SOFTWARE REQUIREMENTS SPECIFICATION

Garcon

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1. Introduction

1.1 Purpose of the System

Inspired by Microsoft's Garcon project, the Garcon System in METU will make the lives of thousands of people easier and faster. As the population of METU increases every year, the university campus grows and the campus life gets more complicated. Even for students, professors, and university staff, it becomes harder to follow events, announcements, or any other news in the university. Garcon solves these issues and creates a network for infrastructural needs and sharing information among the university members. Garcon is not only a service for university members but also it is a general service for the public. METU campus has a very active scientific and cultural life and it hosts thousands of people every day on many occasions such as conferences, workshops, or art exhibitions. Garcon assists these people on the campus and provides all the necessary information they need. In overall, Garcon is designed to make campus life experience in METU easier, faster, and a lot more entertaining than before both for the university population and the public visitors.

1.2 Scope

The scope of this project is providing users to get information that they need about the METU Campus and to solve problems very quickly with combined systems it consists. Garcon creates an environment to take care of multiple needs of its user:

- Users can report infrastructural issues, request solutions, and the system will notify the corresponding METU unit regarding the issue.
- Users can ask for any necessary information about the campus and the system gives the exact information to them.

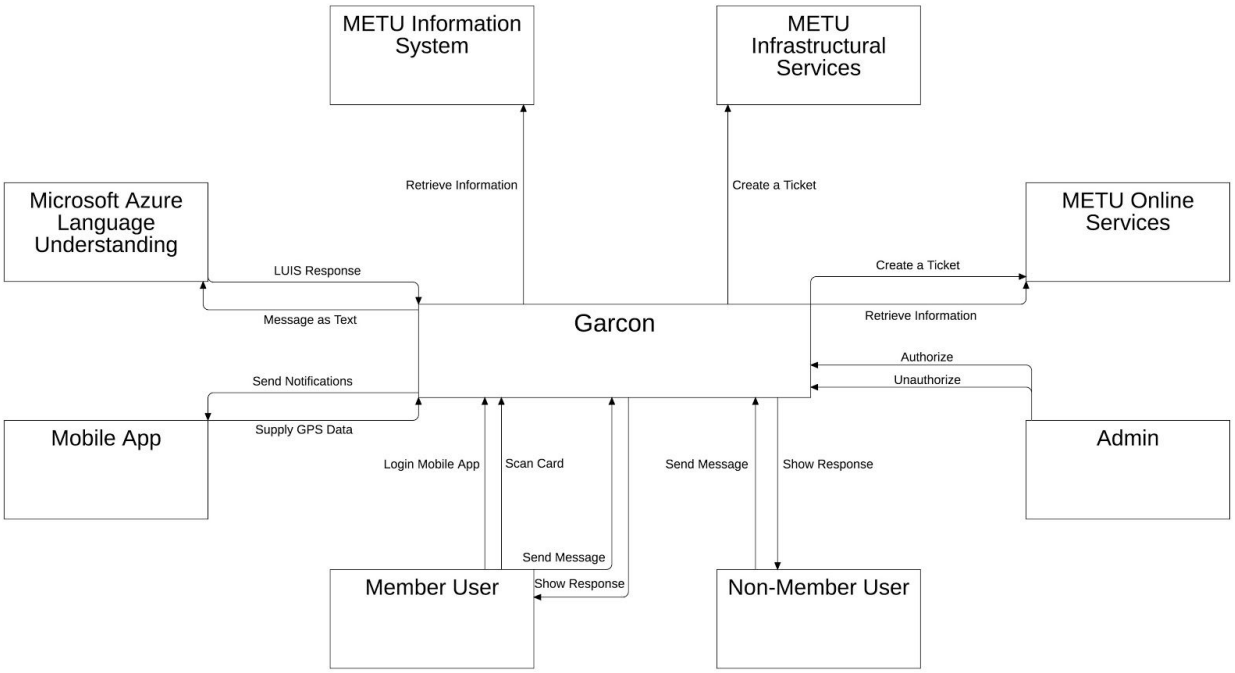
Moreover, Garcon System uses Microsoft Azure Language Understanding API to process user input in natural language and extract intention. By this software, users will be able to receive the information that they need as a response and by using the ticket system, problematic issues will be solved efficiently. Moreover, since Microsoft Azure Language Understanding is a machine learning model that recognizes natural language, provided that the user consent is taken, all of the data that flow through services such as queries, location information, appointments, reservations etc. will be used to train Microsoft Azure Language Understanding model in order to enhance the performance of the system. All in all, Garcon is a system designed to meet any need of university members and visitors.

1.3 System Overview

1.3.1 System Perspective

Garcon targets many needs of the user; hence, it interacts with lots of different user types, applications and databases. In particular, Microsoft Azure Language Understanding is the cloud service to process the given text based message and extract the intent of the message and the corresponding confidence score which are the subfields of JSON formatted LUIS Response. Below, we give a context diagram to summarize the system perspective in detail.

Figure 1: Context Diagram



1.3.2 System Functions

Garcon is a system with wide range of functionalities and applications. Below, we give a table for all of these system functions and describe their behaviour.

Table 1: System Functions

Functionality	**Description**
Scan Card	Member user logs in to system via Smart Box.
Login Mobile App	Member user logs in to mobile app.
Authentication	System admins give permission to member users.
Send Message	User gives input to Smart Box as a voice message in natural language or to mobile app as text message.
Show Event Calendar	User can retrieve the information of the event calendar of academic or social events of METU.
Show Announcements	User can retrieve the information of the announcements made by authorized departments of METU.
Show Course Status	User can retrieve the information of the availability of the course depending on departmental, surname or grade constraints.
Show Map	User can see the local map of METU Campus.
Show Nearest Ring Stop	System shows nearest ring stop by taking the user's location information.
Show Classroom Location	System shows the classroom location which is specified by the user.
Show Estimated Ring Arrival Time	User can retrieve the information of the specified ring's arrival time to the ring stop.
Show Classroom Availability	Member user can retrieve the information of the specified classroom.

Make an Appointment in Medico	If the doctor is available, member user can make an appointment with a doctor in Medico with the ticket created by the Garcon Server.
Reserve Classroom	If the classroom is available, member user can reserve that classroom with the ticket created by the Garcon Server.
Request Cleaning	Member user can request cleaning for a certain location on the campus with the ticket created by the Garcon Server.
Report Maintenance Problem	Member user can report any problem regarding the METU Campus and the Garcon System with the ticket created by the Garcon Server.
Create LUIS Response	System uses Microsoft Azure Language Understanding API to process the query and thereby creates LUIS response.
Send Notifications	System sends important announcements and events as notifications to user through mobile app.
Retrieve Current Location Using GPS	System retrieves the GPS location data of the member user that uses the mobile app.
User Authorization	System admins give privileged permissions to member users regarding their occupation such as professor, student or staff.
Disallow Users	System Admins can block users who do malicious activities.

1.3.3 User Characteristics

The target users of the Garcon System can be divided into three groups: non-member users, member users, and system admins. A non-member is a user who is not related to the university at all, i.e., neither student nor professor nor staff. Since a non-member user does not have a METU ID Card or a METU account, it shall be in the METU Campus physically in order to use the Garcon. A non-member user can only use a limited set of functions of the system. A member user is a user who is a member of the university, i.e., either student or professor or staff. A member user shall have a valid METU ID Card for the Smart Box authentication and valid METU Account for the mobile app authentication. A member user shall have a smartphone which has the adequate software version in order to use the mobile app effectively. System admins are computer engineers who are responsible for the whole system. They should be experts in their fields since they will maintain the system and analyze the problems. In addition to technical skills, they should be able to judge malicious activities in order to decide whether any user should be blocked. All of the target users are expected to know English in common since Garcon doesn't state that any other languages are offered or supported by the system.

1.3.4 Limitations

- **Regulatory Policies:** Since Garcon's server keeps the records of the activities and personal information of the users, any of the data should not be published to community.
- **Hardware Limitations:** Since Smart Boxes are electronic devices, as long as the electricity maintains that would be enough. For the mobile app, smartphone having battery is sufficient.
- **Interfaces to Other Applications:** Garcon system should be compatible with the Microsoft Azure Language Understanding system, METU Online Services, METU Infrastructural Services and METU Information System in order to maintain the continuity of the system.
- **Parallel Operation:** Since METU Campus has almost 30.000 people inside, the system must be capable of serving that much people who use Garcon daily.
- **Audit and Control Functions:** Controlling database functions are only available to system admins. Member and non-member users don't have an ability to control any operation which can disturb the system's integrity.

- **Higher-Order Language Requirements:** System should be written in multi-platform object-oriented programing languages such as Java to provide a compact design. For the Microsoft Language Understanding side Node.js and C# are used.
- **Signal Handshake Protocols:** Since our main system Garcon and cloud system Azure are Microsoft's products, Microsoft Windows NT protocol is used which includes four transport protocols: IPX/SPX (can be used to establish connections between Windows NT computers and MS-DOS, OS/2), TCP/IP (Transmission Control Protocol/Internet Protocol andis an industry-standard suite of protocols designed for wide-area networking.), NBF (NetBIOS Extended User Interface to connect LAN segments to mainframes by gateways) and DLC (provides applications with direct access to the data link layer) [2].
- **Quality Requirements:** Reliability and security are most important features of Garcon System. When a failure happens Garcon Server shall write the error to the Error Log table and the Error Log table shall be reset every week after weekly review by the system admins.
- **Criticality of Application:** Since Garcon system does not consist of life threatening and risky situations, as long as all fails in ticket system aren't lost, errors can be coped and be handled by the system admins.
- **Safety and Security Considerations:** System admins are responsible for the safety and security of the system. Private informations are kept in the server and admins can block other users from accessing these data.
- **Physical/Mental Considerations:** The devices that users interact are Smart Box and mobile phone. Therefore, anyone can talk and know english can use Smart Box not in a disruptive manner. However, the mobile app may consider physical/mental disability of users.

1.4 Definitions

For the sake of presentation, below, we give a table of definitions.

Table 2: Definitions

Term	**Definition**
Non-member User	Person who is not a registered METU Member
Member User	METU Students, academic personnel, METU Staff
System Admin	The experts who are responsible for maintenance of the system and analyzing the problems.
Microsoft Azure	Cloud Platform.
ID	Unique number to identify person.
Smart Box	IoT Device consists of embedded systems
METU Infrastructural Services	A service that receives tickets created by users.
METU Online Services	A multi-procedure service that includes Ring Service, Cafeteria Service, Medico Service and Classroom Scheduling Service.
Microsoft Azure Language Understanding	A machine learning-based service to process natural language and extract intention. It creates LUIS response.

2. References

This document is written with respect to IEEE 29148-2011 standard:
IEEE. (2011, December 1). 29148-2011 - ISO/IEC/IEEE International Standard Systems and software engineering -- Life cycle processes --Requirements engineering. Retrieved from http://ieeexplore.ieee.org/document/6146379/ on March 12, 2018. doi: 10.1109/IEEESTD.2011.6146379

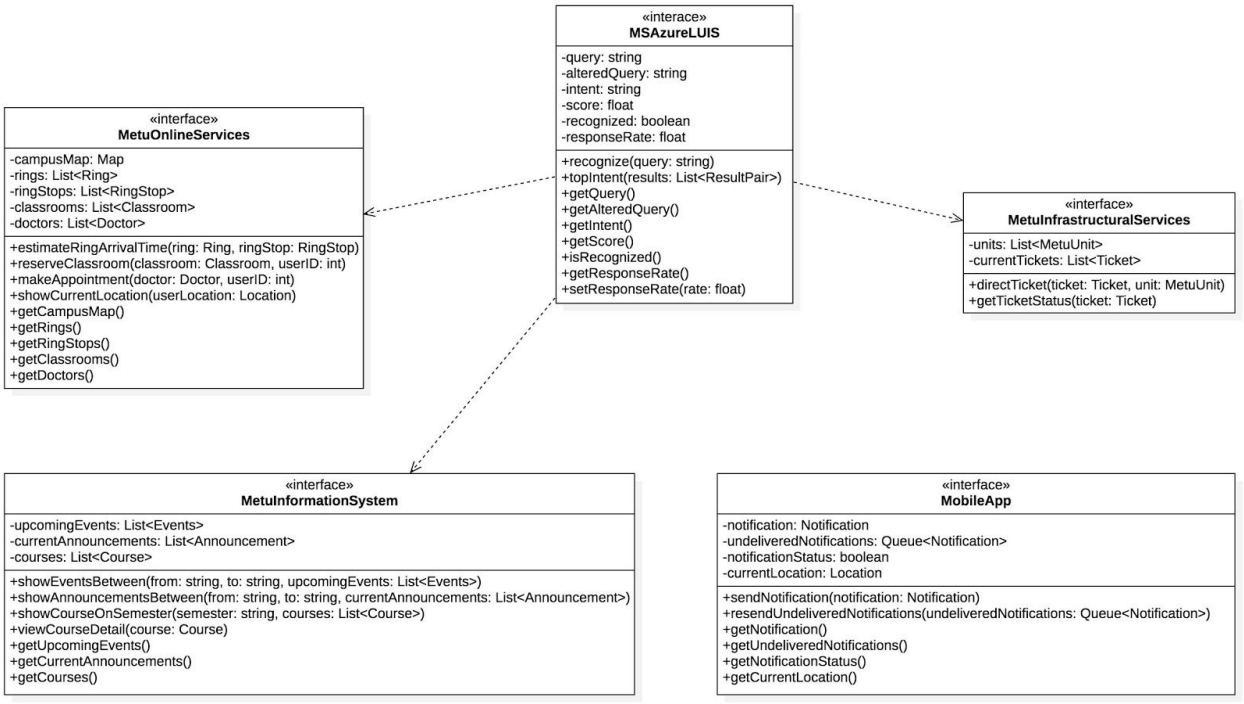
Other Sources:
[1] Language Understanding (LUIS) Documentation,
https://docs.microsoft.com/en-us/azure/cognitive-services/luis/
[2] Microsoft Windows Protocols,
https://docs.microsoft.com/tr-tr/openspecs/windows_protocols/

3. Specific Requirements

3.1 External Interfaces

In this section, a class diagram for external interfaces is given and each interface is explained in detailed as necessary.

Figure 2: External Interfaces Class Diagram



- **MSAzureLUIS Interface**

Microsoft Azure Language Understanding is the cloud service to process the given text based message and extract the intent of the message and the corresponding confidence score which are the subfields of JSON formatted LUIS Response. This interface interacts with the Microsoft Azure Language Understanding and returns LUIS Response to the Garcon Server. In Garcon Server, the ticket is send or the requested information is displayed according to the intent of the LUIS Response.

- **Metu Online Services**

This interface interacts with the METU Online Services to retrieve information such as campus map, ring services, medical services and classroom schedules. Garcon Server first sends the query to Microsoft Azure Language Understanding and processes the result. Then it calls this interface to retrieve information from these services.

- **Metu Infrastructural Services Interface**

This interface interacts with the METU Infrastructural Services to send ticket to related METU Unit such as cleaning staff, cafeteria staff, library staff, gym staff, repair staff etc. Garcon Server first sends the query to Microsoft Azure Language Understanding and processes the result. Then it calls this interface to direct ticket to the units.

- **Metu Information System Interface**

This interface interacts with the METU Information System to retrieve information about events in the campus, announcements and course details. Garcon Server first sends the query to Microsoft Azure Language Understanding and processes the result. Then it calls this interface to retrieve information from these services.

- **Mobile App Interface**

This interface interacts with the Mobile App to send notification and retrieve the current location of the user using the GPS data. Garcon Server uses this interface to send the notification to the mobile devices.

3.2 Functions

In this section, we give a use case diagram for the system. From this use case diagram, we present four description tables for selected system functions and for two of them we provide detailed sequence diagrams to analyze their operation procedures in depth.

Figure 3: Use Case Diagram

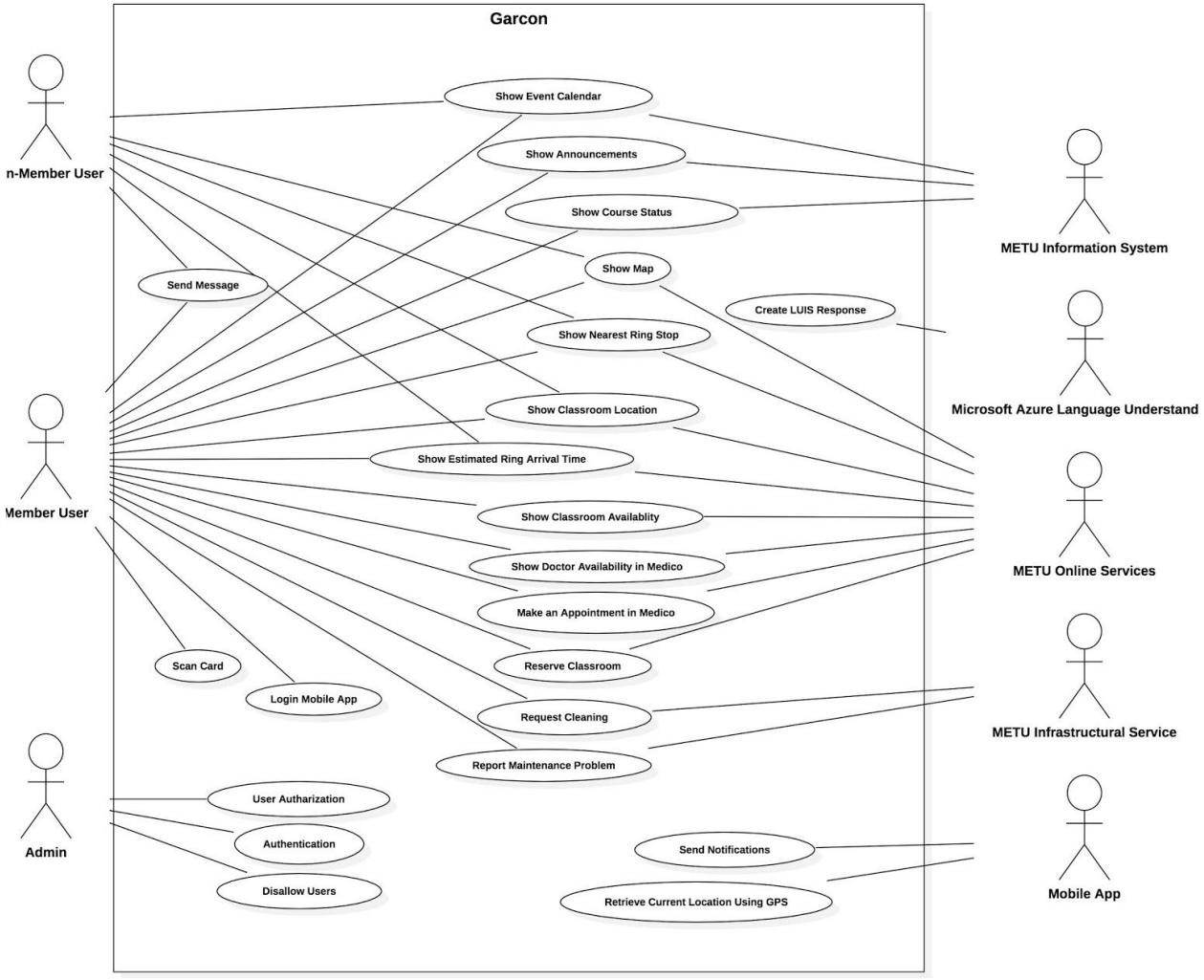


Table 3: Report Maintenance Problem

Use Case Name	Report Maintenance Problem
Actors	Member User, METU Infrastructural Service
Description	Member users can report any problem requiring maintenance such as a toilet is clogged or a bathroom sink is broken. A ticket is sent upon the users request to notify METU Infrastructural Service which is the responsible unit for handling these problems.
Data	Identity information of the user who reported the problem, location, time, and additional information about the problem.
Preconditions	The user must be authenticated by scanning its ID card or logging into the mobile app.
Stimulus	Reporting the problem via the smart boxes located all around the campus or via the mobile app.
Basic Flow	**Step 1-** User scans the ID card, to get authenticated. **Step 2-** User tells the problem in natural language. **Step 3-** Smart box turns speech into text. **Step 4-** Server sends it to Microsoft Azure Language Understanding. **Step 5-** Text is translated into LUIS[1] response in Azure. **Step 6-** Server processes the response and sends a ticket to the corresponding METU Infrastructural Services unit.
Alternative Flow #1	**Step 1-** User logs into mobile app, to get authenticated. **Step 2-** User sends the problem as a text message. **Step 3-** Server sends it to Microsoft Azure Language Understanding. **Step 4-** Text is translated into LUIS [1] response in Azure. **Step 5-** Server processes the response and sends a ticket to the corresponding METU Infrastructural Services unit.
Alternative Flow #2	**Step 1-** User tries to get authenticated by scanning an ID card or logging into the mobile app. **Step 2-** Unauthorized access request is detected. **Step 3**- Permission denied.
Exception Flow	If there is an internet problem to connect Azure server, the error is saved to the Error log file in the server.
Postconditions	Garcon displays and tells a message to inform the user.

Figure 4: Sequence Diagram of Report Maintenance Problem

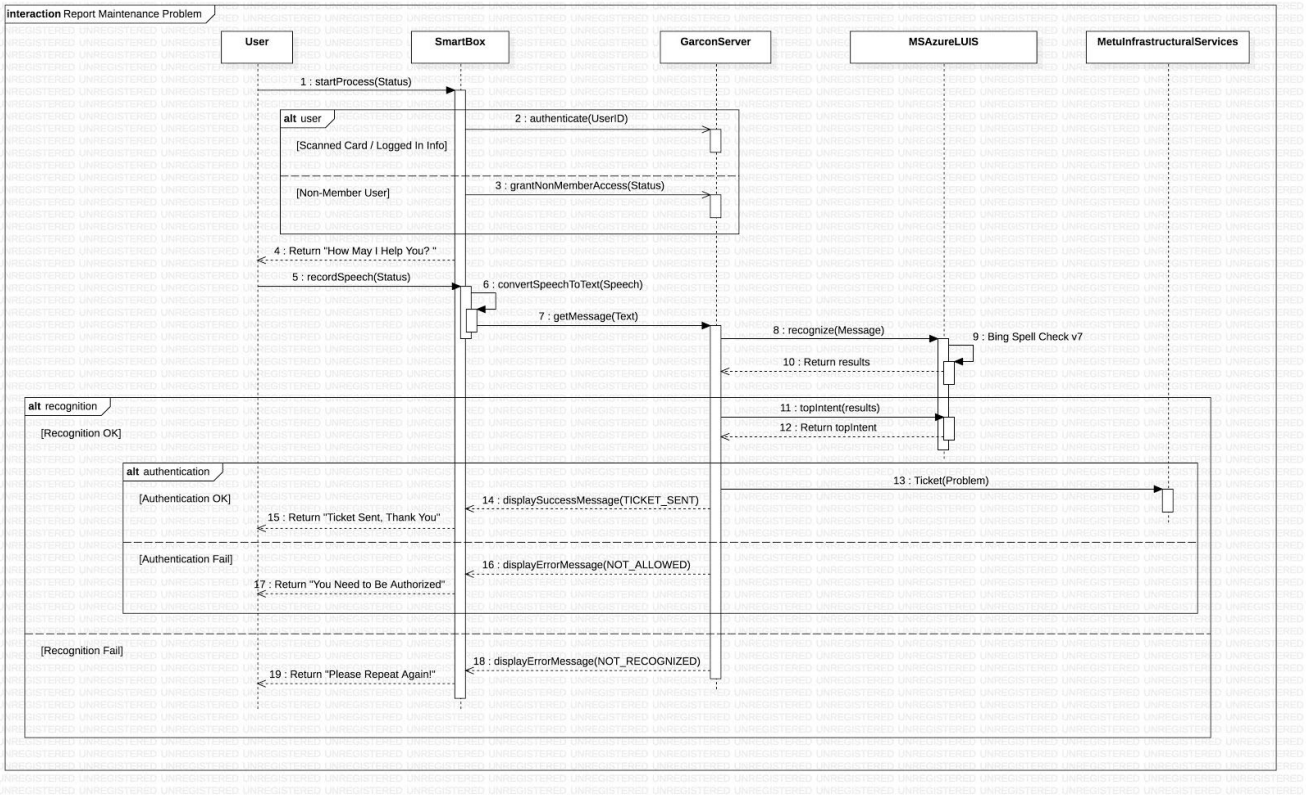


Table 4: Show Classroom Location

Use Case Name	Show Classroom Location
Actors	Member User, Non-Member User, METU Online Services
Description	Member and non-member users can check the exact locations of the classrooms in the campus. Garcon checks the location of the requested classroom from the METU Online Services (specifically, METU Maps) upon the users request and both displays and tells the exact location of the classroom.
Data	Name of the classroom.
Preconditions	A valid classroom name must be provided.
Stimulus	Asking for the location of a classroom via the boxes located all around the campus or via the mobile app.
Basic Flow	**Step 1-** User asks for a classroom location in natural language. **Step 2-** Smart box turns speech into text. **Step 3-** Server sends it to Microsoft Azure Language Understanding. **Step 4-** Text is translated into LUIS[1] response in Azure. **Step 5-** Server processes the response and checks the location of the specified classroom from the METU Online Services. **Step 6-** The location information of the classroom is given to the user as both speech and figure.
Alternative Flow #1	**Step 1-** User enters the classroom name via the mobile app. **Step 2-** Server checks the location of the specified classroom from the METU Online Services. **Step 3-** The location information of the classroom is given to the user as a figure.
Alternative Flow #2	**Step 1-** User enters asks for an invalid classroom name. **Step 2-** The error is reported back to the user as a figure.
Exception Flow	If there is an internet problem to connect Azure server, the error is saved to the Error log file in the server.
Postconditions	Garcon displays and tells an affirmative message to inform the user.

Figure 5: Sequence Diagram of Show Classroom Location

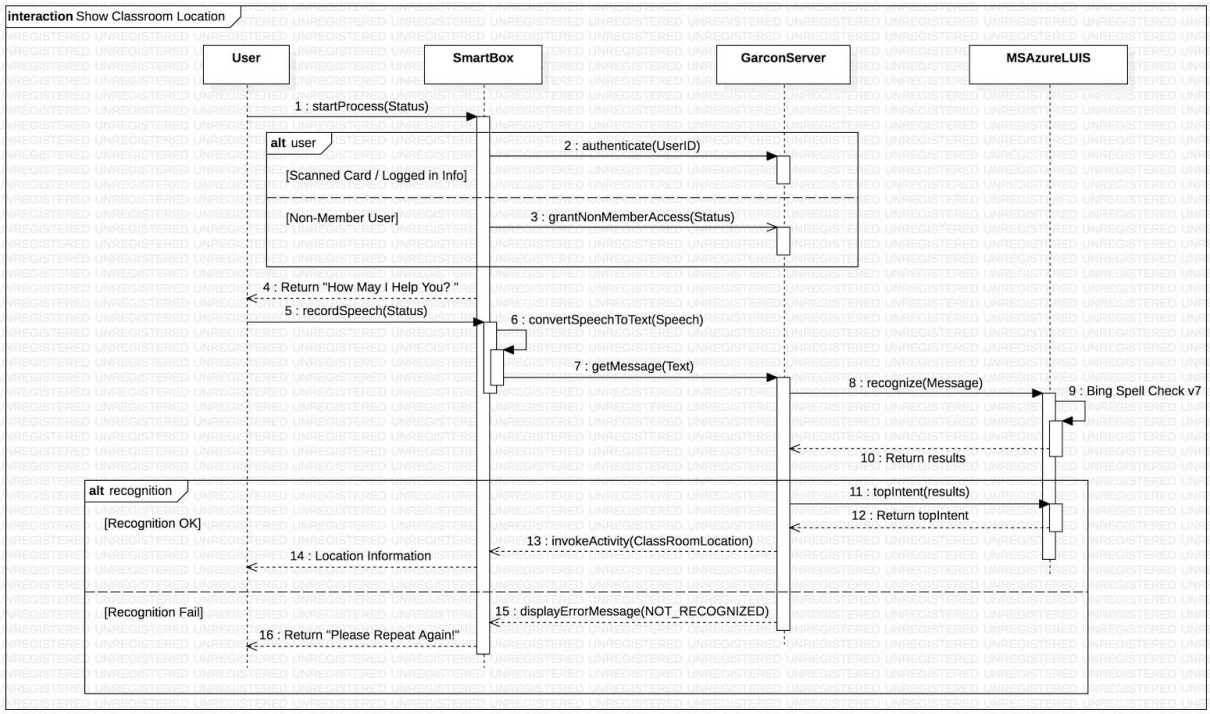


Table 5: Reserve Classroom

Use Case Name	Reserve Classroom
Actors	Member User, METU Online Services, METU Infrastructural Services
Description	Member users can check whether the classroom they want to use is available or not. If the classroom is available, a member user can reserve that classroom for a meeting or lecture by indicating date and time. Garcon creates a ticket upon the user's request and send it to the corresponding METU unit .
Data	Classroom status, date and classroom name.
Preconditions	Classroom must be available for desired time and the user must be authenticated by scanning its ID card or logging into the mobile app.
Stimulus	Asking for the reservation of the classroom via the boxes located all around the campus or via the mobile app.
Basic Flow	**Step 1-** User asks for reservation of the class in natural language. **Step 2-** Smart box turns speech into text. **Step 3-** Server sends it to Microsoft Azure Language Understanding. **Step 4-** Text is translated into LUIS[1] response in Azure. **Step 5-** Server processes the response **Step 6-** Checks if the specified classroom is available from METU Online Services "Show Classroom Availability" **Step 7-** A ticket has created and sent to the corresponding unit of METU Infrastructural Services to save the reservation.
Alternative Flow #1	**Step 1-** User asks for reservation of the class via mobile app. **Step 2-** Server checks if the specified classroom is available. **Step 3-** Server processes the response and send a ticket to the corresponding unit of METU Infrastructural Services to save the reservation.
Alternative Flow #2	**Step 1-** User asks for a unavailable classroom. **Step 2-** The error is reported back to the user as a figure.
Exception Flow	If there is an internet problem to connect mobile app or Azure server, the error is saved to the Error log file in the server.
Postconditions	Garcon displays and tells a message to inform the user.

Table 6: Show Estimated Arrival Time Of The Ring

Use Case Name	Show Estimated Arrival Time Of The Ring
Actors	Member User, Non-Member User, METU Online Services
Description	Member and non-member users can check arrival time of the ring in the campus. Garcon checks the location of the requested ring from the METU Online Services (specifically, METU Ring Service) upon the users request and both displays and tells the arrival time of the classroom.
Data	Arrival time of the ring.
Preconditions	A valid ring type must be provided.
Stimulus	Asking for the arrival time of the ring via the boxes located all around the campus or via the mobile app.
Basic Flow	**Step 1-** User asks for arrival time of the ring in natural language. **Step 2-** Smart box turns speech into text. **Step 3-** Server sends it to Microsoft Azure Language Understanding. **Step 4-** Text is translated into LUIS[1] response in Azure. **Step 5-** Server processes the response and checks arrival time of the specified ring from the METU Online Services. **Step 6-** The arrival time information of the ring is given to the user as both speech and figure.
Alternative Flow #1	**Step 1-** User chooses the ring type via the mobile app. **Step 2-** Server checks the arrival time of the specified ring from the METU Online Services. **Step 3-** The arrival time information of the ring is given to the user as a figure.
Alternative Flow #2	**Step 1-** User enters asks for an invalid ring type. **Step 2-** The error is reported back to the user as a figure.
Exception Flow	If there is an internet problem to connect Azure server, the error is saved to the Error log file in the server.
Postconditions	Garcon displays and tells an affirmative message to inform the user.

3.3 Usability Requirements

In this subsection, usability requirements are listed.

1. Smart boxes shall be triggered to start operating by the English phrase “Hey Garcon!” in order to access non-member user functions.
2. Smart boxes shall be further triggered to operate with member user privileges by scanning the METU ID Card.
3. Mobile app shall be only usable to member users by logging into the system with METU Account information.
4. Smart boxes shall receive the input in English as a voice message.
5. Smart boxes shall give the output both as speech in English and as related images displayed via the screen.
6. Mobile app shall receive the input in English as a text message.
7. Mobile app shall give the output both as text in English and as image displayed via the smartphone’s screen.
8. A user shall be able interact with the image output provided by the smart box using the touch screen.
9. A user shall be able interact with the image output provided by the mobile app.
10. A non-member shall be able to use the Garcon via smart boxes in the campus.
11. A non-member shall not be able to use the Garcon via the mobile app.
12. A member shall be able to use the Garcon via the smart box.
13. A member shall be able to use the Garcon via the mobile app.
14. A non-member user shall be able to use following functions of the system: show event calendar, show campus map, show nearest ring stop, show classroom location, show estimated ring arrival time.
15. A member user shall be able to use following functions of the system: show event calendar, show announcements, show course status, show campus map, show nearest ring stop, show classroom location, show estimated ring arrival time, show classroom availability, show doctor availability in Medico, make an appointment in Medico, reverse classroom, request cleaning, report maintenance problem.
16. A user shall be able to adjust the screen brightness and the volume of the smart box.

3.4 Performance Requirements

In this subsection, performance requirements are presented. For the sake of presentation, the requirement numbering from the previous subsection is continued.

17. The system shall be able to host more than one 50,000 users at the same time.
18. The smart boxes shall response to any audio input given within 800 ms.
19. The mobile app shall response to any textual input given within 1200 ms.
20. The smart boxes shall response to any touchscreen input within 400 ms.
21. The mobile app shall response to any touchscreen input within 600 ms.
22. A member user shall be able to log in the system by scanning his METU ID Card to the smart boxes within 200 ms.
23. A member user shall be able to log in the system by entering his METU Account Information to the mobile app within 300 ms.
24. Any minor change on the system made by admins shall be integrated with the whole system within a week.
25. Any major change on the system made by admins shall be integrated with the whole system within a month.
26. In the case of a power cut in the campus (which contains smart boxes, server, and all the other related METU services), emergency power unit shall start within 1000 ms.
27. In the case of a power cut, the smart boxes shall recover within 1000 ms after the emergency power unit has started to supply power to the campus.
28. In the case of a power cut, the smart boxes shall recover its unfinalized requests and response them within the timing requirements specified above after the emergency power unit has started to supply power to the campus.
29. In the case of a connection failure, the smart boxes shall inform the user about the situation in every 5 second as audio output and display a related image in its screen.
30. In the case of a connection failure, the smart boxes shall recover its unfinalized requests and response them within the timing requirements specified above as soon as the connection failure is solved.
31. In the case of a connection failure, the mobile app shall inform the user about the situation by displaying a related image in its screen.
32. In the case of a connection failure, the mobile app shall recover its unfinalized requests and response them within the timing requirements specified above as soon as the connection failure is solved.

3.5 Logical Database Requirements

In this subsection, logical database class diagram and logical database requirements are presented. For the sake of presentation, the requirement numbering from the previous subsections is continued.

33. Only system admins shall have the permission for accessing all of the tables.
34. Only system admins shall be able to modify tables externally.
35. System admins shall block a user for one month that have sent three redundant tickets in one week.
36. Every week, system admins shall review and handle errors reported to the Error Log table.
37. Any hardware, software, or infrastructural error shall be written to the Error Log table.
38. Only Garcon Server shall write to the Error Log table.
39. Error Log table shall be reset every week after weekly review of the system admins.
40. User table shall keep personal and contact information of the member users.
41. Only member users' information shall be stored in the User table.
42. ticketPermission attribute of the User table shall be used to identify whether a user is blocked by the system admins.
43. lastLoginDevice attribute of the User table shall be used to identify the deviceID of the last device that is used by the user, in other words, it is a foreign key referencing deviceID attribute of the Device table.
44. Each user shall have a unique userID, i.e., userID attribute is a primary key of the User table.
45. Each message shall be stored in the Message table.
46. Each message shall have a unique messageID, i.e., messageID attribute is a primary key of the Message table.
47. System admins shall train Microsoft Azure Language Understanding every six months using the information stored in the tables so that the system performance gets better as it is used.
48. Entire database shall be backed up once every day.
49. In the Message table, userID shall be a foreign key referencing the User table.
50. responseScore attribute of the Message table shall show the accuracy of the response given to the message by the system and it shall be given by the user.
51. LUISResponse table shall contain the detail information regarding the specific message obtained from the Microsoft Azure Language Understanding.

52. score attribute of the LUISResponse table shall indicates the recognition accuracy of the message and it is given by the Microsoft Azure Language Understanding.
53. intent attribute of the LUISResponse table shall be the meaning of the message that is retrieved by the Microsoft Azure Language Understanding.
54. query attribute of the LUISResponse table shall be the text message sent to the Microsoft Azure Language Understanding.
55. alteredQuery attribute of the LUISResponse table shall be the query after the spell check that is made by the Bing Spell Check v7 which is integrated to Microsoft Azure Language Understanding.
56. isRecognized attribute of the LUISResponce table shall indicate if the input text is recognized by the Microsoft Azure Language Understanding.
57. A message shall be either a ticket request or an information request.
58. issiuedUnit attribute of the Ticket table shall indicate which infrastructural unit is reported regarding the ticket.
59. status attribute of the Ticket table shall identify the current status of the ticket, i.e., whether it is being processed or it is done etc..
60. Priority attribute of the Ticket table shall indicate the priority of the ticket.
61. If a ticket has a higher priority, then it shall be taken care of prior to others.
62. Priority of a ticket shall be assigned by the Garcon server according to the intent of the LUIS Response.
63. status attribute of the Information table shall indicate the current status of the message, i.e., successful, unsuccessful, etc..
64. type attribute of the Information table shall identify the type of the information that is requested by the user, i.e., ring arrival time request, doctor availability request, etc..
65. Each device shall have a unique deviceID, i.e., deviceID is a primary key of the Device Table.
66. Type attribute of the Device table shall indicate the type of the device, i.e., either smart box of mobile.
67. Each smart box of the Garcon System shall be in the Smart Box table.
68. Each smart box shall have a unique smartBoxID in the Smart Box table, i.e., smartBoxID is a primary key of the Smart Box table.
69. Since Smart Boxes are embedded systems with fixed locations each smart box entry in the Smart Box table shall have a fixed location information.
70. Status attribute of the Smart Box table shall indicate the technical status of the corresponding smart box, i.e., broken, fixed, etc..
71. When a user logs in to the system from a mobile device for the first time, new device shall be added to the Mobile Device table.

72. Each mobile device that is used to log in to the system shall have a unique mobileDeviceID, i.e., mobileDeviceID is a primary key of the Mobile Device table.
73. requestLocation attribute of the Mobile Device table shall be the location of the mobile device when the message is sent to the system, this information is retrieved from the GPS of the mobile device and sent to the system along with the message.
74. Since multiple messages can be sent from a mobile device and the system needs the location information of each message, requestLocation attribute shall be a primary of the Mobile Device table.
75. User table is in one-to-many relationship with the Massage table since a user can send more than one message.
76. LUISResponse table is in aggregation relationship with the Message table, i.e., LUISResponse table is aggregated by the Message table.
77. Device table is in aggregation relationship with the Message table, i.e., Device table is aggregated by the Message table.
78. Ticket table is in ISA relationship with the Message table, i.e., Ticket “is a” Message.
79. Information table is in ISA relationship with the Message table, i.e., Information “is a” Message.
80. Smart Box table is in ISA relationship with the Device table, i.e., Smart Box “is a” Device.
81. Mobile Device table is in ISA relationship with the Device table, i.e., Mobile Device “is a” Device.
82. Device table is in one-to-many relationship with the Error Log table since multiple errors may occur in a device.
83. System Admin table does not participate in any relationship with other tables.

3.6 Design Constraints

All messages shall be stored for legal purposes and training Microsoft Azure Language Understanding for more accurate input recognition. Users shall be notified regarding these issues and be informed that their messages are stored for legal and technical reasons. However, a user may state that his input should not be used for the training purposes, then this input shall be stored only for legal purposes. The system shall follow all the regulations that is forced by the law. All user information shall be private and cannot be subject to any kind of trade.

3.7 Software System Attributes

- **Reliability:** Extensive testing shall be done before releasing the system. At the end of this extensive testing error probability of the system shall be at most 0.001. Whole database of the system shall be backed up every day between 03.00 am and 04.00 am. System admins shall review and handle errors weekly and ensure the reliability of the system. Any new feature to the system shall be tested extensively and shall be subject to the same error probability constraint, i.e., 0.001. New features shall be added to the system step-by-step, i.e., first it should be applied to a small subset of smart boxes in the campus, then it should be extended to a bigger subset, and finally it should be applied to the whole system including all smart boxes and the mobile app.
- **Availability:** For non-member users, the system shall be available via the smart boxes in the campus. For member users, the system shall be available via the smart boxes in the campus, moreover, they can access the system outside of the campus via the mobile app. Smart boxes shall always be available to users and in case of an error, they shall be replaced by the infrastructural stuff in at most 24 hours. Mobile app shall be available to member users as long as they have the adequate internet connection.
- **Privacy & Security:** All the user information shall be private and cannot be subject any kind of trade. In some occasions, user data shall be used for scientific research and training the Microsoft Azure Language Understanding system provided that the user is agreed upon. Only system admins shall have the permission for accessing the database and no other source shall have this permission. System admins shall use this permission only for maintenance of the system.
- **Maintainability:** Detailed documentation about the system **shall** be kept by the ones who maintain the system. The maintenance team shall consist of system

admins from diverse backgrounds and they should follow a strong professionalism as well as academic integrity. Documentation of the system shall allow easy integration of new features. Moreover, it should allow new system admins to join the maintenance team.

- **Portability:** Smart boxes are only available in the campus; however, their location shall be determined after detailed analysis about the user behaviour and their number shall be increased as needed. Mobile app shall be available in various mobile platforms, i.e., iOS, Android, and other popular mobile operating systems.

3.8 Supporting Information

Garcon System in METU Campus is an initial step towards a more ambitious goal for the future of university campuses as well as the cities. It is a visionary project and one of the first and most extensive instance of smart campuses. By its nature, it is open to improvements and promises lots of new features that can be integrated to the system in the later stages of the project. As a promising feature, since this project is an initial step to establish a connection between the system and the users using machine learning frameworks, Microsoft Azure Language Understanding model can be trained and improved for users need by the data that being kept in Azure Server. All in all, it provides an exceptional experience to the user and carries the campus life to its next level.