE	
2	RC 1, RC3, RC17			
DESCRIPTION To check, those RfID tags are issued to the school staff/ students and visitors which would be capable of wireless mid range (at least 10-30 feet) radio-frequency communications				
TEST PROCEDURE Resources Required: RF Communication Module, Serial Digital signal Generator, Cathode Ray Oscilloscope (CRO) Connect RF Communication Module to a 5V DC power source and conduct the following Tests. <ol style="list-style-type: none"> 1.) Verifying sending data <ol style="list-style-type: none"> a. Use the digital signal generator connected to the RF communication module to generate RF signal of 13.56MHz. b. Place the RF signal receiver(tag) 20 feet away from the RF communication module c. Start transmitting the RF signals and record the strength of the transmitted signal being received by the RF signal receiver. d. The received signal must be at least - 30.0dbm 2.) Verifying receiving data <ol style="list-style-type: none"> a. Place the RF signal generator (reader) 20 feet away from the RF communication module. b. Set signal generator to transmit a continuous signal. c. Record the voltage signal generated using the CRO connected at the output of the RF communication module. 				
EXPECTED RESULTS				
ACTUAL RESULTS				

TEST CASE NUMBER	"Project" Test Case			<input type="radio"/> PASS <input type="radio"/> FAIL
	REQUIREMENT NUMBER	TESTER	DATE	
3	RC 2			
DESCRIPTION To check the RF signal bandwidth of the tag issued to school students/staff and visitors to be less than or equal to 500 KHz				
TEST PROCEDURE Resources Required: Superhetrodyne Receiver (RF Spectrum Analyzer), Tag, Cathode Ray Oscilloscope (CRO) <ol style="list-style-type: none"> 1. Provide an RF signal input from the RFID tag to RF Spectrum Analyzer. 2. Connect the CRO to the RF Spectrum Analyzer. 3. The RF Spectrum Analyzer receives the signal and displays the relative signal strength on the CRO connected to the receiver. 4. The signal bandwidth displayed must be 500 KHz. 				
EXPECTED RESULTS				
ACTUAL RESULTS				

TEST CASE NUMBER	"Project" Test Case			<input type="radio"/> PASS <input type="radio"/> FAIL
	REQUIREMENT NUMBER	TESTER	DATE	
4	RC 4			
DESCRIPTION To check the background noise of the transmission medium does not interfere with the signals transmitted by the RFID tags issued by the school				
TEST PROCEDURE Resources Required: White Noise Simulator, RFID Tag, Cathode Ray Oscilloscope (CRO) <ol style="list-style-type: none"> 1. Switch on the white noise simulator and transmit a noise signal of 5dm 2. Transmit RF signal from the RFID tag. 3. Record the SNR and view the result on the CRO 4. The SNR recorded should be at least 13.5db 				
EXPECTED RESULTS				
ACTUAL RESULTS				

TEST CASE NUMBER	"Project" Test Case			<input type="radio"/> PASS <input type="radio"/> FAIL
	REQUIREMENT NUMBER	TESTER	DATE	
5	RC 5			
DESCRIPTION To check the capability of the RFID tag to modulate/demodulate RF signals.				
TEST PROCEDURE Resources Required: RFID Tag, Cathode Ray Oscilloscope (CRO) <ol style="list-style-type: none"> 1. Transmit RF signal from the RFID tag 2. The signal is received by a pre-selecting filter. 3. The filtered signal is sent through a low noise amplifier connected to a down-converter 4. The signal is then demodulated and bit-decoded 5. The decoded signal is then viewed on a CRO 6. Verify that the displayed signal is be 4-state phase shifted and is received error free 				
EXPECTED RESULTS				
ACTUAL RESULTS				

TEST CASE NUMBER	"Project" Test Case			<input type="radio"/> PASS <input type="radio"/> FAIL
	REQUIREMENT NUMBER	TESTER	DATE	
6	RC 8			
DESCRIPTION To check the compatibility of the clock frequency of the microcontroller with RF transponders signal processing speed				
TEST PROCEDURE Resources Required: RFID Tag, Manufacturer Data Sheet 1. Inspect the manufacturer provided data sheets for the RFID tag and verify that the microcontroller's clock frequency is as required by the RFID tag signal processing speed				
EXPECTED RESULTS				
ACTUAL RESULTS				

TEST CASE NUMBER	"Project" Test Case			<input type="radio"/> PASS <input type="radio"/> FAIL
	REQUIREMENT NUMBER	TESTER	DATE	
7	RC 9			
DESCRIPTION To check the battery of the tag to ensure its lifespan to be 5 years				
TEST PROCEDURE Resources Required: RFID Tag, Digital Multimeter 1. Connect the RFID tag to the digital multimeter. 2. Observe that the power consumption of the RFID tag displayed on the multimeter is not greater than 35 mW.				
EXPECTED RESULTS				
ACTUAL RESULTS				

TEST CASE NUMBER	"Project" Test Case			<input type="radio"/> PASS <input type="radio"/> FAIL
	REQUIREMENT NUMBER	TESTER	DATE	
8	RC 10			
DESCRIPTION To check the trigger initiated by the microcontroller to flash LED indicating a low battery voltage insufficient to operate the Tag.				
TEST PROCEDURE Resources Required: RFID Tag <ol style="list-style-type: none"> 1. Connect the voltage regulator to the 5V battery. 2. Connect the voltage regulator "low voltage" fault signal to microcontroller's input pin 3. Verify that the voltage regulator sends a fault signal to the microcontroller when the voltage drops below 4.6 V 4. Also verify that the microcontroller pulls down the voltage to 0 V and flashes the LED 				
EXPECTED RESULTS				
ACTUAL RESULTS				

TEST CASE NUMBER	"Project" Test Case			<input type="radio"/> PASS <input type="radio"/> FAIL
	REQUIREMENT NUMBER	TESTER	DATE	
9	RC 11			
DESCRIPTION To check the tag to be light weight and small in size so that the staff/students and visitors can carry it with ease				
TEST PROCEDURE Resources Required: RFID Tag, Vernier Caliper, Spring Balance 1. Measure tag enclosure with the vernier caliper and verify that the dimensions are 2.1" X 3.4" X 1" 2. Measure weight of the tag enclosure using the spring balance and verify that the weight is not more than 3 oz				
EXPECTED RESULTS				
ACTUAL RESULTS				

TEST CASE NUMBER	"Project" Test Case			<input type="radio"/> PASS <input type="radio"/> FAIL
	REQUIREMENT NUMBER	TESTER	DATE	
10	RC 12			
DESCRIPTION To check the capability of the tag to handle the interference caused by various factors (electromagnetic interference, lab equipment, mobile devices, and media) inside the school				
TEST PROCEDURE Resources Required: RFID Tag, RFID Reader, Sources of electromagnetic fields generators (computer screens, cellular antennas, microwave ovens, and radios), and metal conductors <ol style="list-style-type: none"> 1. Verify the communication between the RFID reader and the RFID tag in presence of the sources of electromagnetic field generators. 2. To assess the performance of tags near metal: 3. Place each tag at varying distances from a large, flat piece of steel. 4. The tags and metal plate here are separated by air. 5. Place the tag at about 3 feet away from the reader antenna. 6. Use an attenuator to determine the dB attenuation level at which the tag could no longer read. 7. A higher attenuation level, expressed in dB, corresponds to a longer reading distance. 				
EXPECTED RESULTS				
ACTUAL RESULTS				

TEST CASE NUMBER	"Project" Test Case			<input type="radio"/> PASS <input type="radio"/> FAIL
	REQUIREMENT NUMBER	TESTER	DATE	
10	RC 12			
DESCRIPTION To check the capability of the tag to handle the interference caused by various factors (electromagnetic interference, lab equipment, mobile devices, and media) inside the school				
TEST PROCEDURE Resources Required: RFID Tag, RFID Reader, Sources of electromagnetic fields generators (computer screens, cellular antennas, microwave ovens, and radios), and metal conductors <ol style="list-style-type: none"> 1. Verify the communication between the RFID reader and the RFID tag in presence of the sources of electromagnetic field generators. 2. To assess the performance of tags near metal: 3. Place each tag at varying distances from a large, flat piece of steel. 4. The tags and metal plate here are separated by air. 5. Place the tag at about 3 feet away from the reader antenna. 6. Use an attenuator to determine the dB attenuation level at which the tag could no longer read. 7. A higher attenuation level, expressed in dB, corresponds to a longer reading distance. 				
EXPECTED RESULTS				
ACTUAL RESULTS				

TEST CASE NUMBER	“Project” Test Case			<input type="radio"/> PASS <input type="radio"/> FAIL
	REQUIREMENT NUMBER	TESTER	DATE	
11	RC 13			
DESCRIPTION To check the design of the antenna for its capability to send and receive RF signals in a hemispherical pattern				
TEST PROCEDURE Resources Required: Computer Software Simulation 1. Verify the transmission of the RF signal in hemispherical pattern using the computer software simulation of the selected antenna design				
EXPECTED RESULTS				
ACTUAL RESULTS				

TEST CASE NUMBER	“Project” Test Case			<input type="radio"/> PASS <input type="radio"/> FAIL
	REQUIREMENT NUMBER	TESTER	DATE	
12	RC 14			
DESCRIPTION To check the size of the antenna to be small enough to fit in the Tag enclosure				
TEST PROCEDURE Resources Required: Computer Aided Design Software 1. Using CAD software, verify that the selected antenna design fits the enclosure which is restricted within the specified dimensions.				
EXPECTED RESULTS				
ACTUAL RESULTS				

TEST CASE NUMBER	“Project” Test Case			<input type="radio"/> PASS <input type="radio"/> FAIL
	REQUIREMENT NUMBER	TESTER	DATE	
13	RC 15			
DESCRIPTION To check the indication provided by the reader when a low voltage supply situation occurs				
TEST PROCEDURE Resources Required: RFID Reader, Power Supply 1. Connect the power supply to the RFID Reader and reduce the voltage supply below 12 V. 2. Verify that the reader indicates a low power supply.				
EXPECTED RESULTS				
ACTUAL RESULTS				

TEST CASE NUMBER	"Project" Test Case			<input type="radio"/> PASS <input type="radio"/> FAIL
	REQUIREMENT NUMBER	TESTER	DATE	
14	RC 16			
DESCRIPTION To check the ability of the tag reader to read the data from the tag regardless of its orientation (inside staff/ visitor or student's bag, shirt's pocket etc)				
TEST PROCEDURE Resources Required: RFID Reader, RFID Tag, School Bag, Leather Bag, Wallet, and a Shirt with Pocket 1. Place the tag in the school bag and verify that the communication is established between the reader and the tag 2. Repeat the process by putting the tag in the shirt's pocket, inside the wallet and the leather bag. 3. Place the tag behind a wall and verify the same.				
EXPECTED RESULTS				
ACTUAL RESULTS				

TEST CASE NUMBER	"Project" Test Case			<input type="radio"/> PASS <input type="radio"/> FAIL
	REQUIREMENT NUMBER	TESTER	DATE	
15	RC 18			
DESCRIPTION To check the ability of the readers to get connected wirelessly or using cables to form a network inside the school				
TEST PROCEDURE Resources Required: RFID Readers, PC with the tracking software, Ethernet Cables, CRO 1. Create a network, connecting the PC to the 4 port RFID readers (at least 2 readers) using the Ethernet cable. 2. Initiate the trigger from the software loaded on the PC to turn on the RFID readers. 3. Verify the transmission of RF signals by all the readers in the network by connecting CRO at the output of each reader				
EXPECTED RESULTS				
ACTUAL RESULTS				

TEST CASE NUMBER	"Project" Test Case			<input type="radio"/> PASS <input type="radio"/> FAIL
	REQUIREMENT NUMBER	TESTER	DATE	
16	RC 19			
DESCRIPTION To check the performance of the readers under extreme temperatures				
TEST PROCEDURE Resources Required: RFID Reader, Manufacturer Data Sheet 1. Inspect the manufacturer provided data sheets for the RFID reader and verify that the operating temperature for the reader lies in the range 32F to 122F.				
EXPECTED RESULTS				
ACTUAL RESULTS				

TEST CASE NUMBER	"Project" Test Case			<input type="radio"/> PASS <input type="radio"/> FAIL
	REQUIREMENT NUMBER	TESTER	DATE	
17	RC 20			
DESCRIPTION To check the robustness of the Tag reader. It should be robust, splash proof and rugged.				
TEST PROCEDURE Resources Required: RFID Reader, Manufacturer Data Sheet 1. Inspect the manufacturer provided data sheets for the RFID reader and verify that the protection cover type for the reader is either IP 54 or IP 67.				
EXPECTED RESULTS				
ACTUAL RESULTS				

TEST CASE NUMBER	"Project" Test Case			<input type="radio"/> PASS <input type="radio"/> FAIL
	REQUIREMENT NUMBER	TESTER	DATE	
19	RC 22			
DESCRIPTION To check the read accuracy of the tag reader				
TEST PROCEDURE Resources Required: RFID Reader, Multiple RFID tags, Software system and system database, system Savant <ol style="list-style-type: none"> 1. Place multiple tags in the interrogative zone of a reader antenna. 2. The reader should be able to read a tag at a time and place others in standby till it gets a chance to read it. This is the anti-collision algorithm. Verify that the reader should employ this algorithm to handle the huge traffic. 3. Verify this by the data that gets updated in the database. 4. The data obtained through the multiple tag tracking/identification should be accurate and timely. 				
EXPECTED RESULTS				
ACTUAL RESULTS				

TEST CASE NUMBER	"Project" Test Case			<input type="radio"/> PASS <input type="radio"/> FAIL
	REQUIREMENT NUMBER	TESTER	DATE	
20	RC 23			
DESCRIPTION To check the ability of the tag reader to handle false reads situations				
TEST PROCEDURE Resources Required: 2 RFID Readers, RFID tag, Software system and system database, system Savant <ol style="list-style-type: none"> 1. To make sure that the data received by a reader is correct, check the accuracy rates of the data received by two identical RFID readers, in the same environment with different tag orientations. 2. The RFID readers in the same environment should read the exact same data for the tag. 3. If the data obtained by the two readers is different, it implies that there is a problem in the installation or a poorly constructed error-correcting protocol or tag orientation and placement relative to the reader. 				
EXPECTED RESULTS				
ACTUAL RESULTS				

TEST CASE NUMBER	"Project" Test Case			<input type="radio"/> PASS <input type="radio"/> FAIL
	REQUIREMENT NUMBER	TESTER	DATE	
21	RC 24, RC28			
DESCRIPTION To check the ability of the reader to handle any kind of hardware interference provided by the several readers to be installed in the school				
TEST PROCEDURE Resources Required: 2 RFID Readers, RFID tag, Software system and system database, system Savant <ol style="list-style-type: none"> 1. Place the 2 RFID readers in the same orientation relative to a RFID tag in the same environment and at the same time. 2. Place the readers such that their coverage areas overlap and the signal of one reader should interfere with the other in this common coverage area. 3. Verify that the each reader reads the tag at different times rather than reading at the same time. 4. If the tag is accurately read twice and at different times by the two readers, it implies that the readers are using TDMA to avoid reader collision. 5. The system application should also have intelligent filtering mechanism to eliminate duplicate tag reads. 				
EXPECTED RESULTS				
ACTUAL RESULTS				

TEST CASE NUMBER	"Project" Test Case			<input type="radio"/> PASS <input type="radio"/> FAIL
	REQUIREMENT NUMBER	TESTER	DATE	
22	RC 25			
DESCRIPTION To check the compatibility of the tag reader with the windows OS				
TEST PROCEDURE Resources Required: RFID Readers, RFID tag, Software system and system database, system Savant <ol style="list-style-type: none"> 1. Connect the RFID reader to the System database through a Savant interface. 2. Place a RFID tag within the coverage area of the RFID reader. 3. Send a command through the server system to activate the tag and start tracking tags. 4. The RFID reader should read the data from the tag and accurately convey it to the database through the savant. 5. If the data obtained is accurately interpreted with the database and system operating system & if the reader accurately accepts a command from the system, it implies that the reader is compatible with operating system. 				
EXPECTED RESULTS				
ACTUAL RESULTS				

TEST CASE NUMBER	"Project" Test Case			<input type="radio"/> PASS <input type="radio"/> FAIL
	REQUIREMENT NUMBER	TESTER	DATE	
23	RC 26			
DESCRIPTION To check the ability of the DBMS to read and record data with minimum latency				
TEST PROCEDURE Resources Required: RFID Readers, RFID tags, Software system and system database, system Savant <ol style="list-style-type: none"> 1. Connect the RFID reader to the System database through a Savant interface. 2. Place several RFID tags within the coverage area of the RFID reader. 3. Send a command through the server system to activate the reader and start tracking tags. 4. The RFID reader should read the data from the tag and accurately convey it to the database through the savant. 5. Verify that this process of getting the access to the database and updating it should not take more than 20 seconds. 				
EXPECTED RESULTS				
ACTUAL RESULTS				

TEST CASE NUMBER	"Project" Test Case			<input type="radio"/> PASS <input type="radio"/> FAIL
	REQUIREMENT NUMBER	TESTER	DATE	
24	RC 29			
DESCRIPTION To check the ability of the readers to identify the accurate location of the student when tracking				
TEST PROCEDURE Resources Required: 2 RFID Readers, RFID tags, Software system and system database, system Savant 1. Place the RFID tags at various different locations in the room. Also place the tags outside the room where you re testing. (Keep within the reading range) 2. Activate the Readers and view the database entries for the location of the tags. 3. Verify the location from the records to see if the distance calculation algorithm is working fine.				
EXPECTED RESULTS				
ACTUAL RESULTS				

TEST CASE NUMBER	"Project" Test Case			<input type="radio"/> PASS <input type="radio"/> FAIL
	REQUIREMENT NUMBER	TESTER	DATE	
25	RC 30			
DESCRIPTION To check the reader installed at the entrances of the restricted areas and main school entrance reads only the tags only close to it and not the ones outside the door				
TEST PROCEDURE Resources Required: RFID Reader, RFID tags, Software system and system database, system Savant, metal mesh 1. Surround the RFID reader with the metal mesh. 2. Place the RFID tags at various different locations near and far from metal mesh. 3. Place one reader insider the metal mesh 4. Activate the Readers and view the database entries for the tags that have been read. 5. Verify the tags that was inside the mesh has been detected and none other which were outside.				
EXPECTED RESULTS				
ACTUAL RESULTS				

6.2 Verification Traceability Matrix

After developing the Verification Plan, it is important to verify that all high-level requirements will be verified through execution of the plan. The High-level Requirements Traceability Matrix, which is shown in the table below, maps the verification methods with each high-level requirement. This ensures that the Verification Plan does provide verification methods for all high-level requirements and can, therefore, be considered complete.

Requirement #	Test Plan #	Description
FR1.1	Test Plan 1.1	To check that every student/staff in the school has a permanent access id tag. This is a functional test.
FR1.2	Test Plan 1.2	To check that every visitor wishing access to the school has been issued a day access id. The visitor will not be able to get past the visitor/staff entrance without a day access ID. A day access ID is required for entry if a student/staff that has forgotten their ID or lost it. This is a functional test.
FR1.3	Test Plan 1.3	To check that permanent /Day access ids have the right information on them.
FR1.4	Test Plan 1.3	To check that permanent /Day access ids have the right information on them.
FR1.5	Test Plan 1.4	To check that the school has two outside entrances: student entrance and visitor/staff entrance. This is a field test.
FR1.6	Test Plan 1.2	To check that every visitor wishing access to the school has been issued a day access id. The visitor will not be able to get past the visitor/staff entrance without a day access ID. A day access ID is required for entry if a student/staff that has forgotten their ID or lost it. This is a functional test.
FR1.7	Test Plan 1.5	To check that the school student and visitor/staff entrances restrict access after one revolution of the door. This is a functional test at the school.
FR1.8	Test Plan 1.6	To check that the day access ID is valid only for a day and access with a previous day does not provide access to the visitor/student or staff. This is a functional test.
FR1.9	Test Plan 1.4	To check that the school has two outside entrances: student entrance and visitor/staff entrance. This is a field test.
FR1.10	Test Plan 1.7	To check that the school student should be able to additional access to a restricted access after the permission has been verified by the systems administrator. This is a functional test.
FR1.11	Test Plan 1.8	To check that the entrance to the restricted area should not open the doors lock unless the tag is brought very close to the reader at the door of the restricted area. This is a functional test.
FR2.1	Test Plan 1.9	To check that the day access id forms for the student/staff and visitors contain all the required information.
FR2.2	Test Plan 1.2,1.9,1.10	To check that every visitor wishing access to the school has been issued a day access id. The visitor will not be able to get past the visitor/staff entrance without a day access ID. A day access ID is required for entry if a student/staff that has forgotten their ID or lost it. This is a functional test. To check that the day access id forms for the student/staff and visitors contain all the required information. To check that the day access id forms for the student/staff and visitors contain all the required information.
FR2.3	Test Plan 1.11	To check that a tag is deactivated when a access ID tag is returned to the entrance staff.
FR2.4	Test Plan 1.12	To check that an authorized user can access the database to update, add, view or delete a record.
FR2.5	Test Plan 1.13	To check if the user gets a message to save unsaved data when he tries to logout of the school database system.
FR2.6	Test Plan 1.14	To check if the access to the GUI and database is provided to a user only through a secure login.
FR2.7	Test Plan	To check if the login gets locked if a user tries to enter a wrong

	1.15	username and password more than thrice.
FR3.1	Test Plan 1.16	To check if the entry recorded in the database for the student attendance & student/visitor /staff entry and exit are time stamped.
FR3.2	Test Plan 1.17	To check if the authorized user is able to change the default password provided by the systems administrator.
FR3.3	Test Plan 1.18	To check if the authorized user has the ability to print any report from the database.
FR3.4	Test Plan 1.19	To check if there are four kinds of reports generated by the system software. The data in the reports should be correct and valid.
FR4.1	Test Plan 1.20	To check if you are able to print the attendance report that is being generated by the system. Also test if the attendance report is being sent to all the teacher laptops for each classroom. Also Check for data consistency between the two.
FR4.2	Test Plan 1.21	To check if the attendance report being generated is based on the student schedule for the day.
FR4.3	Test Plan 1.22	To check if a list of present, absent and tardy students is generated at the end of the day.
FR5.1	Test Plan 1.16	To check if the entry recorded in the database for the student attendance & student/visitor /staff entry and exit are time stamped.
FR6.1	Test Plan 1.23	To check if the database is robust enough to hold a large number of records.
FR7.1	Test Plan 1.24	To check if the timed tracking functions is performed correctly.
FR7.2	Test Plan 1.25	To check if the forced tracking functions is performed correctly.
FR8.1	Test Plan 1.26	To check if the readers can be stopped and initiated at any time by the systems administrator.
FR9.1	TC19	
FR10.1	Test Plan 1.27	To check if a back up database has been created to ensure that data does not lose on a system crash.

Component Requirement	Specification Attribute	Specification desired performance	Test Case number
CR1	Tags	Semi-Passive	TC2
CR2	RF Signal Bandwidth	500Khz	TC3
CR3	Carrier Frequency	13.56MHZ (UHF)	TC2
CR4	S/N Ratio	13.5db	TC4
CR5	Signal Processing	using PSK 4 (4 state phase shift keying)	TC5
CR6	Microcontroller memory	1Mb and 512KB RAM	T16
CR7	Read/write	WORM tags	TC1
CR8	Microcontroller clock frequency		TC6
CR9	power consumption	<=35mW	TC7

CR10	Battery	Output voltage 4.6 and 5 V(regulated)	TC8
CR11	Weight	<3oz	TC9
	Size	2.1"X3.4"X1"	TC9
CR12	Operating Frequency	UHF(about ~902-928Mhz)	TC10
CR13	Coverage area	Hemispherical	TC11
CR14	Size	0.3 inch	TC12
CR15	Reader Power Indicator	Unregulated 12V DC	TC13
CR16	Antenna	4 port (Circular or linear polarization)	TC14
CR17	Operating Frequency	UHF(about ~902-928Mhz)	TC2
CR18	Connection to Network	Ethernet, 802.11G or 802.3 wired	TC15
CR19	Operating Temperature	:-32F to 122F	TC16
CR20	Protection Type	IP 54, IP 67	TC17
CR21	Tag type and special enclosure	Portal readers work in conjunction with presence detectors and an RF reflector surface such as metal mesh. The metal mesh which surrounds the doorway prevents the transmission from adjoining doors being read in error. Reader Type: IF5	TC25
CR22	Read Accuracy	Anti-collision Algorithm	TC19
CR23	Read Accuracy	No False Reads	TC20
CR24	Read Accuracy	reader collision also using TDMA	TC21
CR25	Reader Compatibility	Windows OS	TC22
CR26	response time	45 sec	TC23
CR28	Data	Duplication Theorem	TC21
CR29	Location	Distance Calculator	TC24

7. Conclusion

Smart School ID System is an efficient way to provide security to student and staff inside the school premise through access control and tracking functionality. In this project we have successfully applied the systems engineering methodology to implement the smart school ID system concept.

Systems engineering principles were applied from the stakeholders requirements to the system validation and verification phase. This ensured that it is consistent from the beginning to the end and serves the intended purpose effectively when designed. Initial requirements are used to develop the use cases and scenarios through which system level requirements are generated which are then synthesize and broken down into functional and component requirements. System modeling and analysis through the use of activity and statechart diagrams reflects the system behavior. Requirements are traced onto the use cases and activity diagrams to ensure

that the use cases and system behavior is reflected in the requirements. Qualitative and quantitative requirements are allocated attributes and assigned parameters.

The two important parts of systems approach are system validation and system verification. Validation ensures that you build the right product whereas verifications ensure that we are building the product right. A verification plan is therefore proposed to test all the functional requirements and specifications. The tests defined in the verification plan are also traced back to the requirements. If the system passes all the tests it can be assured that the final system after actual implementation and deployment will meet the customer requirements.

8. References

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