SOFTWARE

DESIGN

DESCRIPTION

GARCON

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CHANGE HISTORY

VERSION	DATE
1.0	14.04.2019
1.1	25.04.2019

Table Of Contents

List Of Tables

List Of Figures

1. Introduction

This is a Software Design Description document for “Garcon Project” which is introduced by Microsoft.

1.1. Purpose of the System

“Garcon Project” is a smart campus project launched by Microsoft whose objective is presenting a better, safer and smarter campus environment for students and staff. In order to increase collaboration, creativity and efficient use of resources along with space utilization, this project uses IOT and AI technologies to process data comes from sensors and cameras. This background is used by assistants called “Garcons” which are distributed along smart campus, provides the user-end service and communication.

1.2. Scope

This document describes the system at an architectural level. It makes use of various use cases and their detailed descriptions to do so. This document also provides details of all the components and their subcomponents of the system, the interfaces,
how the components of the system interacts with each other and how the system interacts with external systems, the hardwares that this system will run such sensors and communication of all these components.

1.3. Stakeholders and their concerns

User: These are people from all around the campus that have a conversation with one of the Garcon access points. Their first concern is to get up-to-date and reliable information from the system and/or being able to send tickets to get said services. They also need a interface to send and get voice commands to/from access points. The user also needs to get information about the process of tickets. They also need a text query interface in case of voice query does not work.

Admin: Admin is the person who is responsible for the who is responsible for the security, configuration, and reliable operation of the Garcon system. Admins' primary concern is having full authorization of the system. They require to have full access over the system in a way so that they can manage the system. Also they need a clean interface in which they can work efficiently. Being able to view the usage logs is another concern of the admins.

IT Staff: IT staff are the group of people who are responsible for the development, evolution and maintenance of the Garcon. Their primary concern is to easily & quickly identify the problems and have a simple interface to deal with them. Another concern of theirs is that being able to test and resolve system issues with as little work as possible.

They also need to be able to show system logs in order to have information about in what ways the system should be improved.

2. References

This document is written with respect to the specifications of the document below:

29148-2011 - ISO/IEC/IEEE International Standard - Systems and software engineering -- Life cycle processes --Requirements engineering.

Other sources:

"Microsoft shows off Garcon smart campus concierge", March 2019 ,
URL: https://www.iothub.com.au/news/microsoft-shows-off-garcon-smart-campus-concierge-514870

Sommerville, I. (2016). Software engineering. Boston: Pearson Education Limited.

3. Glossary

Term	Definition
User	End-user that utilizes Garcon Smart Campus System
Admin	Person that has administration of Garcon Smart Campus System
IT Staff	Person that responsible for running technically advanced information systems
SATA	Serial ATA, a computer bus interface that connects host bus adapters to mass storage devices
SAS	Serial Attached SCSI , interface between storage device and computer
SSL	Secure Sockets Layer , cryptographic protocols designed to provide communications security over a computer network
HTTPS	“HyperText Transfer Protocol Secure” is a protocol for secure communication over network which is widely used on web
	Solid-state drive,solid-state

SDD	storage device that uses integrated circuit assemblies as memory to store data persistently
SQL	"Structured Query Language" is a domain-specific language used in programming and designed for managing data held in a relational database management system.
CRUD	Create, read, update, and delete he four basic functions of persistent storage

Table 1: Glossary

4. Architectural Views

4.1. Context View

In this view, the context diagram of the system is represented at first. After that, use case models of the system is given and they are explained with the description tables. The reason there are two Use Case models is simply creating a sense of simplicity for the reader. The table descriptions of use cases include alternative flows and error flows if exist. These descriptions show how the system should behave in various scenarios and they are meant to be a baseline for how the functionalities of the system shall be implemented. Context diagram represents the actors in the Garcon project and how they interact with each other. On the other hand, Use Case model shows different kinds of internal or external users and how systems interact with Garcon through a variety of cases.

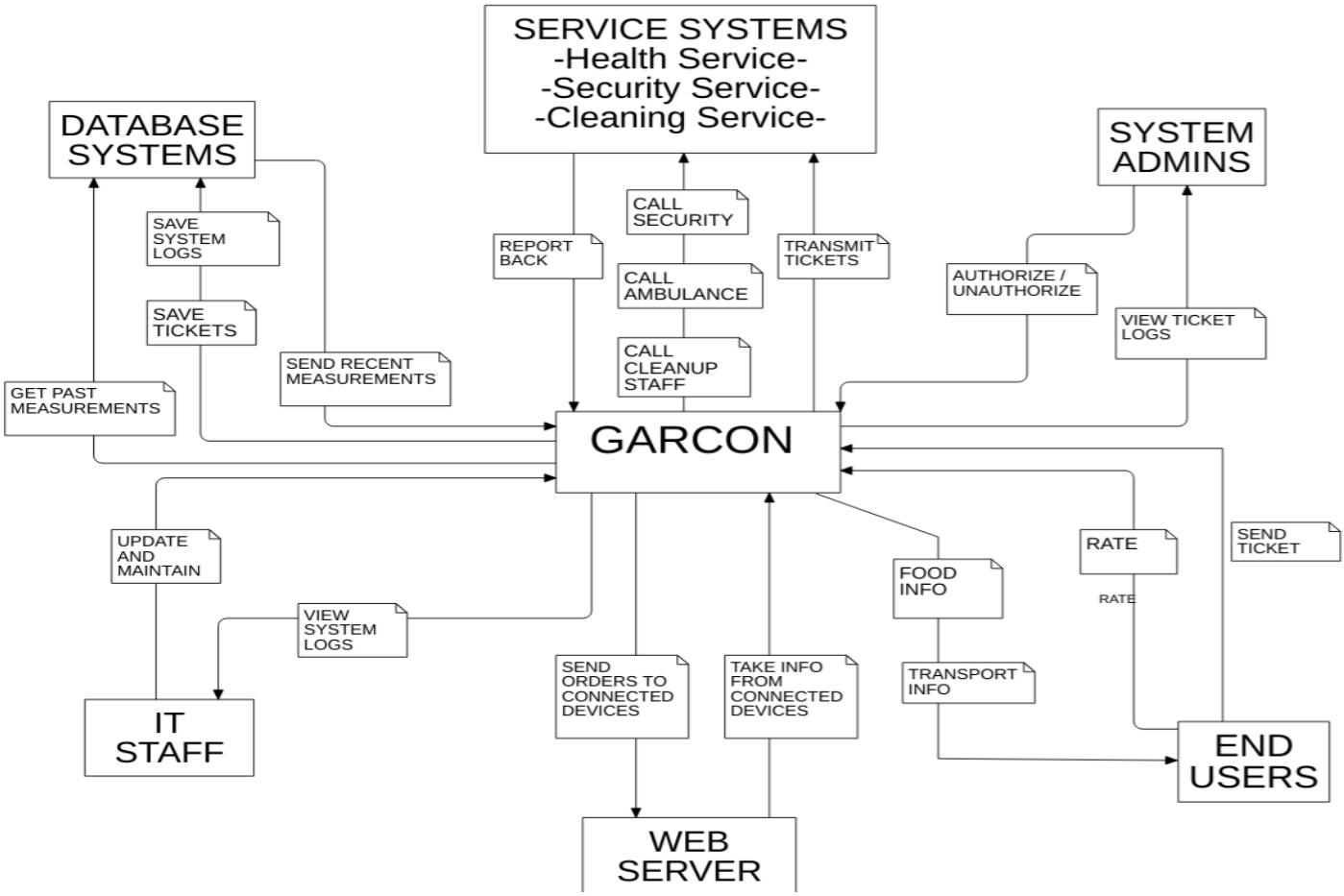

Figure 1:Context Diagram

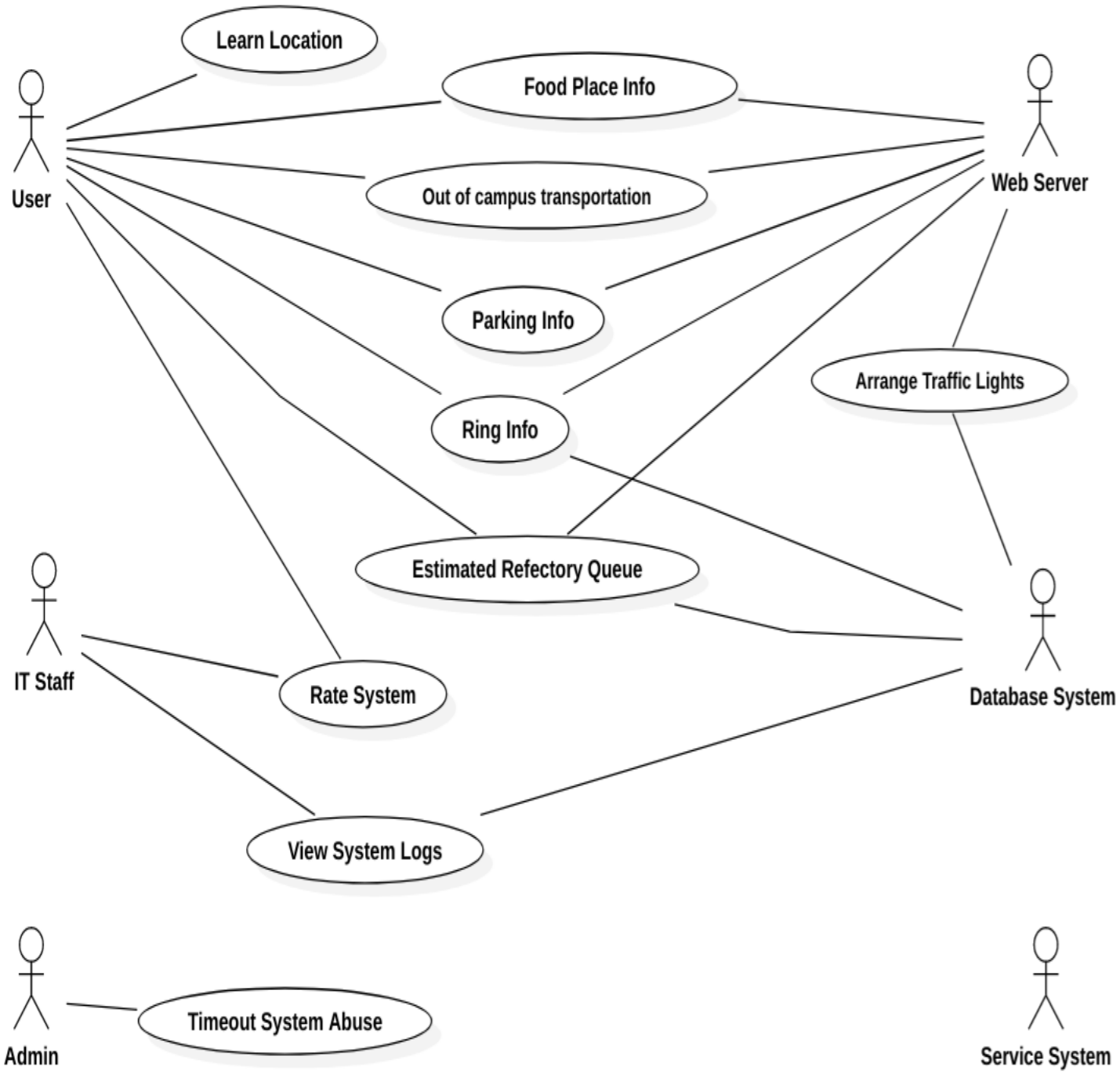

Figure 2:Use Case Model For Information System

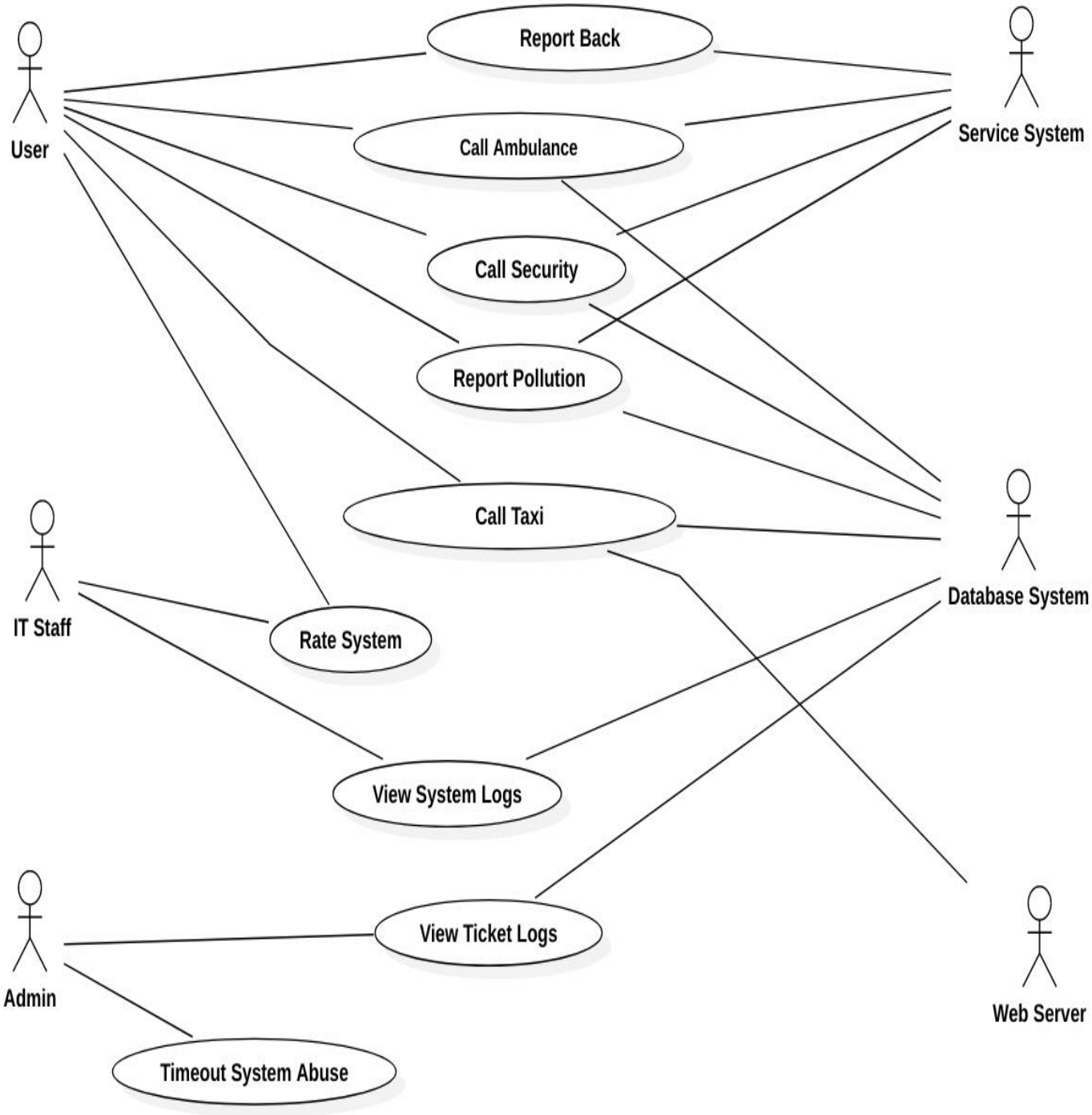

Figure 3:Use Case Model For Ticket System

Use Case Descriptions For Information System are given below.

Use case name	Ring information
Actors	User , Web Server , Database System
Description	Garcon system gives in campus ring system information to end-users.
Data	Current ring locations and their departure times, availability of seats, past data of ring times.
Preconditions	When end-user wants to learn where is the ring and when end-user doesn't know rings' departure times.
Stimulus	Given voice query that contain request ring information.
Basic Flow	Step 0 – System arranges ring times with the help of readings from seat sensors and artificial intelligence calculations which use past data collected from database. Information is now available to use. Step 1 – User sends a voice query about rings. Step 2 – Garcon sends processed query to the system. Step 3 – Web server system takes the current ring location together with the seat availability and sends to Garcon assistant. Step 4- Garcon informs the user about rings.
Alternative Flow	Step 3-When there is no ring , Garcon informs user about this situation.
Exception Flow	When Web Server can't reach current location of rings.
Postconditions	Garcon sends current data of seat availability thanks to IOT to the database in order to use in future AI calculations. Garcon is ready to process new sound queries.

Table 2: Use Case Description for Ring Information

Use case name	Rate System
Actors	End User, IT Staff
Description	End users rate their experience with system and then IT personal uses ratings to improve the system.
Data	Users' satisfaction level from zero stars to five stars with an optional text note.
Preconditions	A conversation between Garcon and end-user.
Stimulus	Garcon notices when end-user finishes the conversation session.
Basic Flow	Step 1 – Garcon acknowledges conversation is over. Step 2 – A message is sent to user about rating procedure. Step 3 – Input for user satisfaction is saved to system logs with satisfaction rating and user note.
Alternative Flow	-
Exception Flow	After not giving an answer in 20 seconds, the system will terminate procedure without a log.
Postconditions	User is appreciated for the review and informed about the interaction is finished.

Table 3: Use Case Description for Rate System

Use-case descriptions for ticket system are given below.

Use case name	Call Ambulance
Actors	End User, Service System, Database System

Description	User creates a ticket to call ambulance.
Data	Number of ambulances needed Reason for the call
Preconditions	Health problem occurs and ambulance is needed. User needs to find an access point to call ambulance.
Stimulus	Garcon gets a ticket to forward health service system.
Basic Flow	Step 1 – Health problem occurs and ambulance become necessary. Step 2 – A user creates a call ambulance ticket. Step 3 – System gets the ticket and communicates with health service systems to send ambulance
Alternative Flow	-
Exception Flow	If system can't contact with health service systems, it can't request ambulance.
Postconditions	User is informed about process with a report back. Ambulance arrives to the needed point. A system log will be created and sent to database.

Table 4: Use Case Description for Call Ambulance

Use case name	Call Security
Actors	End User, Service System, Database System
Description	A user recognizes a security issue and creates a ticket to get security units.

Data	Reason for the call Level of danger Location
Preconditions	Security problem occurs and units are needed. User needs to find an access point to call security.
Stimulus	Garcon gets a security ticket to forward security service system.
Basic Flow	Step 1 – Security problem occurs and units are needed. Step 2 – A user creates a call security ticket specifying danger level. Step 3 – System gets the ticket and communicates with security systems to send units. Step 4 – Service responds to system and sends the units.
Alternative Flow	-
Exception Flow	If system can't contact with health service systems, security units can't be requested.
Postconditions	User will be reported back to get informed about the process. Security units will arrive at the time that user is informed about. A system log will be created and sent to database.

Table 5: Use Case Description for Call Security

4.2. Composition View

In a high-level-fashion, this viewpoint comprises components of the system along with their subcomponents. The relationships between these components and hardware are also demonstrated.Exhaustive explanations of these components are in their corresponding section.

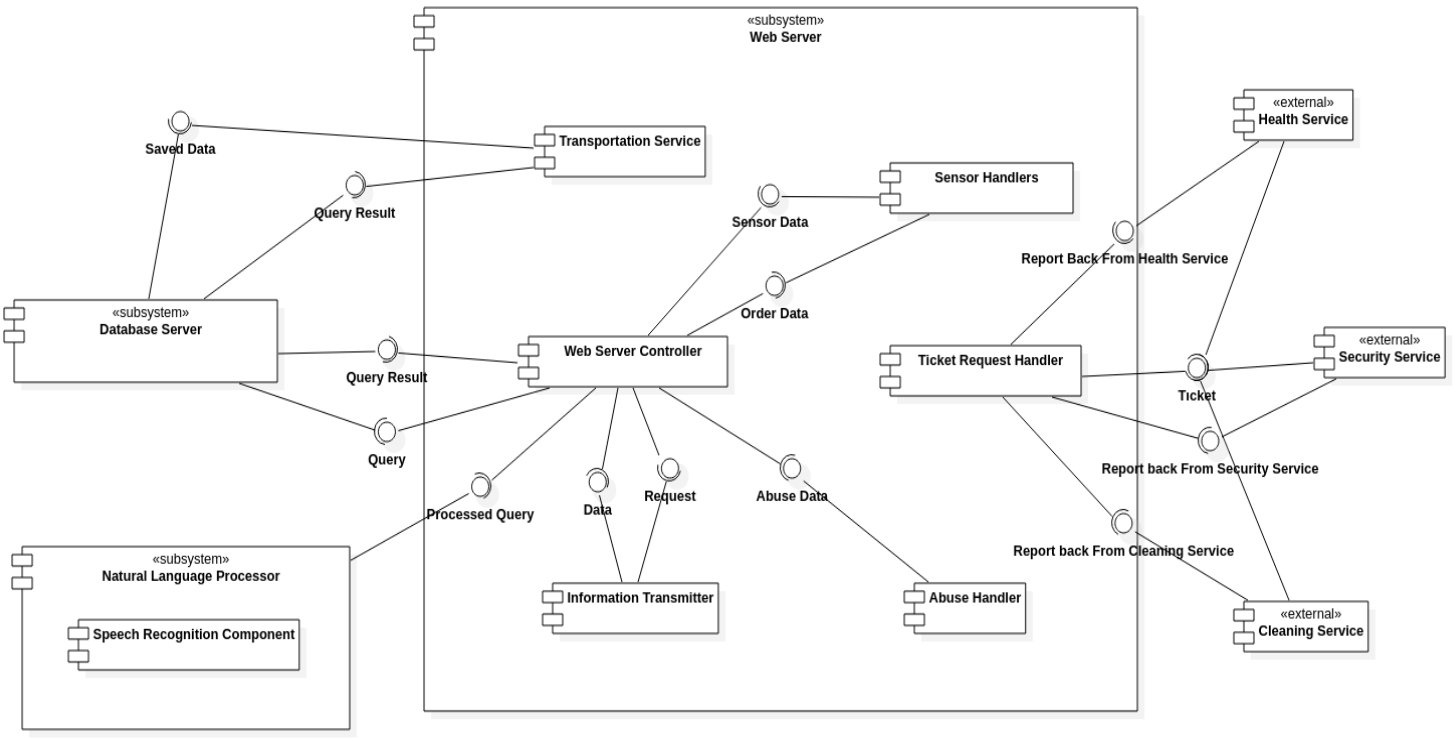

Figure 4:Component Diagram

Design Rationale:

- Web Server subsystem includes components that have interaction with other subsystems and external components.In general, Web Server Subsystem handles the connection issue of Garcon with external entities.
- Information transmitter component carries out finding the related data about the received request and transmits it back to the web server controller component.

- Abuse handler is responsible for detecting improper usage of Garcon system and giving related abuse data to web server controller component.
- Sensor handler component connects web server subsystem to sensors that are distributed along campus.It is simply responsible for delivering measurements and sensor data to web server and transmitting orders to sensors.
- Transportation service component is responsible for the answering requests about transportation and location. This component can communicate database subsystem in order to take saved information about campus rings and campus location.
- Ticket request handler handles generated tickets by transmitting ticket to
    - health service
    - security service
    - cleaning service

  and reporting back from these institutions.
- Web server controller manages the interaction of web server's inside components with external entities.This component controls
    - communication between database subsystem with web server subsystem controller by giving queries to database subsystem and taking result of that query ,
    - communication between natural language processor subsystem with web server subsystem by taking translated query from that subsystem
    - information transmitter component by passing the translated query from user voice to this component and taking requested data from it ,
    - abuse handler component by transmitting the abuse data to related stuff,
    - sensor handler component by receiving the sensor data and forwarding orders to corresponding sensors.
- Database server subsystem connects database to other subsystems.This subsystem takes the given query and returns answer.Database system in Garcon is used to save necessary data of other components in order to forward utilization.

- Natural language processor is the subsystem where given user queries taken from and processed in order to make these queries understandable for other subsystems and components.This subsystem can connect to web server system to transmit the processed query.

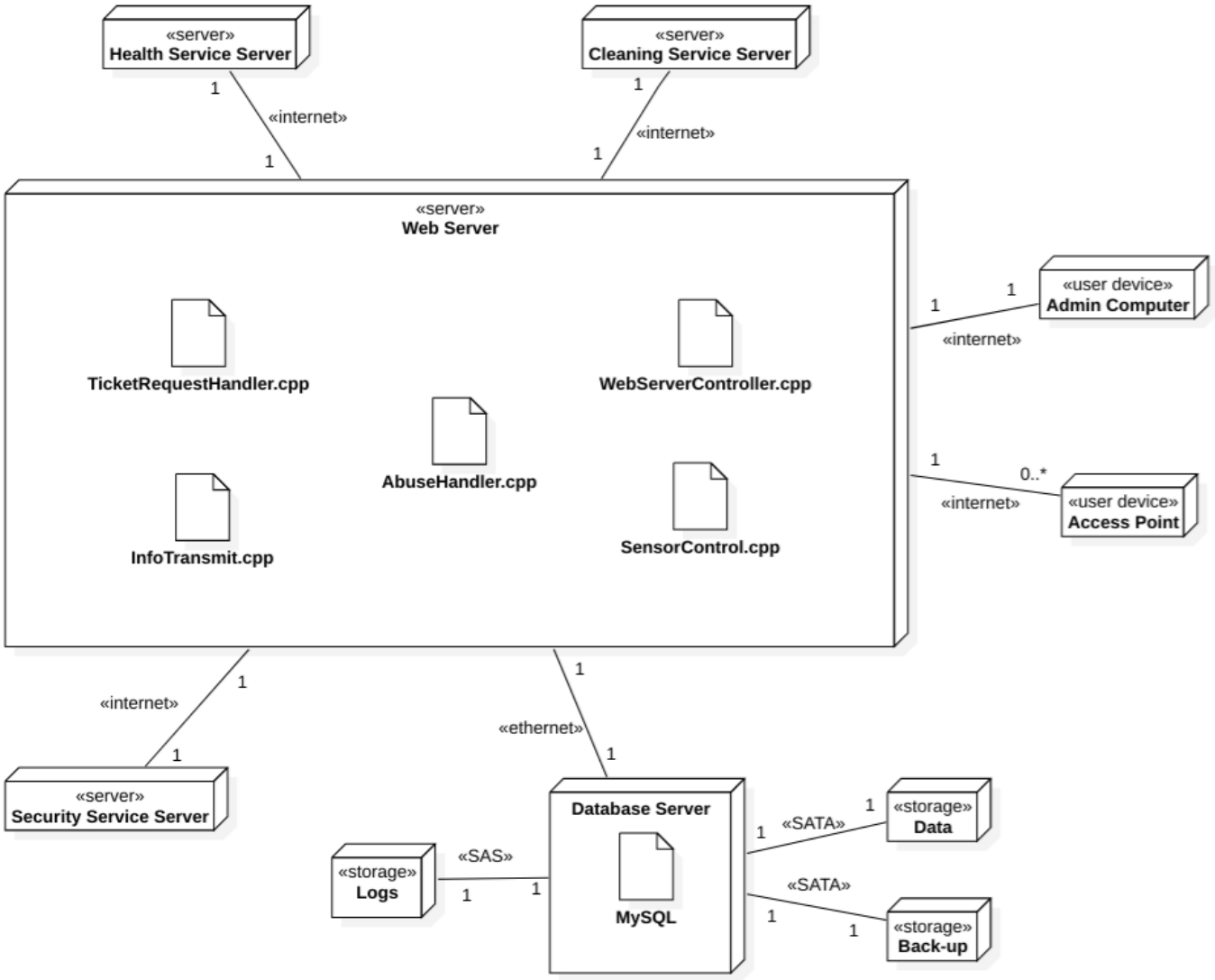

Figure 5: Deployment Diagram

Design Rationale:

- There are three separate database storages;
    - Data storage is for ticket and campus information storage together with system use about these informations.
    - Logs storage is to hold log information.
    - Backup storage is for keeping a backup of all data stored.

    - Garcon is a system based on information about campus and ticket data. Thus, preventing any kind of data loss is crucial. In order to prevent such failures we have a backup SSD where we store copies of all data we have. In case of any failure, data loss will be significantly decreased.
- Internet based connections will use encrypted communication protocols like SSL and HTTPS for increased security
    - SAS is used to store logs since logs require a faster pace of transfer and SAS provide an enhanced speed of SATA .
    - C++ is used as backend language because of its speed and ability to cheaply use resources is superior.
    - Access points which end users have and computer of admin connect to the system
    - In terms of scaling, we separate the Web Server and Database Server into 2 different components. As a result, our system will scale up more easily since changing the Database Server only would be enough to scale up.

4.3. Information View

Information view shows the classes of the system, their attributes and methods with the detailed descriptions. These information would be stored on the database of the system. Thus, they would be stable and it is necessary to specify how this information will be stored. In other words, create, read, update and delete suitability of every component that will be stored in the database of the system will be specified in this section.

4.3.1. Service Interfaces

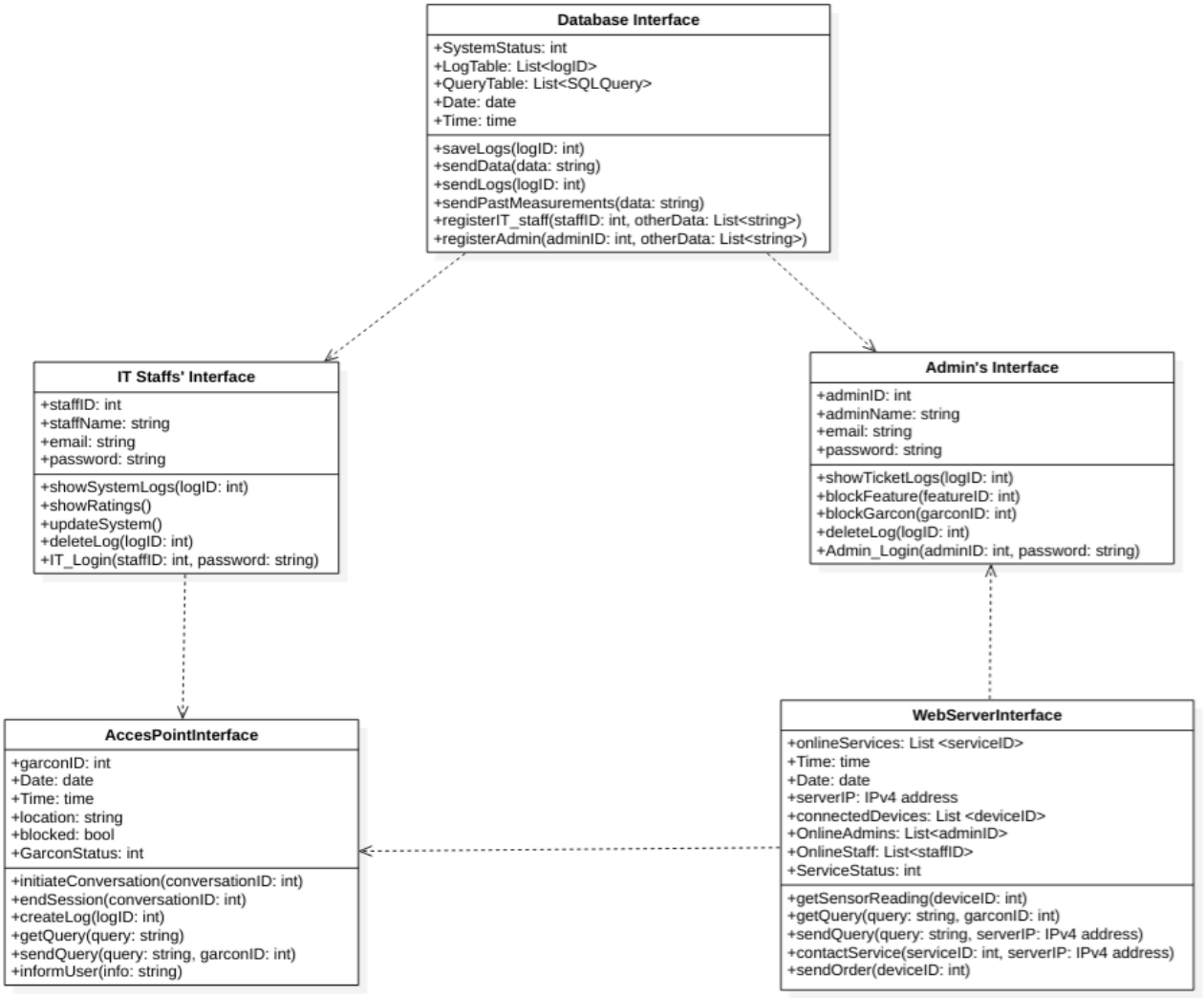

Figure 6:External Interfaces

Operation	**Description**
saveLogs	When a log is created, this operation is used to save it to the database.
sendData	Database sends data to other interfaces with this operation.
sendLogs	Database sends logs to other interfaces with this operation.
sendPastMeasurements	Database sends past sensor readings to other interfaces with this operation.
register_ITstaff	When a new IT member joins the team or an already existing one registers the system, it will be done via this method.
register_Admin	When a system Admin registers the system, it will be done via this method.
showSystemLogs	When IT staff need to see system logs, this operation is used.
showRatings	When IT staff need to user reviews, this operation is used.
updateSystem	System updates are done via this operation by IT staff.
deleteLog	Logs are deleted with this method by either admin or IT staff.
IT_login	IT members login to system using their ID and password through this operation.
showTicketLogs	This operation allows admins to see ticket logs.
blockFeature	Whenever there is an abuse of a feature, admins are capable of block that feature via this operation.
blockAccessPoint	Whenever there is an abuse of a Garcon access point, admins are capable of block that feature via this operation.
adminLogin	Admins login to system using their ID and password through this operation.
initiateConversation	Whenever a end-user tries to conversate with an access point, this method is called first.
endSession	Whenever a end-user tries to close a conversation at an access point, this operation is used.
createLog	This method is used to create logs.
sendQuery	Whenever an interface wants to send query to the database of the system, it will be done through this operation.

informUser	This operation is used to inform user about the process of the work when a ticket is sent.
getQuery	Database is allowed to poll and evaluate queries via this method.
getSensorReading	Whenever web server tries to get sensor reading data from the database, it will use this operation.
sendQuery	Whenever web server tries to send a query to the database, it will use this operation.
sendOrder	Web server sends orders to other interfaces through this operation.
contactService	This operation allows web server to contact with health, security and cleaning services.

Table 6: Service interface operation descriptions

Operation	**Inputs**	**Outputs**	**Exceptions**
saveLogs	logID	list of logs	Database not available
sendData	data	successful / failed	Database not available
sendLogs	logID	successful / failed	Database not available
sendPastMeasurements	data	successful / failed	Database not available
register_ITstaff	stafID otherData	-	Database not available Web server not available
register_Admin	adminID otherData	-	Database not available Web server not available
showSystemLogs	logID	list of logs	Database not available
showRatings	-	list of ratings	Database not available
updateSystem	-	-	-
deleteLog	logID	successful / failed	Database not available

IT_login	staffID password	-	ID or password is wrong
showTicketLogs	logID	list of logs	-
blockFeature	featureID	successful / failed	-
blockAccessPoint	garconID	successful / failed	-
adminLogin	adminID password	successful / failed	ID or password is wrong
initiateConversation	conversationID	conversation	Access point not available
endSession	conversationID	-	-
createLog	logID	successful / failed	Database not available
sendQuery	query garconID	successful / failed	Database not available
informUser	info	-	Web server not available
getQuery	query garconID	-	-
getSensorReading	deviceID	-	Database not available
sendQuery	query serverIP	-	Database not available
sendOrder	deviceID	successful / failed	Web server not available Database not available
contactService	serviceID serverIP	successful / failed	Service not available

Table 7: Service interfaces operations

Design Rationale:

- In order to data communication to be established, web server will act like a organizer as it is providing most of the functionality.
- Database server and web server communicate with each other constantly in order to provide services Garcon offers.
- Database interface is loaded with all the work of storage and integrity of the information in system except up-to-date information which is being held at web service.
- Web server interface has the vital job of contacting with external service interfaces. Since it is important for that communication to be fast and real time based, it is a responsibility of the web server interface.
- Authorization of the system personal is done via database interface.
- All log related operations done with the database interface since they are kept in there. Authorized personnel can reach and monitor logs when necessary.

4.3.2. Database Operations

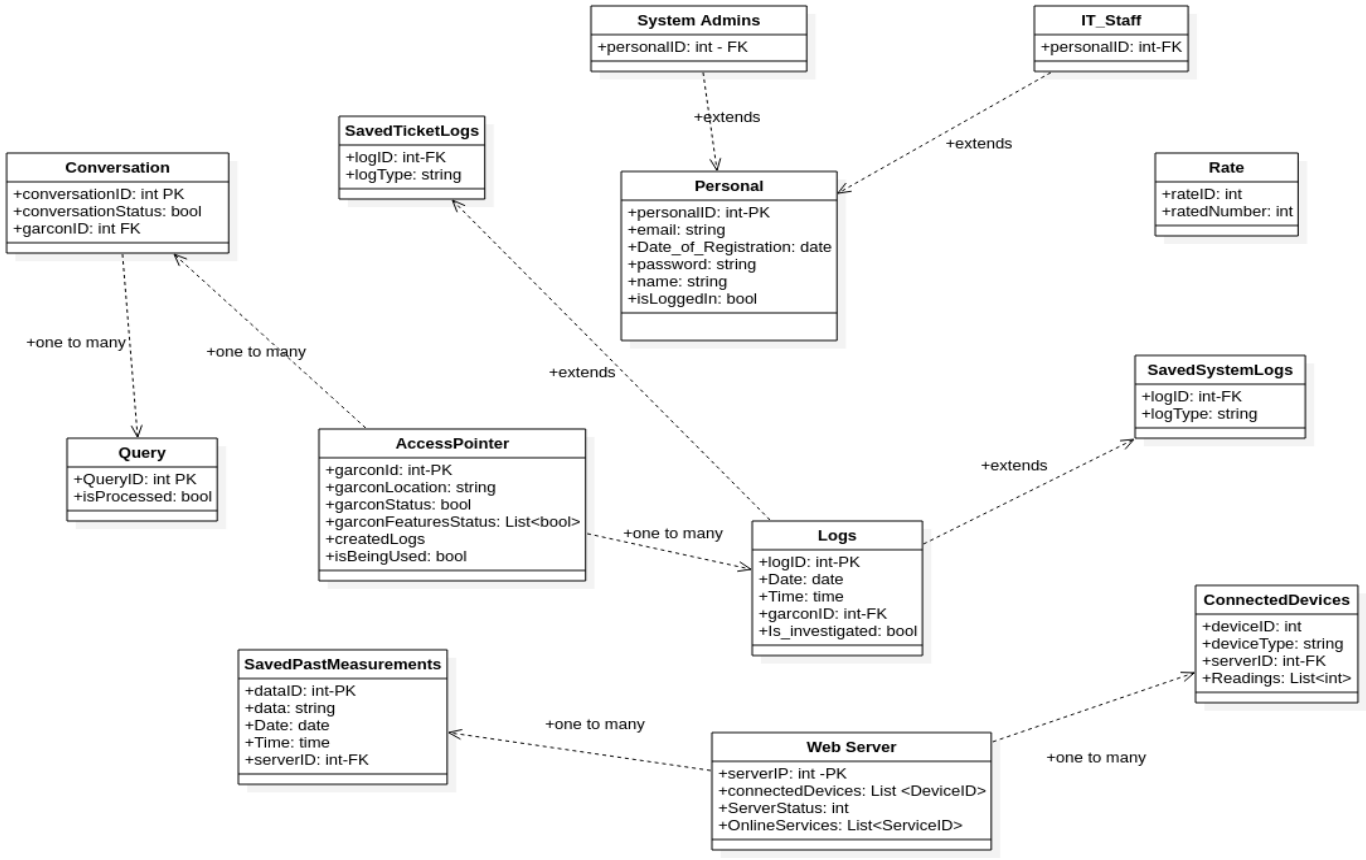

Figure 7: Database Class Diagram

Operation	**Description**
saveLogs	Create : Logs Read : - Update : - Delete : -
sendData	Create : - Read : SavedPastMeasurements Update : - Delete : -
sendLogs	Create : - Read : Logs

	Update : - Delete : -
sendPastMeasurements	Create : - Read : SavedPastMeasurements Update : - Delete : -
register_Itstaff	Create : IT_Staff Read : - Update : - Delete : -
register_Admin	Create : Admin Read : - Update : - Delete : -
showSystemLogs	Create : - Read : SavedSystemLogs Update : - Delete : -
showRatings	Create : - Read : Rate Update : - Delete : -
updateSystem	Create : - Read : SavedSystemLogs Update : Logs Delete : -
deleteLog	Create : - Read : - Update : - Delete : Logs
IT_login	Create : - Read : - Update : Personal Delete : -
showTicketLogs	Create : - Read : SavedTicketLogs Update : - Delete : -

blockFeature	Create : Logs Read : - Update : AccessPointer , Conversation Delete : -
blockGarcon	Create : Logs Read : - Update : AccessPointer , Conversation Delete : -
adminLogin	Create : - Read : - Update : Personal Delete : -
initiateConversation	Create : Conversation Read : - Update : AccessPointer Delete : -
endSession	Create : - Read : - Update : AccessPointer , Conversation Delete : -
createLog	Create : Logs Read : - Update : AccessPointer Delete : -
informUser	Create : - Read : - Update : Conversation Delete : -
getQuery	Create : - Read : Query Update : Query Delete : -
getSensorReading	Create : - Read : ConnectedDevices Update : - Delete : -
sendQuery	Create : Query Read : - Update : Conversation

	Delete : -
sendOrder	Create : - Read : Web Server Update : ConnectedDevices Delete : -
contactService	Create : - Read : TicketLogs , Web Server Update : - Delete : -

Table 8: CRUD Operations

Design Rationale:

- For database management, MySQL is used.
- These created classes and instances are kept in database for further usage like improving Garcon Smart Campus System or keep track the request for analysis.

4.4. Interface View

In this view, internal interfaces between components of the Garcon and external interfaces between Garcon system and other systems or users are specified in detail.

4.4.1. Internal Interfaces

The Interface between the Database Server and the Web Server Controller:
All the information retrieval between access points and Database Server runs through Web Server Interface. Thus, the interface between these two components is needed. Also all queries to the Database Server is sent through Web Server Controller so this interface is indeed necessary.

Design Rationale:

- Database Server component will be storing all user, access point and log information.

- Data could be deleted, manipulated,created and monitored. Thus SQL queries will consist of combinations of select, insert, update and delete operations.
- Web Server Controller will be responsible for composing the corresponding SQL queries for each operation.

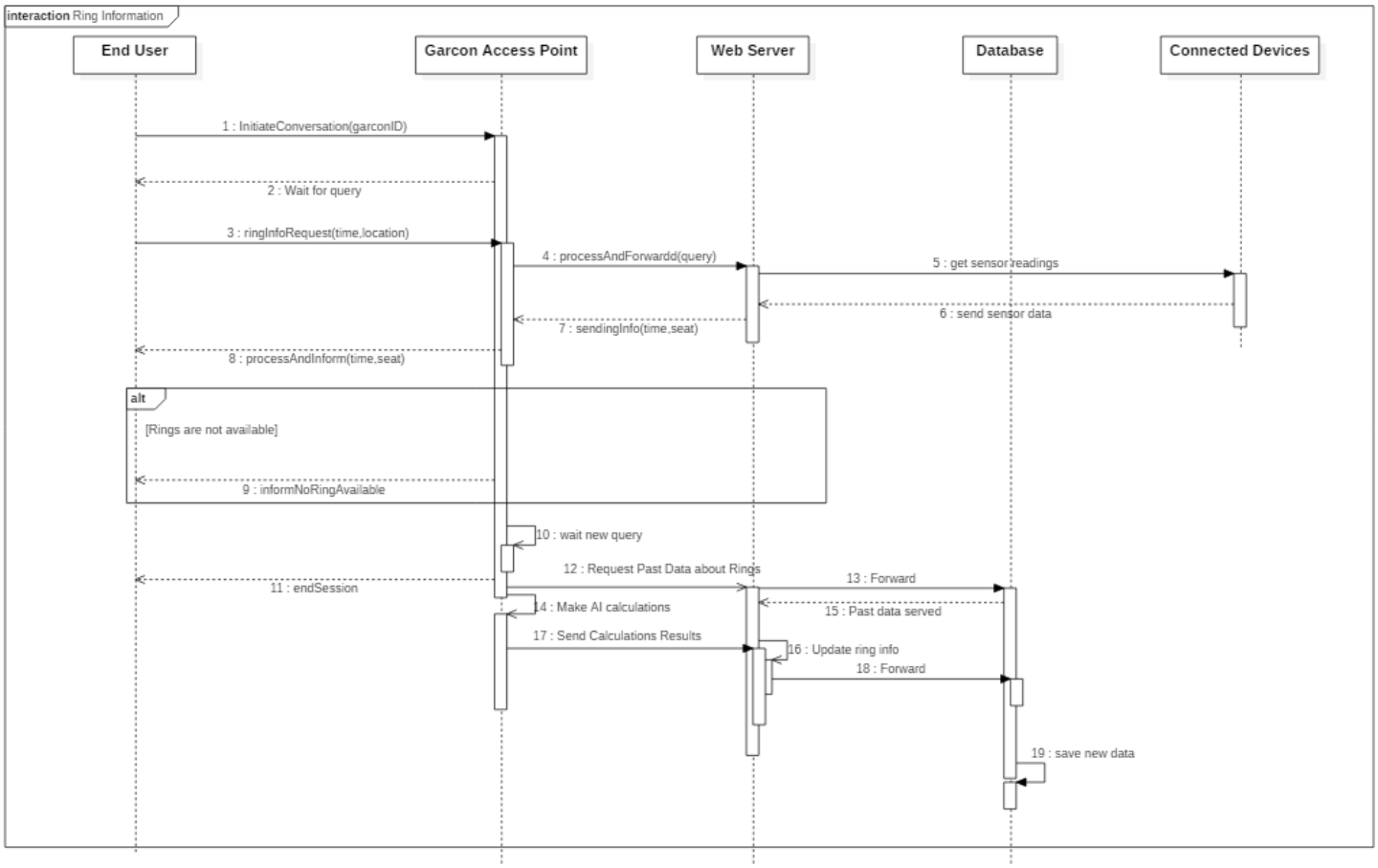

Figure 8: Ring Information Sequence Diagram showing the interface between Web Server Controller and Database Server components of the system

The Interface between the Transportation Service and the Web Server Controller:

Transportation Service uses Web Server interface in order to get information such as past measurements and ring information. Thus there is a need of interface between these components. All information retrieval is through web server from perspective of Transportation service.

Design Rationale:

- Web Server Controller will be providing all the information that Transportation Service requires.
- Web Server is also responsible for putting recent measurements to database server from Transportation services.
- Transportation Service will connect with only Web Server Controller Interface. This approach helps us to keep the integrity of Transportation service .

The Interface between the Information Transmitter and the Web Server Controller:

Information Transmitter is the system for providing users information about campus. Connecting it to Web Server with an interface is necessary since all information retrieval run through Web Server Controller for the system. This interface acts as a intermediate step to information system for users.

Design Rationale:

- Web Server Controller will be provider of all the information that Information Transmitter needs.
- Since all the information that Web Server reaches is up-to-date. Thus it is possible to serve real time information with high accuracy.

The Interface between the Abuse Handler and the Web Server Controller:

Interface between these two components is required since Abuse Handler will alert the system whenever there is an abuse of the system. End users can be tough to deal with from time to time, so we want this interface to be real time based. Web Server Controller will later follow this abuse to necessary places but first, Abuse Handler needs an interface to transmit it to Web Server.

Design Rationale:

- The interface will work based on real time since system abuse is a big concern of ours and it should be reacted immediately.

- Web Server Controller will be responsible for the report of incoming abuse informations coming from that interface.
- Abuse Handler will be waiting orders from Admins and IT staff, so the information transmission is bidirectional.

4.4.2. External Interfaces

4.4.2.1. User Interfaces

User interfaces are different in Garcon Smart Campus System.

- End user interface is especially conversation with Garcon.
- Admin interface is designed to provide admin operations such as block feature or show ticket logs .
- IT staff interface is like Admin interface, it operates to execute IT staffs' directives to system.

All of the interfaces are explained detaily in the corresponding section.

Garcon Voice Interface:

End user comes to the Garcon distributed along campus, creates a conversation with voice. Natural language subsystem recognized voice queries and translate them into machine code.The main purpose of this interface is to take voice queries from end users.This interface is used for giving responses as well.

Design Rationale:

- Since usage of this interface is apparent, misusing of the service is nearly impossible.
- Mainly, natural language subsystem operates this interface.
- There is no need to login to this system.

Admin Interface:

- Admins are the managers in the Garcon Smart Campus System.They conduct the smart campus system via this interface.It enables Admins to
  - block feature in the Garcon assistant for temporary time
  - block the Garcon as a whole if misuse are detected

- show and delete ticket logs saved in the database system

In order to use the specifications of the interface, Admins should be logged in.

Design Rationale:

- In this Interface, management can see ticket logs easily by looking the logs panel.
- Reports panel is used for investigating reports.
- Also, deleting ticket logs from database system is easy with the trash icon next to the log.
- Admins can see the current status of the Garcon assistant by investigating devices tab.
- Users panel provides admins to see the currently being used Garcon assistans.This tab enables Admins to detect the misuse of system.
- Garcon's features or whole Garcon can be disabled via devices tab.

IT Staff Interface:

IT Staffs are the developer and executive people in the system. They are maintaining system with solving the problems occurred by looking the system logs. If the corresponding system log is investigated and solved properly, they can delete this log as well. Also they are improving this smart campus system by evaluating the feedbacks coming from users.

Design Rationale:

- In the dashboard, IT Staff can consider the status of the whole system, active Garcons and clients, recent errors & warnings and crashed Garcon assistans.
- In devices tab, IT Staff can see the current status of the Garcon. If a problem exists in the Garcon, they can examine why this problem occurred from this tab.
- Below devices tab, they can investigate the reports created by the system in the reports tab.
- In the logs panel, IT Staff can see the created system logs.These logs not only can be viewed , but also examined and deleted in this panel.
- Users panel enables IT Staff to evaluate the given votes from end users. This panel is one of the main source that users' feedbacks are taken. This leads to IT Staff that which points in the system can be improved.
- In order to use this specifications, IT Staff should login to the staff system.

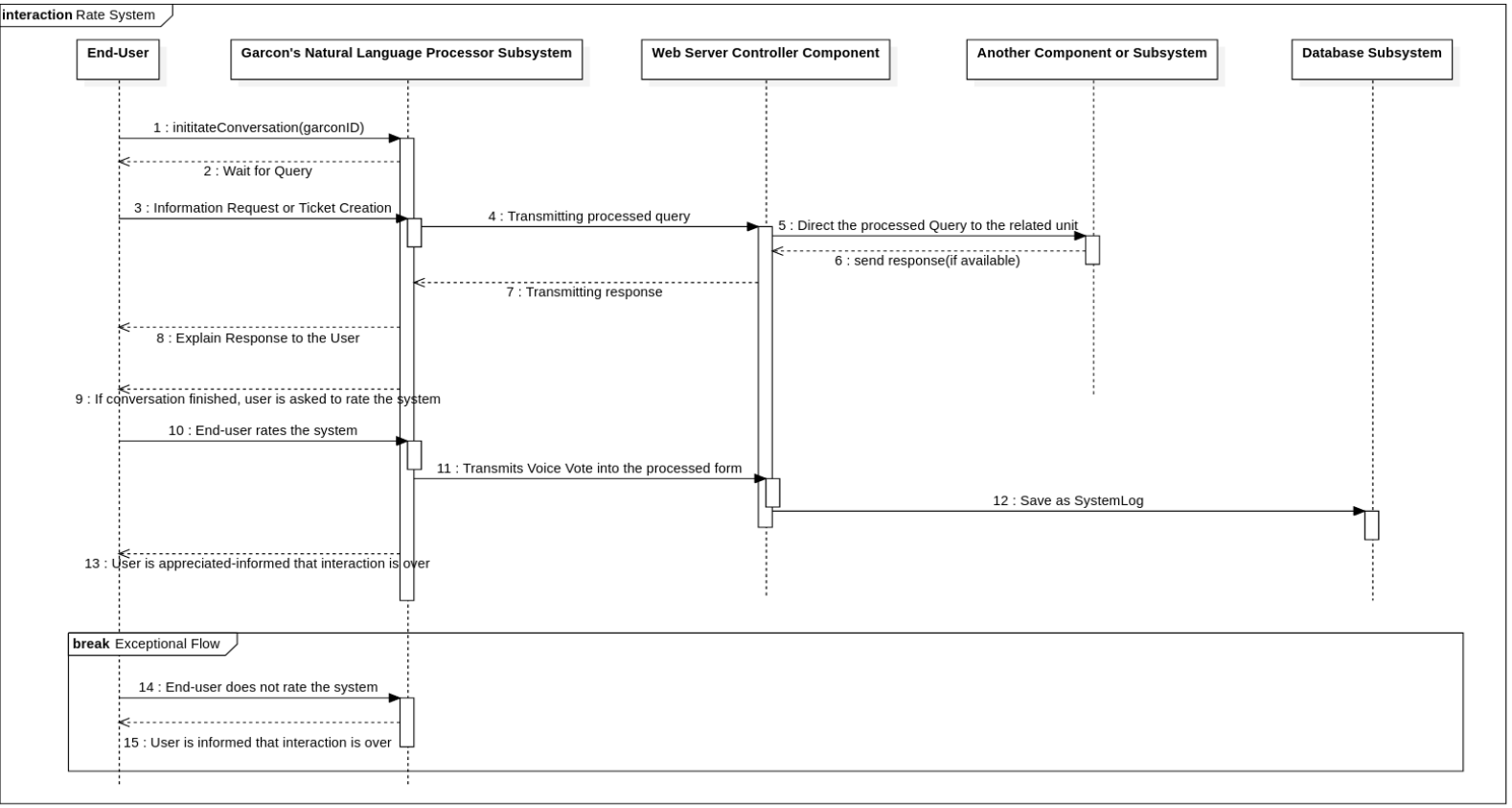

Figure 9: Rate System Sequence Diagram showing the interface of IT Staff

In order to visualize these interfaces, Staff system's graphical user interfaces are added below.

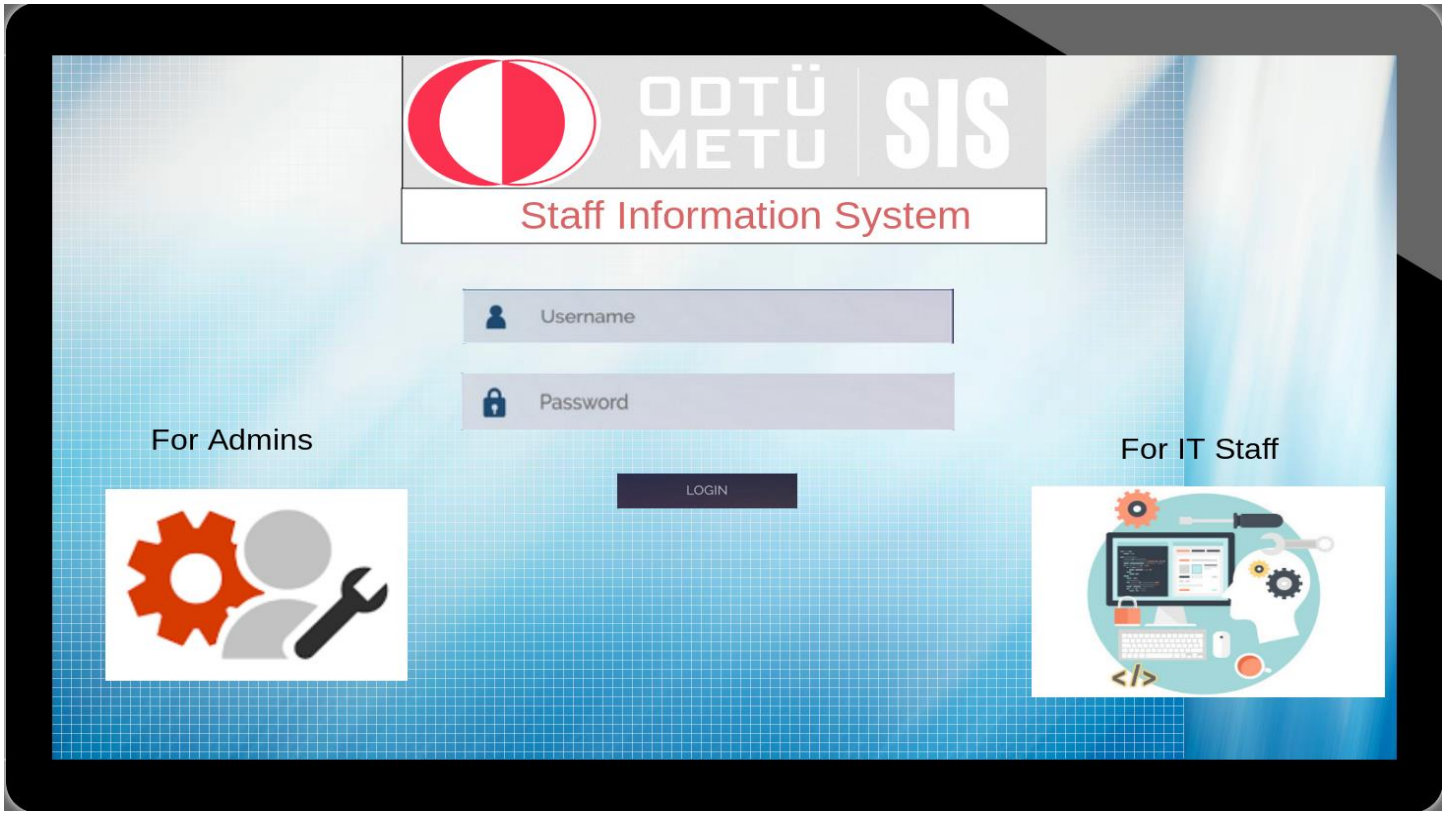

Figure 10: Login Page Interface of the Staff System

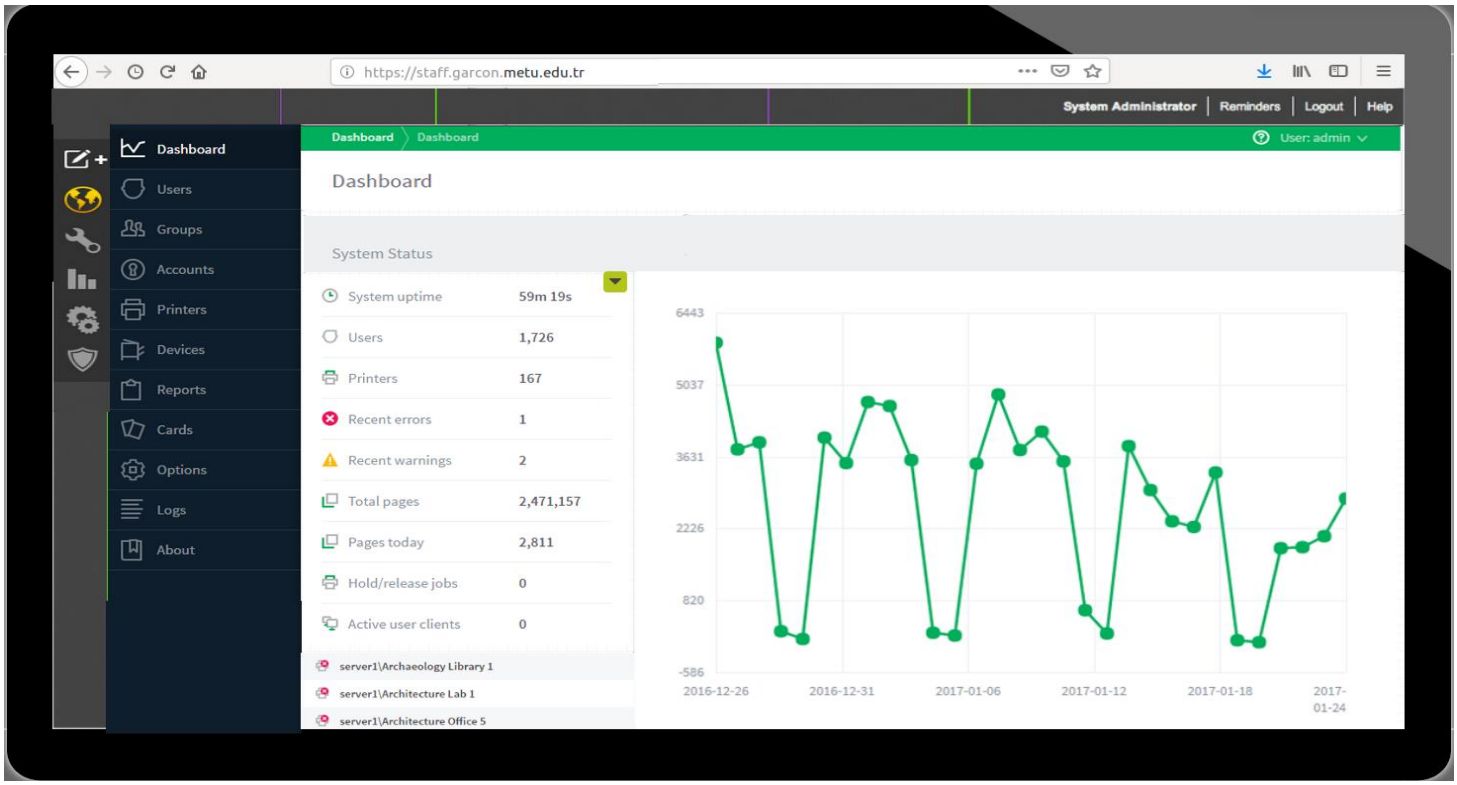

Figure 11: Main Page Interface of the Staff System

4.4.2.2. System Interfaces

The Interface between the Health Service and the Ticket Request Handler System:

Ticket Request Handler system is responsible for transmitting tickets. When an end user comes to the Garcon assistant and creates a ticket, this ticket will be handled by Ticket Request Handler component. This component should be connected to external systems, therefore it is in the Web Server. Ticket Request Handler is not only transmits the tickets to services according to ticket type, but it also responsible to take feedback of the ticket.
Health services are the most close healthcare providers of the Campus as well as medical service of the campus. If a health problem occurred, ticket request handler sends tickets to those medical service providers according to availability of those services and ambulances and doesn't stop until one of them response in a positive way.

Design Rationale:

- Predetermined healthcare providers are ordered in terms of their distance for the different regions of the campus so that called ambulance can reach in a very short time period.
- In case of error occurred, this error is immediately reported to all staffs since this type of tickets are so important.
- This ticket is saved in the database for further usage and analysis of the response in order to improve the system.

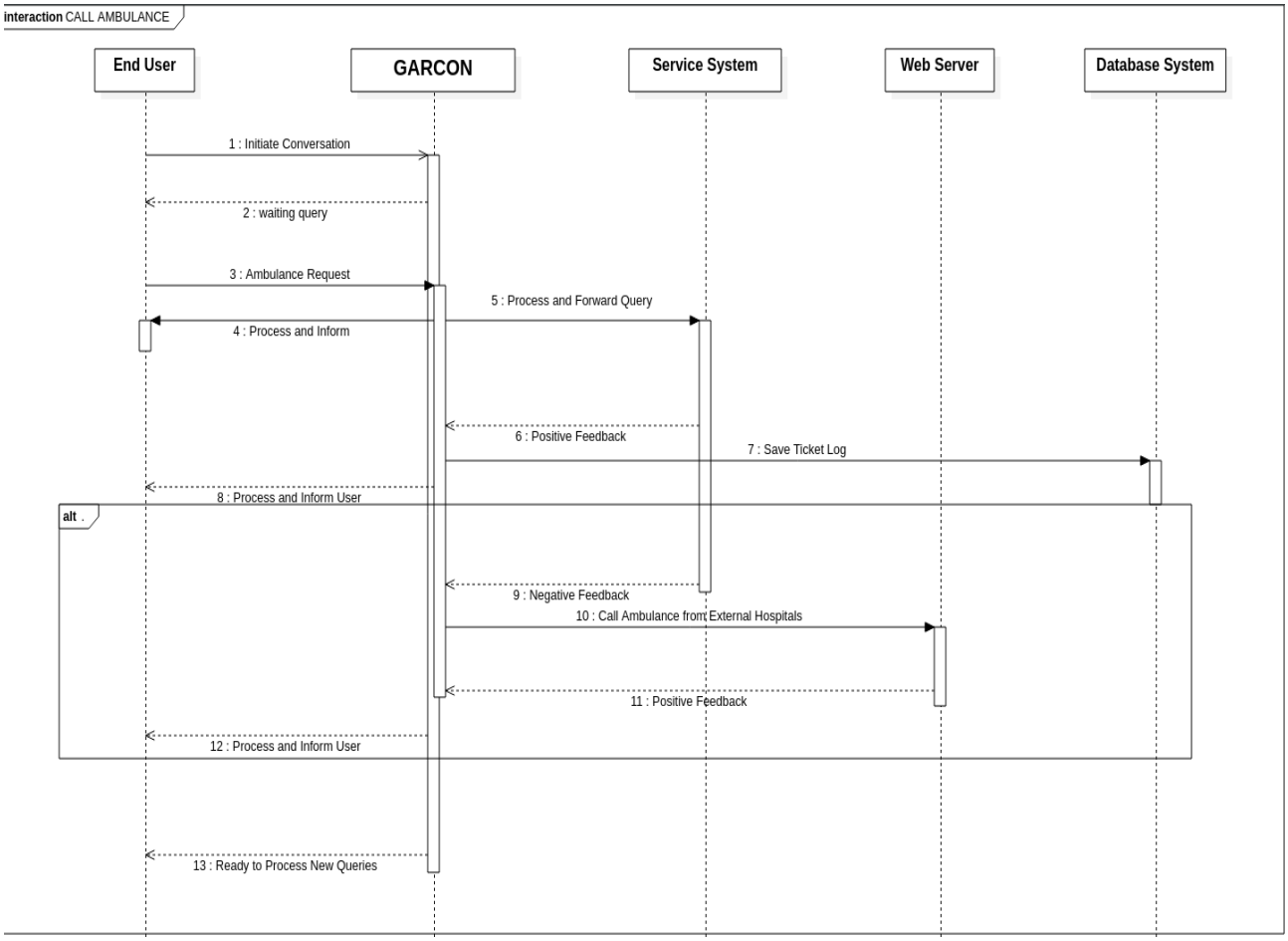

Figure 12: Call Ambulance Sequence Diagram showing the Interface between the Health Service and the Ticket Request Handler System

The Interface between the Natural Language Processor and the Web Server Controller:

Natural Language Processor is a subsystem that is responsible of taking voice queries from the user and transmitting it into machine code that other subsystems can understand. This subsystem is the first subsystem that interacts with the user. If response are needed, this subsystem is responsible of giving answers to the end user as well.

Design Rationale :

- Natural Language Processor is ready when there is no interaction with Garcon assistant.

- Other subsystems are awaken when Natural Language Processor are taking inputs from end user.

The Interface between the Security Service and the Ticket Request Handler System:

Ticket Request Handler system is responsible for transmitting tickets. When an end user comes to the Garcon assistant and creates a ticket, this ticket will be handled by Ticket Request Handler component. This component should be connected to external systems, therefore it is in the Web Server. Ticket Request Handler is not only transmits the tickets to services according to ticket type, but it also responsible to take feedback of the ticket.

Design Rationale:

- Garcon location is automatically sended to security service if no location info is given.
- In case of error occurred, this error is reported to admins.
- This ticket is saved in the database for further usage and analysis of the response in order to improve the system.