CS615 Project Step 2 Report
- User, Task, Domain Analysis of Parking app at UMB -

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Introduction

In this report, we will study the potential users, break them down into high-level tasks, and entities and relationships of our proposed parking management system at UMB. This will enable us to know the user, task, and domain analysis aspects, and can understand better potential users and appropriately cover the current problem.

Analysis

- **User Analysis: students, faculty members, and parking manager**
  - Student parkers
    - General information:
      The primary users of the parking management system are students, who prevail on campus. We will call students "Student parkers". Student parkers can be divided as either undergraduate or graduate and as either full-time or part-time. In terms of Hierarchical Task Analysis (HTA), only the status between full-time and part-time will differentiate them.

    - Demographics and patterns:
      We'll analyze key demographic characteristics, such as gender, education, and physical location, to gain a better understanding of our potential users. The age range for students is typically between **18 and 40**, with the majority falling between 19 and 24, followed by those aged 25 to 32. There are no gender restrictions, with **both male and female** students. Most have **completed high school**, and some **have a Master's degree**. Most student parkers **live in Massachusetts and commute by car** unless they are online students. We will not count online students since they are not likely to be a user of the parking management system.
      In terms of computer experience, student parkers possess **decent proficiency in computer knowledge**, with over half of the population having more than eight years of experience with smart devices. This proficiency is largely due to the fact that they belong to the Millennial and Gen Z generations, who are comfortable with computers and smart devices from an early age. We expect the users to use the app regularly in **a real-time manner**. Thus, the relationship between our app and student parkers will be **heavily related**.

- ■ Motivation and Interest:
  Student parkers spend more than a couple of minutes searching for a parking space. They roam around each floor of the parking lot, preferring to park as low as possible if there are multiple floors and choosing the closest parking lot to their class. However, the current parking facilities at UMass Boston lack real-time parking availability and monitoring systems for parking information. As a result, students have no choice but to roam around every time they visit the lot.

  Supporting a real-time parking space monitoring feature would greatly motivate student parkers to use the app regularly. Additionally, student parkers tend to have less parking experience compared to other parkers on campus. This suggests that students may prefer parking in spacious areas rather than crowded spaces. The real-time information would help them easily locate their preferred parking spots and attract them to use the app.

  Moreover, there are several compelling motivations to use the app. It will provide support for NFC tagging instead of physical cards, eliminating the need to visit the parking office in person for lost or damaged cards. Furthermore, we will provide a statistics chart displaying the parking patterns of all user types. This will help them analyze their parking patterns and choose the best parking pass options available.

- ○ Faculty members
  - ■ General information:
    Faculty members account for a smaller portion of parkers compared to student parkers. However, some faculty members have reserved parking spaces, which sets them apart from student parkers. Faculty members who use parking facilities can be categorized into full-time and part-time faculty members, similar to student parkers.

  - ■ Demographics and patterns:
    Since most faculty members have **at least a Ph.D. degree**, which takes longer to obtain than a high school diploma or Master's degree, they are generally older than student parkers. The age range for faculty members is typically **between 30 and 80, but not limited to this range**. In terms of computer experience, faculty members have likely experienced the early stages of smart device distribution and the rapid proliferation throughout their careers. Therefore, **they have a longer smart device experience compared to other user groups**. This nature will motivate their use of the parking management app without requiring significant adaptation as the student parker group is. The difference from them would be that faculty members visit the campus on an irregular basis due to varying research routines, so their use of parking facilities may also be irregular.

- ■ Motivation and interest:
  Faculty members, like student parkers, use the same parking facilities and exhibit similar behavior by searching for nearby parking spaces in the parking lot. However, there is a difference: faculty members typically have more parking experience and some may have reserved spots. This difference may distract some of them from using the parking app. Nevertheless, since most faculty members do not have reserved spots and still desire real-time parking information, the parking app will also appeal to them.

  - ○ Parking manager
    - ■ General information:
      Parking managers are those who manage the on-site parking facilities. Their main duties include monitoring parking facilities, addressing customer issues, providing services, overseeing event parking, etc. Parking managers are still a good example of our parking management system in that their tasks can greatly benefit from real-time information from our app. Additionally, the app will occasionally make room for them to work remotely.

    - ■ Demographics and patterns:
      Their age, level of education, and computer experience will vary greatly. **The age range can span from early 20s to 80s**, as there are no age restrictions for working as a parking manager. The level of education will mostly range from **high school diploma holders to bachelor's degree holders**. Additionally, **they will generally have a fair amount of computer experience, including familiarity with smart devices, for at least 4 years**. Since most current job markets require at least a couple of computer skills, they are generally open to using various web environments such as smartphones, desktops, or tablets.

    - ■ Motivation and interest:
      Managing parking facilities involves various tasks. In addition to regularly checking parking spaces, parking managers must also monitor malfunctioning equipment, address issues like accidents, vandalism, or unfavorable events, and support sports events parking. Therefore, there is a strong motivation for them to start using a real-time parking app. Furthermore, as their primary work location is typically on-site, adopting the parking app and its state-of-the-art technology may enable some managers to transition to remote working, which would serve as an additional source of motivation.

Overall, we present the personas we have identified as below:

Students at UMass Boston

- Either undergraduate or graduate student at UMass Boston
- Full-time / Part-time student

Age: **18-40**
Gender: **Male/Female**
Education: **From high school graduate to Master's degree holder**
Use cases: **Commute to campus**

Age distribution

0 - 18 years old

19 - 24 years old

25 - 32 years old

Over 32 years old

Education

High school diplomat

Bachelor's degree holder

Master's degree holder

Ph.D. degree holder

Fast learner   **Real-time**   **Young drivers**

General Process per semester

- Purchase a parking pass
- Wait for an email for the parking pass to be active
- Present student ID card at the parking facility every day
- Roam around the parking facility on every floor
- Wait and take the elevator

Motivation

- Good at mobile environment
- They spend at least 15 minutes at the parking facility to find a parking spot
- They usually need to rush into the class when parking
- They prefer to park near his classroom
- Most of them have less than 4 years of experience in parking, so they prefer parking spaces that are not crowded around
- They want to see easily if their parking passes are active or being charged correctly
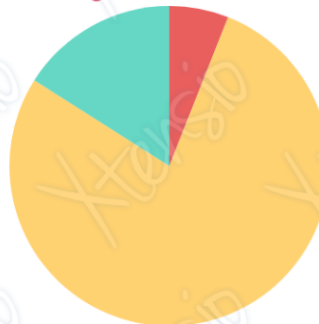- They want to pay less analyzing their parking behavior

Parking time breakdown

- 6% Tapping parking pass
- 78% Locating parking spot
- 16% Head out the garage

Parking experience

- 80% 0 - 4 years
- 18% 5 - 7 years
- 2% Over 7 years

Smartphone experience

- 13% 0 - 3 years
- 25% 4 - 8 years
- 40% 9 - 12 years
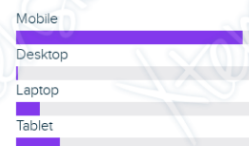- 22% More than 12 years

Time spent on parking

- 58% 0 - 20 mins
- 36% 16 - 30
- 6% Over 30 mins

Preferred communication

Mobile

Desktop

Laptop

Tablet

Faculty at UMass Boston

General Process per semester

- Purchase a parking pass
- Wait for an email for the parking pass to be active
- Present faculty ID card at the parking facility every day
- Roam around the parking facility on every floor
- Wait and take the elevator

- *Commute to campus for teaching, researching, and advising purposes*
- *Irregular visits to campus*
- *Full-time / Part-time faculty*

Age: **30-80**
Gender: **Male/Female**
Education: **Ph.D. degree**
Use cases: **Commute to campus**
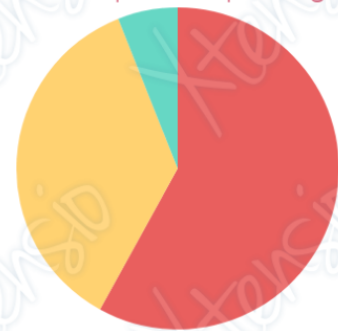
Motivation

- Since they visit campus on an irregular basis, their time to find a parking spot depends on the campus's crowdedness
- They sometimes need to rush into the class they are teaching
- They prefer to park near his lecturing classroom or lab
- They have a fair amount of parking experience compared with students
- They want to see easily if their parking passes are active or being charged correctly
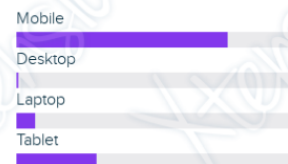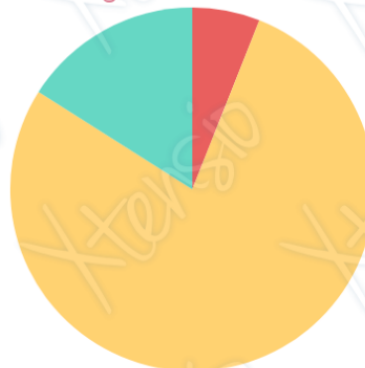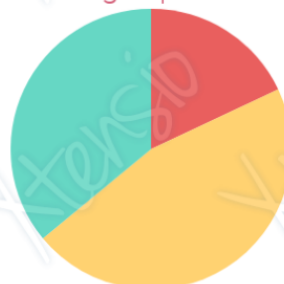
Smartphone experience
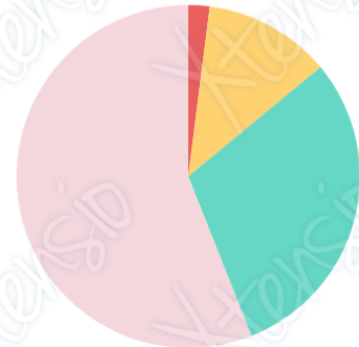
- 2% 0 - 3 years
- 12% 4 - 8 years
- 30% 9 - 12 years
- 56% More than 12 years

Parking time breakdown

- 6% Tapping parking pass
- 78% Locating parking spot
- 16% Head out the garage

Time spent on parking

- 58% 0 - 20 mins
- 36% 16 - 30 mins
- 6% Over 30 mins

Age distribution

0 - 18 years old

19 - 24 years old

25 - 32 years old

Over 32 years old

Education

High school diplomat

Bachelor's degree holder

Master's degree holder

Ph.D. degree holder

Preferred communication

Mobile

Desktop

Laptop

Tablet

Parking experience

- 18% 0 - 4 years
- 46% 5 - 7 years
- 36% Over 7 years

Parking Manager at UMass Boston

Keep facility safe and stable | Multitasker

Work 24/365 | Customer service

General Work Process
- Manage a parking pass (send email, change status)
- Monitor parking facility availability
- Generate tickets for parking violators
- Manage reserved parking spots
- Watch parkers appropriately entering/exiting the entrance
- Roam around the parking facility for violators, space availability, and any incidents monitoring
- Deal with customer issues such as questions, facility malfunctioning, and any events

Motivation
- They need to monitor parking space availability every day
- Parking spaces are limited in rush hours
- Deal with violators such as parking at reserved spots, parking next to a fire hydrant, or any against rules
- Answer parking issues or question regular basis

- Work on campus for parking facility management
- Monitors parking facility
- Customer service
- Handles parking issues

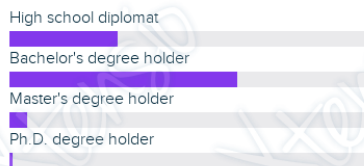Age: **20-80**
Gender: **Male/Female**
Education: **High school deplomat, Bachelor's degree holder**
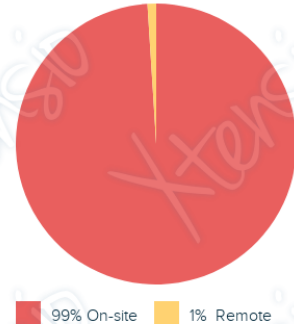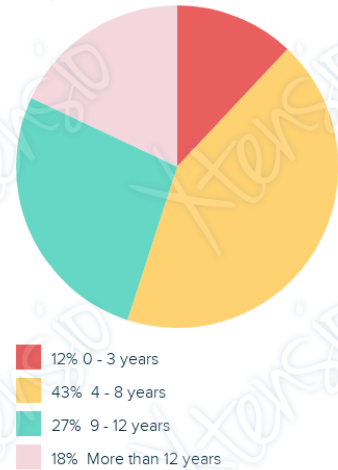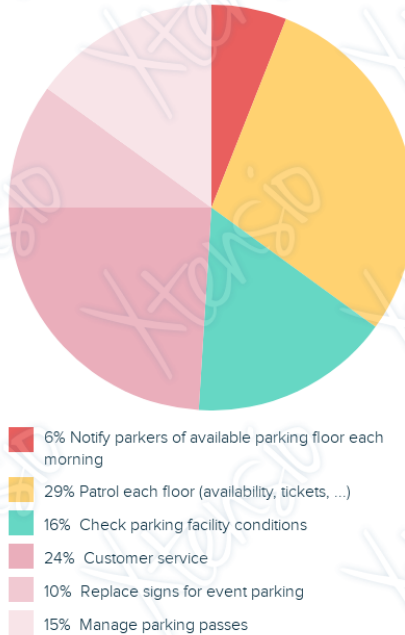Use cases: **Monitor parking facility remotely and make a plan**

Working location

99% On-site | 1% Remote

Age distribution

0 - 18 years old

19 - 24 years old

25 - 32 years old

Over 32 years old

Education

High school diplomat

Bachelor's degree holder

Master's degree holder

Ph.D. degree holder

Parking management subtasks

6% Notify parkers of available parking floor each morning

29% Patrol each floor (availability, tickets, ...)

16% Check parking facility conditions

24% Customer service

10% Replace signs for event parking

15% Manage parking passes

Smart device experience

12% 0 - 3 years

43% 4 - 8 years

27% 9 - 12 years

18% More than 12 years

Preferred communication

Mobile

Desktop

Laptop

Tablet
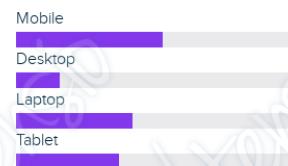
● Problem observation based on interviews:

Based on some interviews, we have identified key problems from each user class - student, faculty member, and parking manager. We will explore inconveniences and distractions students face while using the current real-world parking facilities on campus.

- **A student on campus**: The parking lot is usually crowded in the morning, making it hard for the student to determine the floor with available parking spaces. So he makes rounds of each floor to find a parking space every morning, spending at least 10 minutes in rush hours. Sometimes, he is late for important classes because there is no space left in the parking lot, and needs to move to another lot which makes him waste even more time. On top of that, he is not used to parking because he has just started driving, so he needs a large parking space.

- **A faculty member**: Professor Bob comes to campus irregularly. It is hard for him to predict the parking time before arriving, so he barely makes it in time for his important meetings which makes him nervous. In addition, he often doesn't show up at school because his schedule changes irregularly every semester, and he often feels it is unnecessary to purchase a parking ticket for each semester. He wanted to review the records of parking lot usage and parking ticket purchases, but he found it regrettable that there wasn't an integrated system to easily access this data.

- **Parking facility manager**: The parking facility manager's morning duties at the parking lot management office include checking the parking lot's usage rate and installing information signs. Since each floor has to be patrolled, it takes time to patrol, and it is difficult to respond immediately when the customer visits the office during the patrol. Occasionally, customers have difficulty remembering where they parked, resulting in inquiries about their vehicle's location. The manager needs to spend extra time to locate the customer's vehicle by looking through security cameras and patrolling. If there is a special event at school, it is more likely to be overworked because it takes more time to respond to outside vehicles in the busy morning.

● Task Analysis

We will explore high-level tasks and subtasks when using the parking facilities on campus. This will enable us to analyze tasks associated with campus parking and have better knowledge when designing our parking management system. Since parking has comprehensive higher level tasks such as purchasing semester parking pass, parking at the facilities, and paying parking fines if having one, we will have three distinct hierarchical descriptions. Our project will cover all existing hierarchical descriptions.

A. The hierarchical description for parking on campus:
  1. Pick parking facilities among West Garage | Lot D | Campus Center | Bayside
  2. Enter the parking facility entrance
      a. Present a parking pass

      b. Pull a ticket
3. Find a parking spot
      a. Check parking spots on each floor
4. Park
5. Walk out of the parking lot
      a. Take the elevator
      b. Take the stairs
6. Walk into the parking lot
7. Pay the parking fee
      a. Insert parking ticket
      b. Use a credit card to pay
      c. Obtain a parking validation ticket
8. Locate the vehicle
      a. Recall where parked
      b. Take the elevator
      c. Take the stairs
9. Exit the parking facility
      a. Present a parking pass
      b. Present a parking validation ticket

Plan 0: Do (1) - (2) - (3) - (4) - (5) - (6) - (7) - (8) - (9) in that order.
Plan 1: (2.b), (7), (9.b) are only for magnetic ticket users
Plan 2: If no parking spots are available, do (9) immediately and repeat (1) - (2) - (3) - (4) - (5) until a parking spot is found
Plan 3: Parkers decide whether to take elevator or stair (5.b, 8.c) on their preference

B. The hierarchical description of purchasing parking passes
1. Apply for a parking pass
      a. Pick on-campus | off-campus lot
      b. Pick between full-time rates | part-time rates
      c. Reserve a parking spot
2. A parking manager makes a decision on the applied parking pass
      a. Accept
      b. Reject
3. Pay
      a. Pay in full
      b. Set up installment

Plan 0: Do (1) - (2) - (3) in that order.
Plan 1: Parkers only do (1) and (3). A parking manager does only (2).
Plan 2: Repeat (1) - (2) - (3) whenever users need to have a valid parking pass

C. The hierarchical description of paying parking fines

1. The parking manager writes a parking citation
2. A parker notices the parking citation
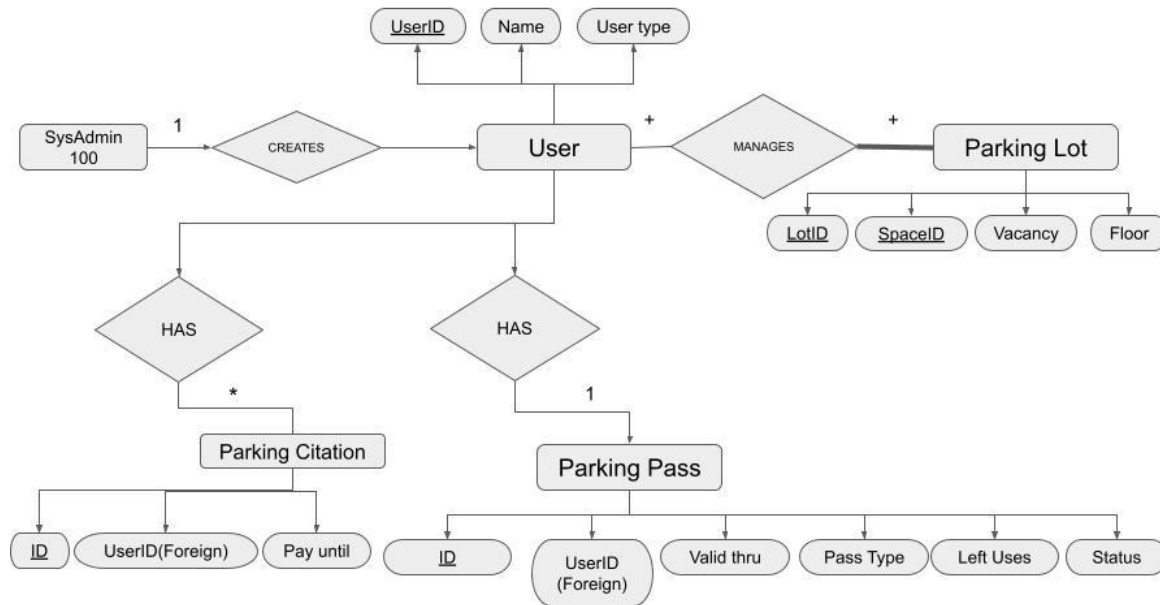3. A parker looks up parking citations online
4. Pay
    a. Pay online
    b. Pay in person

Plan 0: Do (1) - (2) - (3) - (4) in that order.
Plan 1: Do this hierarchy only if (1) occurs

- **Domain Analysis**

In this diagram, there are four entities, namely:

    User- An individual using the app. The User entity has 3 attributes:
- UserID: This is the primary key of this entity.
- Name: The user's name.
- User Type: The user can be classified into four major groups- Student, Faculty, Parking Manager, Visitor, etc.

    Parking Lot- The lot where the space is located.
- LotID: The primary key of this entity. It indicates which parking lot it is (West Garage | Lot D | Campus Center | Bayside)
- SpaceID: This attribute represents the unique parking space, and it becomes the super key when combined with LotID.
- Vacancy: Indicates whether the space is vacant or occupied.
- Floor: Indicates which floor the spot is on.

Parking Pass-
- ID: Indicates the ID of the parking pass.
- UserID: This is a foreign key to determine which user the pass belongs to.
- Valid Thru: The date/time after which the pass cannot be used.
- Pass type: Indicates whether the pass is a daily pass, a monthly pass, a semester pass, or any other type.
- Left Uses: (Only for part-time users) Indicates how many times the pass can still be used.
- Status: Indicates whether the pass is active or inactive.
- Notation 1: Each user will have at least one parking pass

Parking Citation:
- ID: Indicates the ID of the citation
- UserID: This is a foreign key to determine which user the citation belongs to.
- Pay until: The date/time until which the fine must be paid.
- Notation *: Parking citations can be 0 or more.

Relation **MANAGES**
- This indicates that parking lot data will be monitored by more than one user.

The ER diagram also describes the relationship between the various entities. The User can manage the data in the Parking Lot entity. This consists of data like the vacancy of each parking spot on each floor. A User can have **one** parking pass but can have **many** parking citations. Similarly, a User can manage **one or more** parking spots. There can be up to 100 System Admins who can monitor User's data, like using an invalid pass, etc.

Reference

UMass Boston parking information:
- https://www.umb.edu/transportation/parking-rates/
- https://forms.umb.edu/transportation/form/parking-signup-form

Smartphone usage
- https://www.pewresearch.org/short-reads/2022/01/13/share-of-those-65-and-older-who-are-tech-users-has-grown-in-the-past-decade/