Software Requirements Specification

for

Autonomous Robot Service

Version 3.0 approved

Prepared by:

- Omar ElBarbary (2001205)
- Youssef Khaled (2000925)
- Momen Yasser (2001627)
- Mohamed Bassem (2003731)

Sbace_Bots

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Content

1.Introduction

1.1 purpose

The purpose of this project is to build a delivery robot software along with a smart phone application used by GIU users to send and receive packages across the campus to save their time.

1.2 scope

The Scope of the project is as follows:-

- To build a software for the robot through which a robot can navigate around campus
- To build a convenient and easy-to-use smartphone application for users to use the robot to send and receive packages
- The system is based on locations specified by the user (pick up / drop off).
- To provide a safe and secure delivery system around the GIU.

1.3 Definitions , acronyms and abbreviations

Definitions:

- Robot: autonomous robot that provides delivery.
- Margin error: in statistics, is the degree of *error* in results received from random sampling
- German International university: university in the new administrative capital of Egypt where this project is based

abbreviations:

- DB: database
- GIU: German International University
- SRS: software requirements specification
- OTP: one time password
- PIN: Personal Identification Number

1.4 Document Overview

The SRS is organized as follows:-

- Section 2 talk more about the purpose of the project by stating the problem and goals,these goals are then refined into the initial requirements in addition it outlines the world that the project will work in
- Section 3 states some of the problems that we might come across in the domain and requirements
- Section 4 states the improvements that can be done to make the requirements better with some assumptions about the world for it to run smoothly finally it tackles the specifications for how exactly will the system work
- Section 5 is Traceability matrix which contains briefings about each functional requirement its description,issue,improvement and specification

2. Preliminary definitions

2.1 problem

Students of the GIU often find themselves constantly moving around the campus and end up late for their lectures/tutorials. There are many reasons, some of which are: grabbing food, borrowing books from the library, printing documents, and many other reasons. In Addition, students are given only 15 minutes of gap between lectures/tutorials which makes it difficult for them to arrive on time, thus an automated system that helps deliver food,books and documents can help cut time of moving around campus.

2.2 Goal

The goal of the system is to aid users with their tasks by delivering whatever they want around campus by developing a mobile application where they can request a delivery robot to pick up and deliver items for them instead of having to go themselves. The sender shall add a pick up and drop off point and the robot shall calculate the optimal route and travel to the drop off using the built in camera and light sensors to detect any obstacles and avoid them.

2.3 Domain

The system is developed to be used in the GIU campus outdoor areas in case of an indoors order the sender can specify the building and the robot will deliver to the nearest entrance of the building where the receiver will pick it up. The campus has facilities such as ramps for the Robot to move around.

2.4 Stakeholders

- Users(sender/receiver): Anyone on the GIU campus who is registered on the mobile application (Students,Staff,TAs,Professors)
- Engineers:responsible for robot maintenance and help stuck robots
- Developers: responsible for fixing bugs and application update and of course system development
- Robot: Delivery robots responsible for making the delivery

2.5 Functional Requirements

Given the goals of the system the following requirements were made:

- FR1:The user should be able to login
- FR2: The user chooses pick up and drop off
- FR3: user should choose food or other
- FR4: Robot take the item from pickup
- FR5: Robot deliver the item to drop off location
- FR6: Robot would detect obstacles and walls
- FR7: Robot would avoid obstacles
- FR8: Robot would turn and stop when necessary
- FR9: Robot should only open when given the right pin
- FR10: If something goes wrong robot should notify the engineer
- FR11:User should be notified with the status of the order
- FR12: user should be able to create an order
- FR13:user should be able to pick a receiver
- FR14: receiver should be able to accept sending request

2.6 Non-functional Requirements

Non-functional requirements to make the system better:

- NFR1: The application shall be on all platforms(Android ,IOS,Windows…etc)
- NFR2: System should be expandable (more robots could be added)
- NFR3: System should help the robot to reach its destination
- NFR4: Packages should delivered in a good condition
- NFR5: The packages should be delivered quickly
- NFR6: The packages should be sent securely
- NFR7: Robots should be identifiable for the users

2.7 Use case diagram

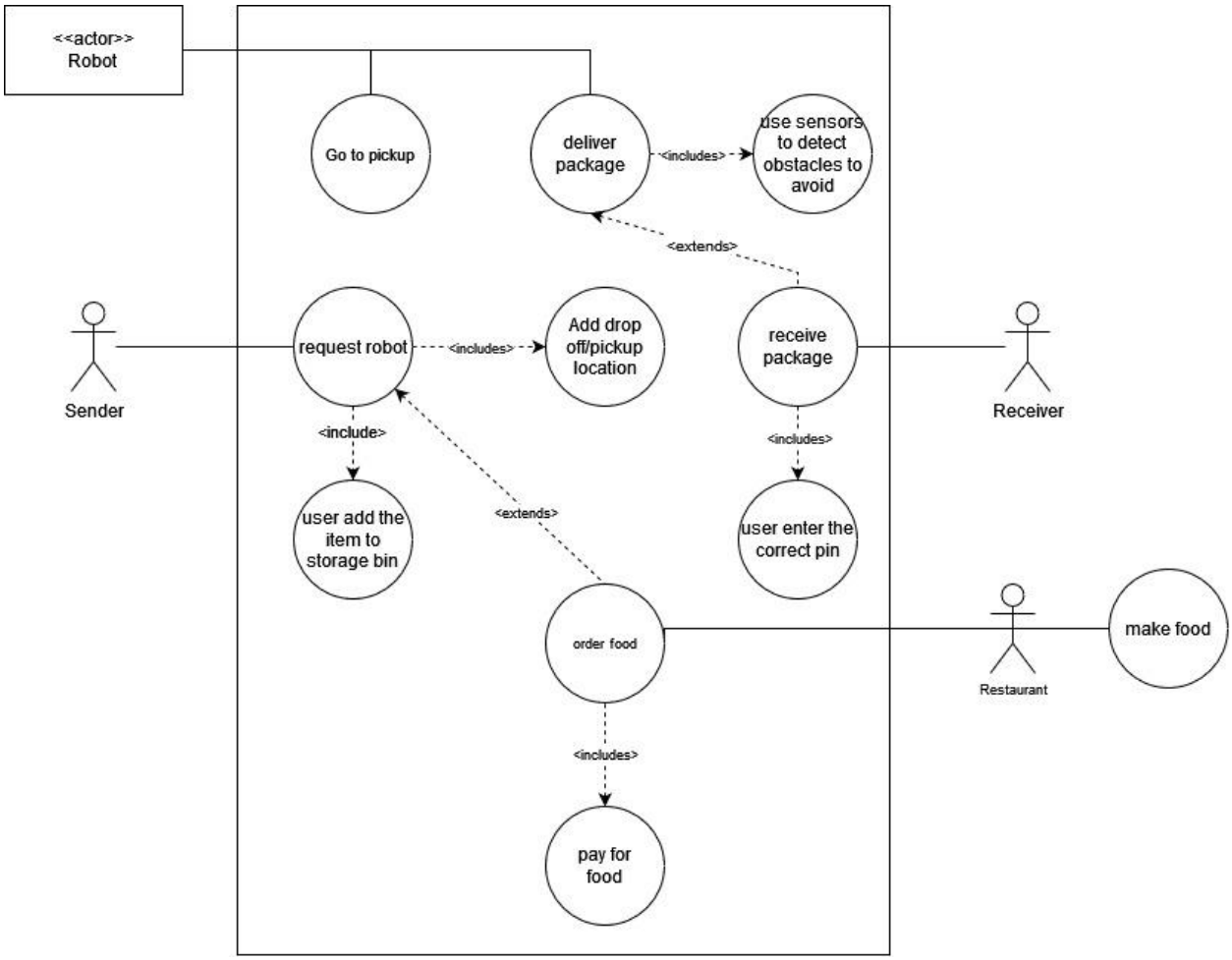

Fig1 : use case diagram

The following use case diagram is as follows:
Actors:

- The sender:
    - requests a robot for delivery to do so the user has to decide on a pickup and drop off also putting the item being delivered in the robot
    - the user can choose to order food which will then be sent to restaurant
    - Pay for the food in case of ordering food
- Receiver:
    - Receives the package delivered by the robot

- Restaurant:
    - Makes the food delivered by the bot
- Robot:
    - Picks up the package from sender/restaurant
    - Delivers the package to the receiver

2.8 Class diagram

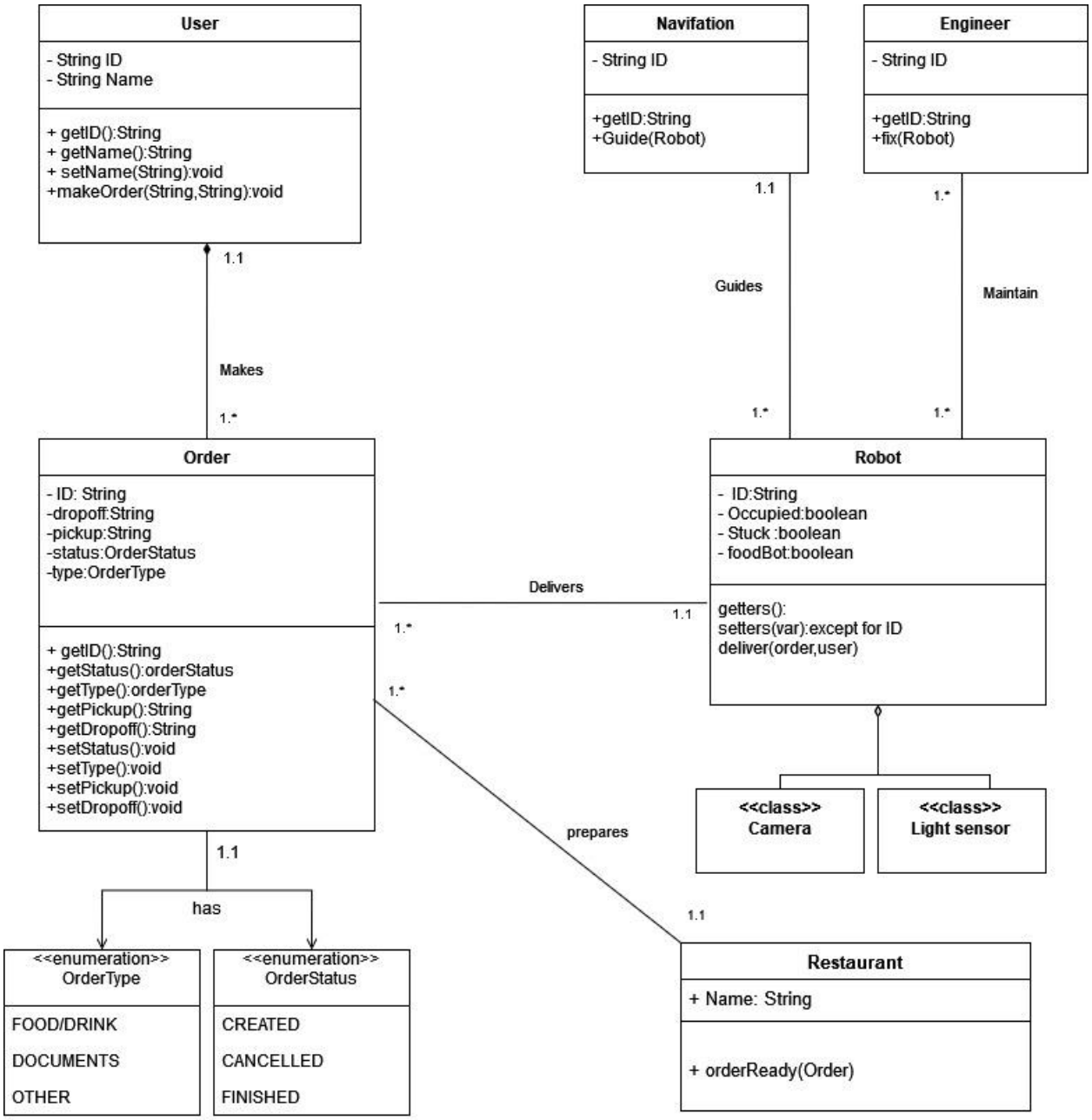

Fig2 : class diagram

3. Issues with Preliminary Definition

3.1 Domain

1. Given that the robot uses wheels the campus has places inaccessible to the robot as the robots are not designed to climb or go down stairs.
2. some students could have malicious intent that could hinder the robots activities.
3. The robot could run out of power
4. Receiver might not take the order

3.2 Functional requirements

FR1: 5. problems logging in as they are not registered
FR2: 6. user can provide wrong pickup/drop-off location (e.g. outside the campus)
FR3: 7. robot can pick up an item from the wrong person
FR6: 9. How could the robot avoid the obstacle?
FR8: 10. How is the pin given to the users
11.What if the user enters the wrong pin more than once?
FR9: 12.How does the robot know that something went wrong
FR10: 13. How should the user be notified when their order goes wrong?

3.3 Non Functional requirements

NFR3: 15.How can the system know the location of the robot?
16.What happens when the robot goes out of bound?
NFR4: 17.The residuals that might be left in the container could ruin the next one
(the previous order could be some oily food that ruin the documents)
NFR5: 18. What is the quickest way?

note:the numbers are the issue ID

4.Improved Understanding

4.1 World

Given the issues above there should be some worldly assumptions for the system to work as intended : -

- The campus should give facilities to help the robot travel around(ramps and lanes)
- All students and Staff will be registered on the system using the university's account (portal account)
- Students should be informed about robots and not hinder the way of the robot
- Senders know that closing the bin after opening means to start delivering
- Stations should be made in various places for charging,cleaning and maintenance
- There should be a sender and receiver in every case
- The sender and receiver should know about each other
- The sender should put the right pick up and drop off locations
- The sender should provide packages that fit the storage bin of the robot
- There are 2 types of robots 1 for documents and other for delivering food where the food robot is station near the food court prepared with cup holders and heat insulators for food and drinks

4.2 Requirements Specification

- SR1: System takes username and password then checks the if the user name exists in the DB if it exists the system sends an otp to the user if the user name does not exist an error message is sent to user with a register link
- SR2: Application screen asks the user if he wants to deliver food or deliver other packages
- SR3: when user chooses food the system displays on the screen a list of restaurants and user chooses a restaurant and a map where the drop off pin that he wants it delivered to
- SR4: in case of documents the system displays a map where the sender chooses pickup and drop off and chooses the receiver and a notification is sent to receiver
- SR5: When the receiver accepts the system sends an otp to both sender and receiver and an order is created
- SR6: The navigation system checks the pickup drop off and traffic of other robots then calculates the best possible route and gives it to the robot
- SR7: The Robot uses the camera ,light sensors and GPS to detect any obstacle in proximity to reach destination when a turn is due on map the robot turns
- SR8: When the Robot sees an obstacle a wider camera angle is taken to see if road is available left or right of obstacle then the robot takes the turn

- SR9: if the robot stays in place for more than 5 minutes it fires Stuck notification which is sent to the engineer through the application
- SR10: when the engineer receives the stuck notification the engineer then goes to help
- SR11: when the robot reaches pickup it sends notification to sender/restaurant
- SR12: when the sender enters the correct pin the storage bin opens up on closing the bin the robot starts to navigate to drop off
- SR13: When receiver enters the right pin number the bin opens when it is closed the order is marked as complete and robot returns to assigned station
- SR14: When the robot reaches the drop off a notification is sent to the receiver
- SR15: if wrong pin is entered a beep sound is sent
- SR16: if the receiver enters the wrong pin 3 times in a row the robot shall lock with a notification sent to all of sender ,receiver and engineer and the robot will head back to the nearest station
- SR17: When camera and sensors sees an object an event is triggered in robot that an obstacle is in the way
- SR18: When the gps of the robot aligns with pickup/dropoff pin it stops
- SR19: When user chooses a place out of bounds error message appears
- SR20: Robot emits its location to the system in heartbeat method
- SR21: When the delivery is done the robot returns to its station
- SR22: if users chooses a place out of bound an error message shall be sent
- SR23: a notification is sent to receiver with accept and reject options
- SR24: when receiver rejects a message is sent to user

4.3 Improved Functional Requirements

- IFR1:Only registered users should be able to login
- IFR2: unregistered Users should be able to register easily
- IFR3: User should be able to choose to order food or package delivery
- IFR4:The user should be able to provide pick up and drop off locations
- IFR5:System should prevent user from choosing out of zone areas
- IFR6: System should verify both sender and receiver
- IFR7: robot Should go to pick up
- IFR8: Robot take the item from the verified sender at pickup
- IFR9: The system should assign the right robots to the proper order
- IFR10: Robot deliver the item to drop off location
- IFR11: Robot would detect obstacles and walls
- IFR12: If the robot cannot avoid an obstacle it stops
- IFR13: Robot would turn when necessary
- IFR14: Robot should only open when given the right pin
- IFR15: Robot should detect that something is wrong
- IFR16: If something goes wrong robot should notify the engineer
- IFR17: Users should be notified with the status of the order
- IFR18: pin should be provided to users
- IFR19: User should know that he entered wrong PIN
- IFR20: user should be able to create an order

- IFR21:user should be able to pick a receiver
- IFR22: receiver should be able to accept sending request

4.4 Improved Non-Functional requirements

- INFR1: The application shall be on all platforms(Android ,IOS,Windows…etc)
- INFR2: System should be expandable (more robots could be added)
- INFR3: Robots should be identifiable for the users
- INFR4: System should help the robot to reach its destination
- INFR5: Packages should safely delivered in a good condition
- INFR6: Stations should be spread in campus for higher coverage
- INFR7: The packages should be delivered quickly
- INFR8: System should detect the optimal route for the robot to take with estimated time
- INFR9: Robots should be maintained regularly
- INFR10:System knows of the location of robot at all time
- INFR11: packages should be secure

5. Backward/Forward Traceability

FR ID	Requirement description	Issue ID	Issue description	Improved requirement ID	Improved Requirement description	requirement specification ID	Specification description
FR 1	User Login	5	User not registered	IFR 1	Only registered users should log in	SR 1	System takes username and password and checks if it exists if not register message appears
				IFR2	Unregistered users can apply to register		
FR3	User choose food or other	-	-	IFR3	Choose restaurant or package	SR2	Application displays a screen asking the user to choose from restaurant or other
				IFR10	System assigns the right robot to right order		
FR 2	User should be able to choose pick up and drop off	6	Wrong location can be provided	IFR4	User able to put pick up and drop off pins	SR 3	list of restaurants is displayed along with a map for drop off
				IFR5	System should prevent user from putting wrong locations	SR4	Map for pick up and drop off
						SR19	error when location out of bounds

FR4	Robot take item from pickup	7	Robot can pick up from wrong user	IFR6	System should verify sender and receiver	SR5	System sends otp to both sender and recevier
				IFR8	Robot should pick up from verified user	SR6	navigation system calculates best route
				IFR7	Robot should go to pick up	SR11	Notification sent to sender
						SR12	bin open when right pin is written
FR5	robot should deliver item to drop off	-	-	IFR10	Robot shall deliver package to drop off	SR6	navigation system calculates best route
						SR14	Notification sent to receiver
						SR13	Right pin opens the bin to receiver
FR6	Robot would detect walls and obstacles	-	-	IFR11	Robot would detect walls and obstacles	SR7	Robot uses camera ,sensors and GPS to reach destination
						SR17	When the camera or sensor reads an object message is sent to robot
FR7	Robot avoid obstacles	9	which obstacles are avoidable	IFR12	Robot would stop if it cannot avoid	SR8	When an obstacle appears the camera checks for a way around it
FR8	Robot should turn when necessary	-	-	IFR13	Robot should stop when necessary	SR19	when the robot gps aligns with the pin it should stop
FR9	Robot should open on right pin	10	How does the user know the pin	IFR18	Pin provided to user	SR5	System sends otp to both sender and receiver
		11	If the user enters the wrong pin	IFR14	Robot should open on right pin	SR11	System sends otp to both sender and receiver
				IFR19	User should know if wrong pin is entered	SR15	Notify that wrong pin is entered
FR10	If something goes wrong	12	How does the robot	IFR16	Robot notify engineer	SR16	wrong pin 3 times is a problem

	notify engineer		know that something is wrong	IFR15	Robot should detect problems	SR9	robot is in place for more than 5 mins a problem
						SR10	When engineer receives problem notification he goes to location
FR11	user notified with order status	-	-	IFR17	user notified with order status	SR14	on each update on order a notification is sent on app
FR12	user should be able to create an order	-	-	IFR20	user should be able to create an order	SR2	Applications asks the user type of order he wants
FR13	user should be able to pick a receiver	-	-	IFR21	user should be able to pick a receiver	SR4	Sender chooses the receiver along with drop off
FR14	receiver should be able to accept sending request	-	-	IFR22	receiver should be able to accept or reject request	SR23	receiver gets a message of delivery request with the option to decline
						SR24	if receiver rejects notification is sent to sender
NFR1	The application shall be on all platforms	-		INFR1	The application shall be on all platforms	-	-
NFR2	system is expandable	-		INFR2	system is expandable	-	-
NFR3	System should help the robot to reach its destination	15	How can the system know the location of the robot?	INFR4	System should help the robot to reach its destination	SR	Robot emits its location while moving
		16	What happens when the robot goes out of bound?	INFR10	System knows of the location of robot at all time		

NFR4	Packages should delivered in a good condition	17	The residuals that might be left in the container could ruin the next one	INFR5	Packages should delivered in a good condition	SR	After delivery robot goes back to station
				INFR9	Robot is maintained		
NFR5	The packages should be delivered quickly	18	How can the robot know the quickest route	INFR7	The packages should be delivered quickly	SR6	When request is received the system checks which route is less congested and closest station to it
				INFR8	System should detect the optimal route for the robot to take		
				INFR6	Stations should be spread in campus for higher coverage		
NFR6	The packages should be sent securely	-	-	INFR11	The packages should be sent securely	SR11	bin open when right pin is written
NFR7	Robots should be identifiable for the users	-	-	INFR3	Robot should be identifiable by users		