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School of Computer Science

SPLASH - 3 - Project Proposal

ParkMate

"*ParkMate - A smart parking application designed to simplify and enhance the parking experience by providing personalized solution for locating, reserving, and managing parking spaces*"

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List of Symbols, Abbreviations and Nomenclature

- OpenCV – Open-Source Computer Vision Library
- OCR – Optical Character Recognition
- SMS - Short Message Service
- HTTPS - Hypertext Transfer Protocol
- ER - Entity Relationship
- UI - User Interface
- IOS - iPhone Operating System
- RAM - Random-access memory
- MB - Mega Bytes
- GB - Giga Bytes

Introduction

In our day-to-day life, figuring out a hassle-free parking spot in urban areas has become an increasingly frustrating challenge because of inefficiency of traditional systems and lack of real time information. Drivers are often forced to circle around the streets for parking lots, which involves wastage of fuel and time also parking congestion may arise. The problem is not limited to the normal user, but a landowner also does not have proper platform where his land can be utilized and managed by without involvement of manpower also the traditional does not support different tool to obtain revenue generation statistics so that provider can take best decisions.

Imagine a driver heading to a bustling shopping district during peak hours. They spend 20 minutes navigating through congested streets, looking for an available parking spot. Once they find one, they face additional challenges such as unclear slot markings, manual payment systems that require exact change, and long queues at exit gates. These inefficiencies disrupt the parking experience, leading to frustration for the user and operational challenges for parking lot operators.

In this era of technology which has enabled smart cities and well communicated systems, the parking industry still lags, where the finding of spot and its management is a big issue. There is a pressing need for an innovative, tech-driven approach to parking management that not only simplifies the process for users but also optimizes operations for businesses, ensuring seamless functionality and greater efficiency. Our project seeks to bridge this gap by introducing a smart parking system designed to revolutionize the way parking is managed and experienced. We provide a solution by using a mobile application where the user would easily find and book the nearest parking space from the desired destination also, he can subscribe to the plan. Furthermore, Provider will have access to the revenue charts generated from the allocated lands also can track of the parking at ease.

Problem Statement:

The increased number of vehicles in the current era has been a common trend which ultimately makes a challenge for parking: Although many land areas are there across the cities but users always struggle to efficiently discover and use appropriate parking when required. Along with that landowners do not have the facility to provide their land as parking to gather revenue. Due to these issues, it contributes to time and money wastages. This challenge involves a few related issues:

1. Consumer Frustration with Parking Discovery

This is a pervasive issue that affects many people globally, especially in the urban areas where parking demand is much higher than the actual need. According to one report from INRIX from 2023 Global Traffic Scorecard, drivers in the United States waste an average of 17 hours per year for searching for parking, at the end it costs them $345 in terms of time, fuel and emissions yearly. In United Kingdom also the statistics showcases 44 hours. Not only this incapable of searching parking could lead to parking congestion as all the people will go room around the destination which will lead to traffic jam. A study by IBM revealed that 30% of urban traffic congestion is caused by drivers searching for parking, leading to significant environmental and economic effects. Even during peak hours or major events, the problem level rises, where drivers may suffer from stress and lose productivity due to prolonged searches for parking. Hence, a user needs to go through this phase again and again to reach the appropriate parking.

2. Ineffective Land Management

Land Management is a critical issue in any part of world. In the cities where the price of the land is comparatively high then the owners need to involve their time to allocate the land for potential revenue generation. In most cases the land is unoccupied and remains vacant for years. The owner does not have a good option to utilize land for parking area. Where he can integrate his land into a system which can accommodate many vehicles in the long run and results in a money

flow. Also, sometimes it happens where users do not enter the land as parking area, so the inner-city area has no option for parking due to unenrolled lands, so the user needs to find alternative.

3. Worker Requirement

In the traditional parking systems that heavily relieve human interactions for all the operations are an unhighlighted issue. Conventional parking setups seldom need attendants for monitoring vehicle entry and exit also they need collect payments and guiding drivers to available spaces. This all would lead to increased operational costs. As the person involved in this process could support fraudulent activity and the accuracy with which he handles the cash flow is not high, then the owner must bear the cost. Moreover, there can be also a need for workforce training, as the implementation of the parking process is lengthy, but this approach also could result in higher time and money investment. This issue must be addressed by an automated system which can manage all the tasks by using real-time parking sensors, cameras, mobile payment platforms, and centralized monitoring dashboards.

4. Slot Tracing

Normally the traditional system sometimes does not have accurate slots for parking according to the size of the vehicle also in worst case some parking lot has absence of slots at all. Due to this, users may be confused to find proper slots to park their vehicles so they will park at any portion of the parking lot which will result in the unorganized space utilization of the land. Also, people may face the issue of grabbing vehicles out of the mess. Slots are a necessary element to have seamless flow in the process of parking. But it requires having proper slot traced out according to the size of the vehicle.

5. Payment Management

Payment management is a critical issue in parking systems that often leads to inefficiencies, delays, and customer dissatisfaction. Traditional payment methods,

such as cash or manual ticketing systems, are time-consuming, error-prone, and require significant manpower for handling transactions. A 2022 study by the International Parking Institute revealed that over 60% of parking operators face challenges in managing payments effectively due to outdated infrastructure. Additionally, a survey by Statista found that 47% of drivers prefer cashless payment options, yet many parking systems fail to provide seamless digital payment solutions. This gap not only creates inconvenience for users but also results in revenue loss due to uncollected payments or errors in manual transactions.

6. Challenges in Revenue Analysis

As the traditional system does not allow providers to maintain their transaction records accurately with a timetable which will lead to inability to have analysis for future financial growth of the land. Parking statistics allow owners to work on their strategies to maximize the profit by implementing appropriate measures. But absence of analysis feature owner finds it hard to do as he must go through all the manual transactions and calculate by their own. Also, accuracy is a big concern manually way give us less accurate results and may lead to vulnerable decisions.

Solution Statement

To resolve the challenges of inefficient parking discovery and make use of unused land for better revenue generation along with proper management , we propose the solution in form of the development of an integrated Mobile App which allows both normal user to search, register and subscribe to parking easily and also supports provider (land owner) to successfully register the land and gather revenue distribution over different car types.

1. **Integrated App Platform:**
   The app will have all the functionality for normal users and provider also it will be supporting queries raised by the user. The platform will enable a user to have stress-free parking experience throughout where he can find book and access the entire car park. Also, the provider will easily add remove and track of his parking areas.

2. **User-Friendly Design:**
   The user-friendly design will ensure that both the users can easily navigate and interact with the platform without any technical hurdles. Also, all the features will be easily accessible from the User interface. The design will prioritize simplicity and accessibility, with a clean layout and straightforward navigation so that even those who are not tech-savvy can effortlessly make us of the app. Also, the support for maps and revenue chart will enhance overall user experience.

3. **Public User Support:**
   For the public user of the application the following support will result in a solution to the problems for them.

   Searching

   Public users will be able to search parking areas by providing basic details like the type of their car, Date, Time, duration, and the city name which he

wants to find. As a result, all the possible parking areas are displayed in the form of a list and map. To book a particular parking area the user can click on the know more option in the list and pin it in the map view. Detailed information about the selected parking should be visible.

Booking

Once the user has the parking area, he will be able to book the parking area by providing details like the type of car, car number, duration, and days for which he wants to park. Once the data is submitted and successful payment is made the parking area is allocated for the user. Along with that the booked parking area details can be edited as well as canceled within the time limit. Users will also be able to show their likeliness to the previously booked parking using ratings.

Subscription

Like the booking process but the user will be capable of selecting multiple days from the booking form to subscribe to the parking location. Also, the subscribed parking can be edited as well as canceled. User can rate the parking areas that he subscribed to.

4. **Provider User Support:**

For the provider user of the application the following support will result in a solution to the problems to them.

New area registration

To register a parking area in the app, providers may use one registration form for enrolling their area into the system. The form takes data related to the area like the name of the car park, city, address, vehicle types, corresponding rates, location of the parking, etc. Once the submission is done the area will be verified.

Statistics

A provider will be able to analyze data to take decisions regarding the areas. The data can be like revenue generated or a rush of cars from the car park provided**.**

Manage provided Areas

All the parking areas that were added to the system will be displayed and these areas are editable so that the user can change the details of the types of cars provided and the corresponding rates, name of the service, etc. The area can be canceled too by giving the appropriate reason.

5. **Authentication for Land Resources:**

   All the land resources that are uploaded by providers need to be checked and verified for the vehicle capacity first. Our app does support this Firstly. As soon as the land is uploaded with the location, capacity numbers of vehicles and the top-level photo of the parking area, our parking team will analyze the data and visit the spot where they will make sure that the data matches the location.

6. **Effective On-Site Processing:**

   Firstly, the camera or sensors, whichever is necessary, is placed to track of slot. The camera will be placed on the top of the parking area as soon as the car enters the car park. First, at the gate the number plate will be detected if the number plate matches with the registered vehicle number entered while booking then the car will be allowed to enter. Also, when the car enters in the designated slot. With the use of machine learning the position of the car will be determined and the data will be updated in the database. By this way we can properly manage whether the slots are available or not for car in specific parking.

After the completion of the application, we want to eliminate the traditional way of parking by making it more accessible and stress-free. Also, apps will provide

users with starting a new source of income by providing land for the usage along with proper management of analytics. This solution will truly remove the unnecessary barriers and enhance the parking system procedure in a standardized manner.

Market Study

Overview

The overall demand for smart parking solutions has grown significantly in the last years. Possible reasons could be rapid urbanization, increased vehicle ownership, and the growing focus on efficient urban infrastructure. Users are actively seeking digital platforms that simplify parking discovery, reservation and payment so that they can address daily frustrations of finding parking.

- **Current Trends**: Smart mobility and digital payment adoption are on the rise, along with that consumers increasingly preferring apps that offer real-time information. Parking solutions today have seen in popularity, as they address the inefficiencies of traditional parking methods. Moreover, landowners are asking possible ways to monetize their unused spaces and create opportunities for apps that connect landowners into the parking ecosystem.

- **Market Potential**: The global parking management market is expected to grow at a CAGR of 10–15% over the next five years, which indicates strong demand for digital parking solutions. The solution to reduce time, fuel consumption, and emissions aligns with environmental and urban planning goals, which make such applications more helpful to governments and users.

Target Audience Analysis

ParkMate's primary users will be as follows:

a. **Urban Commuters:**

- Individuals who frequently travel in urban areas and face challenges in finding affordable parking spaces.
- Generally, in this group users might be office workers, shoppers and tourists.

b. **Landowners and Businesses:**

- Owners who have unused land and want to have an additional revenue stream are

having high chances of using the app.

-Also, sometimes businesses have fixed parking and the employes have the same schedule for a month in that a month subscription can be taken.

c. **Environmentally Conscious Drivers**:

-This group is environmentally sensitive; they want to save fuel and carbon emissions by locating parking spots quickly and efficiently.

Age Group: This application does not have a specific age group limit but yes anyone having car license can use the parking facility.

Pain Points

ParkMate addresses the following user pain points:

a. Subscription Limitations: As the application is in the initial stage it only supports subscription for a week only once the subscription is over. The user needs to add again another subscription.

b. Multiple Choice: The user might have different possible choices in parking with different prices in particular area so user might have difficulty in figuring out the optimal option.

c. Vehicle Support: This app only supports parking for cars only so in order to support parking for a wide range of vehicles then it would another target.

Competitor Analysis

Many parking applications exist in the market in foreign countries like SpotHero, Parkwhiz, Parkopedia, Passport parking, Parkmobile, Parking parking, Paybyphone, and many more. A few of them are described below with their features.

• **Parkwhiz:-**

Users can purchase daily or monthly parking through the web as well as mobile apps. Users can be able to compare prices of different parking spaces across various locations. Once the user books parking, he will get an electronic

parking pass that will be useful in the parking area for verification.

• **Parkopedia:-**. The application provides the facility to search for parking by providing a parking area. It gives possibly the nearest results to your destination along with information like cost and availability of space

• **Passport Parking: -** This app allows users to find and reserve parking and pay for their spots by entering a location number on the app and paying from their device. Notification is sent when the parking time is about to be over. Also, the user is updated with the latest parking rates.

Unique Selling Proposition (USP)

The ParkMate app distinguishes itself through its seamless integration of real-time data, user-focused features, and support for landowners.

- **Real-Time Parking Availability**: Live updates on nearby parking slots, helping users save time and reduce stress.

- **Integrated User and Landowner Platform**: A single app where users can reserve and pay for parking, while landowners can register spaces, set prices, and track revenue.

- **Automated Payment Solutions**: Multiple secure, cashless payment options for a hassle-free experience.

- **Enhanced Efficiency**: Dynamic slot tracing and navigation assistance to ensure smooth parking experience.

Market Positioning

The ParkMate app provides user-centric management solutions, and it aims to simplify parking discovery and enhance operational efficiency. It supports urban commuters, visitors, and landowners to find reserves, and manage parking spaces by maximizing convenience

Competitive Strategy

a. Freemium Model: Provide essential features such as real- time parking availability, basic reservations, and standard payment options for free. On the other hand, priority reservations, and cost for camera and other tool at the parking spot etc. will be under premium feature.

b. Strategic Partnerships: We can partner with local businesses, malls and event organizers to provide exclusive parking deals along with that we can promote our app from celebrities. Apart from this collaboration with payment gateways is also a good choice.

c. User Engagement: Incorporate interactive features like feedback loops, daily mood check-ins, and community-driven content suggestions to create a vibrant user community.

Key Challenges

a. Adoption Resistance: Convincing many users and landowners from traditional parking methods to a technology-based system would be difficult and specifically for the person who doesn't have technological knowledge.

b. Infrastructure Limitations: Integrating the app with existing parking facilities and ensuring that it works with different systems and hardware will require effort and investment. Especially the places where it is not possible to install a camera on the top so that the entire car parking is covered need to have sensors which will be again const involving.

c. Real-Time Accuracy: It would be hard to maintain the accuracy of real-time parking availability data, especially in areas with high traffic and demand occurs. On a large-scale, maintaining databases would be too complex a task.

d. Scalability: Ensuring that the app can handle many users and parking areas with the best performance without compromising any feature would be a challenge where the userbase grows faster.

e. Market Competition: Releasing new features and users meet user expectations to maintain competition by ensuring a unique value proposition to attract and retain users.

Overall Opportunity

The smart parking app has the potential to revolutionize the parking industry by offering a comprehensive, user-friendly platform that bridges the gap between users searching for parking and landowners looking to optimize their unused spaces. With the increasing demand for smart city solutions and efficient parking management, the app can position itself as a go-to solution for urban commuters, attendees and businesses.

Cost Analysis

Overview:

It estimates the costs required to develop, launch, promote and maintenance for application. We are going to use all the possible tools which are cheap as well as efficient to meet user needs. At the end we will make sure that at the lowest possible cost we can give the quality product.

1. Development Costs:

1. **Human Resource Costs (Development Team):** The team spend approximately 25-30 hours per week, so around 400 - 500 hours in total for development of the application.
    - **Estimated Hourly Rate:** Assuming a rate of $25 CAD/hour (industry standard for app development)
    - **Total Human Resource Cost:**
      For 500 hours: 500 hours x 4 people x $25 CAD/hour = $50,000 CAD
2. **Software and Hardware Tools and Licenses:**
    - **Open-Source Tools:** Free development environments such as React Native, VSCode, and Python.
    - **Hardware Cost:**
      Two high-definition camera costs: $1000
      One control center with barrier gate: $500
    - **API Integrations:**
      Google maps API for showing parking location and give direction and estimated time towards it.
      Firebase is used for storing the data (database cost)
      Twilio API for SMS.
    - **Estimated API integration costs:**
    - Google Maps API cost: $7 per month (https://mapsplatform.google.com/pricing/)
    - Firebase cost: $0.026 per GB (https://firebase.google.com/pricing/)
    - SMS service cost: $0.0079 per 1000 messages (https://www.twilio.com/en-us/sms/pricing/ca)
3. **Additional Development Expenses:**
    - **Design Tools (Figma):** This will be used to generate different diagrams and logo for the application.

- **Domain Name and Hosting (if required):**
  - In order to purchase domain, we need to but at cost around $20 CAD/year.
  - If the application needs to be hosted somewhere for production access, then the cost would be $50.

Total Development Costs:

- Human Resource Cost: **$50,000 CAD**
- Infrastructure & Miscellaneous: **Approx. $2000 CAD**

2. Maintenance Costs:

1. **Post-Launch Maintenance:**
   - After the Release of the application, it needs to be hosted somewhere to provide wide level service hence for hosting platforms would be needed which may charge around $200 CAD/year
2. **Bug Fixes and Updates:**
   - Bug fix and other maintenance support for the servers will be provided by our team

Total Maintenance Costs:

- **Approx. $200 CAD per year.**

3. Operational Costs:

1. **Content Providers:**
   - As all the images videos are generated by our team then there would not be any additional content costs expected at this time.
2. **Marketing and User Acquisition:**
   - **Entry Level Marketing:**
     - If we need to use social media or online ads to promote the application, we can spend around $200 for social media ads or digital marketing.

Total Operational Costs:

- **Approx. $200 CAD**.

4. Summary of Costs:

Category	Estimated Cost
Development Cost	$52,000CAD
Maintenance Cost	$200 CAD per year
Operational Cost	$200 CAD
Total Project Cost	$52,400 CAD

Project Management Plan

Development Lifecycle

We are going to divide our entire development in terms of sprints where each individual sprint is responsible for completion of assigned task under that period. By working in parts eventually our final application requirements will be achieved easily.

1. **Sprint 1**
   Timeline: 26 Jan – 2 Feb
   Description:
   -Planning of timeline, distribution of tasks and defining team roles also environment setup for coding is done through this phase.
   -Overall basic system diagrams are designed and understand it via meeting.
   -Solve queries related to the idea of the project, client requirements and perform task breakdown.

2 **Sprint 2**
   Timeline: 3 Feb – 12 Feb.
   Description:
   -Core Public user module and visitor module Implementation: All the basic functionalities like registration, login, forgot password and query page, about us , home page etc. Also need to start development of parking search page, and listing of all booked parking needs to be done for public user.
   -Creation of the database for the client application must be done and tested.

3 **Sprint 3**
   Timeline: 13 Feb – 02 Mar
   Description:
   -All the remaining modules from public users like location navigation, subscription screen and listing must be done.
   -Completion of Provider user Modules: Parking Area registration, Mange parking areas, working areas and pending areas where authentication of the place must be checked etc.
   -Start on parking slot detection where the slot of the parking lot must be detected using python object detection.
   -Testing needs to be done on recently developed public user modules, provider

modules from the UI part and for car detection.

4 Sprint 4

Timeline: 03 Mar – 16 Mar

Description:

-Integration for Front End, backend and Database should be done where all the possible scenarios related testing will be performed for the integration.

-Car movement detection in slot through camera will be done also number plate recognition should be completed using OCR technology.

-Testing of the number plate recognition, slot empty ness detection and app integration need to be checked.

5 Sprint 5

Timeline: 17 Mar – 23 Mar

Description:

-Beta Testing and Refinement: Conduct end-to-end testing, release beta and gather feedback.

6 Sprint 6 (Final Release)

Timeline: 24 Mar – 30 Mar

Description:

-Design of font styles, Position UI/UX if needed, theme option exploration etc.

-Cloud hosting for database and backend will be checked and finally app will be released.

Development and Operations Pipeline

The development and operations pipeline will employ a range of tools and technologies to ensure seamless project execution. Below is a detailed description of each component and its role: it gives different tools and framework to ensure smooth flow of the project. Here the detailed information on the tools and technology that we used is given.

Component	Purpose
Version Control: GitHub	Centralized version control for code management and collaboration.
Project Management	Sprint planning, backlog management, and task tracking for Agile workflow.
CI/CD Pipeline	Automate build, test, and deployment processes.
Programming languages	JavaScript, Python,
Frontend	React Native
Database	Firebase
Backend	Node and Express JS
Code Review:	Continuous code quality checks through automated testing and peer review integrations.
UI/UX Design: Figma	Created different UI Components and generated ERD Diagrams for all users
Automated Testing: Selenium	UI testing for front-end components.
Backend Testing: Postman	All the Backend API were tested using postman
Cloud Hosting: AWS	Final database monitoring, hosting of the application and monitoring performance is done by AWS Cloud service.

Project Roles and Responsibilities

- Lead Developer: Responsible to follow agile methodologies and solve any problems in project and conflicts in team and need to monitor sprints.
- Backend Developer: Creates database also write server-side backend logic and performs API integration.
- Frontend Developer: Generate a User Interface at client-side application with support to functionality.
- Full-stack Developer: Expert is making Front end (User Interface) as well as backend logic for the application also knows database design along with integration.
- UI/UX Designer: Handles UI components and suggests new creative ideas to enhance user experience along with retention.
- Quality Assurance Engineer: Responsible for testing out all the possible scenarios strategically along with given importance to final quality of product.

Team Distribution

1. Om Siddhapura

-Role: Lead Developer, Scrum Master

-Expertise: Expert in Frontend, Backend (Full stack engineer) and leadership

-Weaknesses: Less experienced in testing and hosting.

-Major Task: Design timeline for tasks and solve technical problems for teammates, Team Coordinator, project timeline manager, contribution in front end, backend and database integration and testing.

2. Anshul Prajapati

-Role: Backend Developer and Tester.

-Expertise: Detail oriented, much skilled in database integration and API creation in backend. and expert in writing tests for all the scenarios.

-Weaknesses: Less knowledge of Front end and hosting

-Major Task: Contribution towards database and backend API design, making test scenarios along with script.

3. Ved Prajapati

-Role: Full Stack Developer and Tester.

-Expertise: Ideal in code deployment, hosting and testing of the application

-Weaknesses: Lacks in timeline management and UI/UX.

-Major Task: Responsible for Front end development and support backend as and when needed, give support in final production hosting and maintenance.

4. Nisthaben Patel

-Role: QA Engineer and UI/UX manager.

-Expertise: Strong in creative UI/UX screen designs and good with JavaScript and solves potential issues by performing scenario-based testing

-Weaknesses: Lack of experience in Backend and database design and hosting.

-Major Task: Act as QA whenever any feature is out and test out all cases appropriately, generate bugs and suggest user enriching UI for higher user retention.

Quality Management Plan

Introduction

The Quality Management Plan defines the methods and procedures which make sure that the project satisfies the required objectives and fulfils the criteria. Our objective is to come up with a user-friendly and high-quality solution that resolves parking inefficiency and provides reliable parking experience.

Definition of Quality

Internal Quality: The project will make sure sustainable and efficient code using the standard coding practice. The objective is to ensure that the mobile application and the backend system are well organized and uncomplicated.

External Quality: The resultant product ought to fulfill the expectations of the user. The product will be examined based on the functionality of the app, the app resolves user requirements as well as how fast and accurate the parking spot searches and user-friendly application.

Measurable Metrics

Code Quality: Maintain and monitor the readability of code and trace the code complexity.

Performance Metrics: Keep track of how long it takes for the app to display the parking data in real time. And tracks how quickly the backend system reacts to user for parking spots.

User Experience Metrics: With the data of ratings, Net Promoter Score (NPS) evaluates how satisfied the user is to the app and monitoring the customer's reviews.

Bug Rates: Monitors the quantity and intensity of reported bugs and the time taken to fix the problem which disturbs the user experience.

Persons Responsible for Quality

Team Lead: Manages planning and make sure that the project follows the appropriate practice while using the agile process.

QA Team: Oversees the development and implementation of the project including the testing strategy.

Developers: Ensure the code compiles with the coding standards and maintain the quality of the code through peer reviews.

Product Owner: Makes sure that the project features align with the user requirements and business objectives.

Actions to Assess and Evaluate Quality

- **Code Reviews:** Peer reviews are carried out on a regular basis to maintain the efficient, secure procedure that adheres to coding standards.
- **Automated Testing:** Using end-to-end integration and unit testing for the app and backend services.
- **Manual Testing:** Ensures that the application resolves the parking issue, application is tested by the actual user.
- **User Feedback Collection:** Feedback and reviews to identify problems and suggestions to improve the app.

Corrective Actions

- **Sprint Retrospectives:** Team will hold retrospectives following each sprint to identify problems and provide solutions for improvement in the upcoming sprint.
- **Continuous Integration (CI):** Quick resolutions are possible by using Continuous Integration to automatically run tests and identifying issues early.
- **Bug Fix Cycles:** High-impact bugs will be given priority for fixing in the sprints.

Documents for Quality Evaluation

- **Test Reports:** To examine the performance of the application and backend,

unit and integration test results to be put under consideration.

- **Code Review Reports:** Reviews and suggested feedback from peers for improvement.
- **Bug Reports:** Detailed information of the recorded bugs and the intensity to fix bugs.

Standards and Regulations

- **Coding Standards:** Following SOLID principles, to maintain the quality of code as well as the best methods are used to designed it.
- **Legal Compliance:** Make sure that the data is secure by adhering to GDPR for data protection.

Issue Tracking

- **Issue Tracking Tools:** Project targets, tasks and bugs to be tracked using JIRA
- **Issue Prioritization:** Prioritizing the impact of the issues and resolving them on the level of severity.

Tools Selection

- **Testing Tools**: For testing the frontend components react native to be used and pytest to be used for backend testing.
- **CI/CD:** Builds, tests and deployment will be automated by the GitHub actions.

Artifact Archival and Operations Follow-Up

- **Archiving:** Version-controlled repository to store the tests, code and user feedback.
- **Deployment Monitoring:** To track the performance of the application and user engagement automated pipelines will be setup.

Information and Data Communication plan

Objectives of Communication and Data Management:

The communication plan for the parking management software project establishes a comprehensive strategy to facilitate transparent, efficient, and secure information exchange among team members, stakeholders, and external partners. Recognizing the critical nature of both technological development and interpersonal collaboration, the plan prioritizes clear communication channels, structured information dissemination, and robust data protection mechanisms. The project will implement a robust data management approach that prioritizes security, accessibility, and compliance. All project-related information will be stored on secure, encrypted cloud platforms with multi-factor authentication. Version-controlled documentation repositories will ensure that team members always access the most current project materials while maintaining a comprehensive historical record of project evolution.

Frequency of Communication:

- **Internal Team Communication:**
  - Weekly meetings through MS Teams.
  - All time chat to prioritize seamless workflow and understanding between team members
  - Weekly sync meetings to review completed tasks, address roadblocks,
  - Setting new goals and completing milestones

- **External Stakeholders (Sponsors, Content Providers, Local Businesses):**
  - Bi-weekly progress reports to update stakeholders on milestones.
  - Monthly meetings with external stakeholders to discuss feedback, challenges, and upcoming features.

Communication Tools and Processes:

Communication Tools:

- Microsoft Teams: For weekly team meetings and stakeholder meetings and for day-to-day communication.
- GitHub: For tracking project progress, task assignments, and issue tracking,

committees and Repository management.

- Microsoft Word: To document all meeting minutes, decisions, and action items.

Stakeholder Communication:

- Email: For formal updates, meeting requests, and document sharing with sponsors or external stakeholders.

Data Storage and Security:

- It will collect data according to car details and the parking lots that are available and geographic and demographic data as well.
- API from integrated system of parking lots and device data according to users' choice of permission to allow or not.

Data Archival and Retrieval:

- Data from communication exchanges and user interactions will be stored for a period of 1-year post-project to ensure traceability.
- The archived data will be accessible to authorized stakeholders via shared drives.

Privacy and Confidentiality:

- All communications and shared data will be stored in encrypted, secure with strict access controls to protect confidential information.
- Regular audits will be conducted to ensure data integrity and to check compliance with GDPR and internal privacy guidelines.

Ethical Perspective for Data: Data will be anonymized according to permission-based approach, while some permissions are compulsory (The user must surely abide by it). Other permissions are not always necessary, and the user can turn them off whenever possible.

Risk Management Plan

Methodology

- **Brainstorming Sessions:** Different team discussions will be scheduled to figure out if there is any minimal risk there or not.
- **SWOT Analysis:** For any of the functionality and solution its strengths, weaknesses are determined to prevent any potential threat.

Resources

- **Risk Assessment Tools:** Various software is used to make sure that the application does not have any possibility of password and other important information leak. Example of software includes. GitHub – for storing code files, JIRA to track daily task and evaluate velocity of team etc.

Risk Identification

1. **Technical Risks:**
    - **Integration Challenges:** There would be an issue in integration of APIs with the Front end, backend and database due to incompatibility.
    - **Performance Issues:** App may not have supported structure where it can handle large user base. Also Due to large scale of application if there is lot of traffic in backend API call system might respond slowly.

2. **Operational Risks:**
    - **Team Availability:** Due to conflict in schedule some members would not work to complete sprint.
    - **Resource Constraints:** Lack of important tools or having budget constraint may limit our development.
3. **Market Risks:**
    - **Competitive Landscape:** New competitors may emerge, affecting market share. If any new competitor comes into the market, then it will affect our revenue.
    - **User Adoption:** If there is no more user engagement then the app

will suffer from lower user response.

Risk Assessment

- **Constraints:**
  - **Technical Constraints:** Some technical resources may be restricted as they require premium.
  - **Social Constraints:** Reputation can be shifted down by the users that are available in the market due to low ratings.
- **Probability of Outcomes:** Probability can be very extensive or low or medium based on surrounding circumstances

Risk Monitoring Plan

- **Regular Review Meetings:** a stand meeting would be held to plan for risks and to keep track of the daily track of tasks.
- **Risk Tracking Dashboard:** Different project management tools will be used to figure out and visualize risks.
- **Key Performance Indicators (KPIs):** Number of bugs raised in the app, metrics representing performance and quality of software and feedback would be taken in the account to ensure great product while lowering risk.

Risk Mitigation Plan

- **Preemptive Actions:**
  - All the coding will be done following IT standards to minimize technical bugs.
  - Daily team meetings would avoid any misunderstanding regarding the project.

Risk Contingency Plan

- **Action Steps:** For each identified risk there will be a preventive action plan designed to fight.
- **Integration Challenges:** Find out the un deprecated libraries and

alternative APIs packages for smooth integration.

- **Performance Issues:** Use cloud tools which support good support to large number of simultaneous user interactions.
- **Impact Evaluation:** If there is any risk a review will be conducted to assess the quality of solution and need to find alternative if there is any necessity.

Appendices

Modeling and Design

For better visualization of implemented methodology, software design diagrams were constructed which provided a glimpse of the flow of control as well as the data in our project. The following diagrams proved useful information for a better understanding of this project. As the system has three users' visitors, public and provider all the diagrams are given according to all user types.

- The ER diagram illustrates the entities that are involved in the application and the type of data information that they have.

- The Use case diagram talks about the user and their possible set of use cases. What different kinds of features the user can hold.

- The State Diagram indicates the possible transition between different states.

- The activity diagram will show all the activities carried out by the user to use the system efficiently and effectively for their own benefit.

- Data flow presents how the flow of the data in the application goes.

- The Sequence Diagram will show the simplest form of interaction between the user to the system.

ER diagram

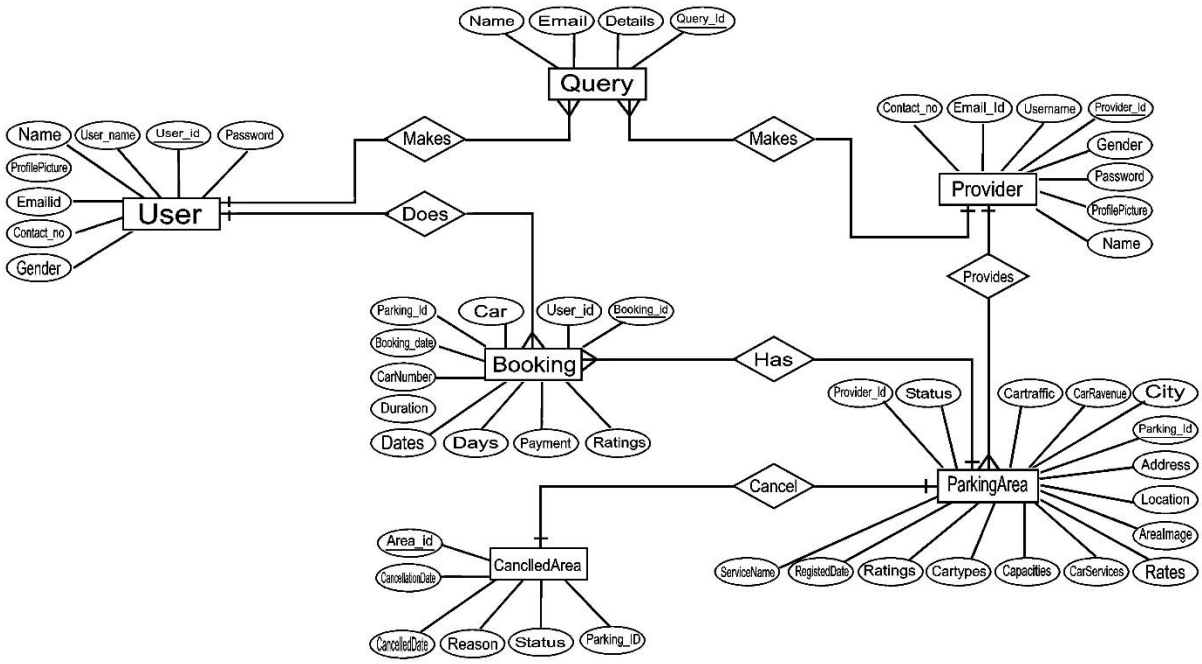

Fig 1.1 ER diagram

Use case diagram

Visitor

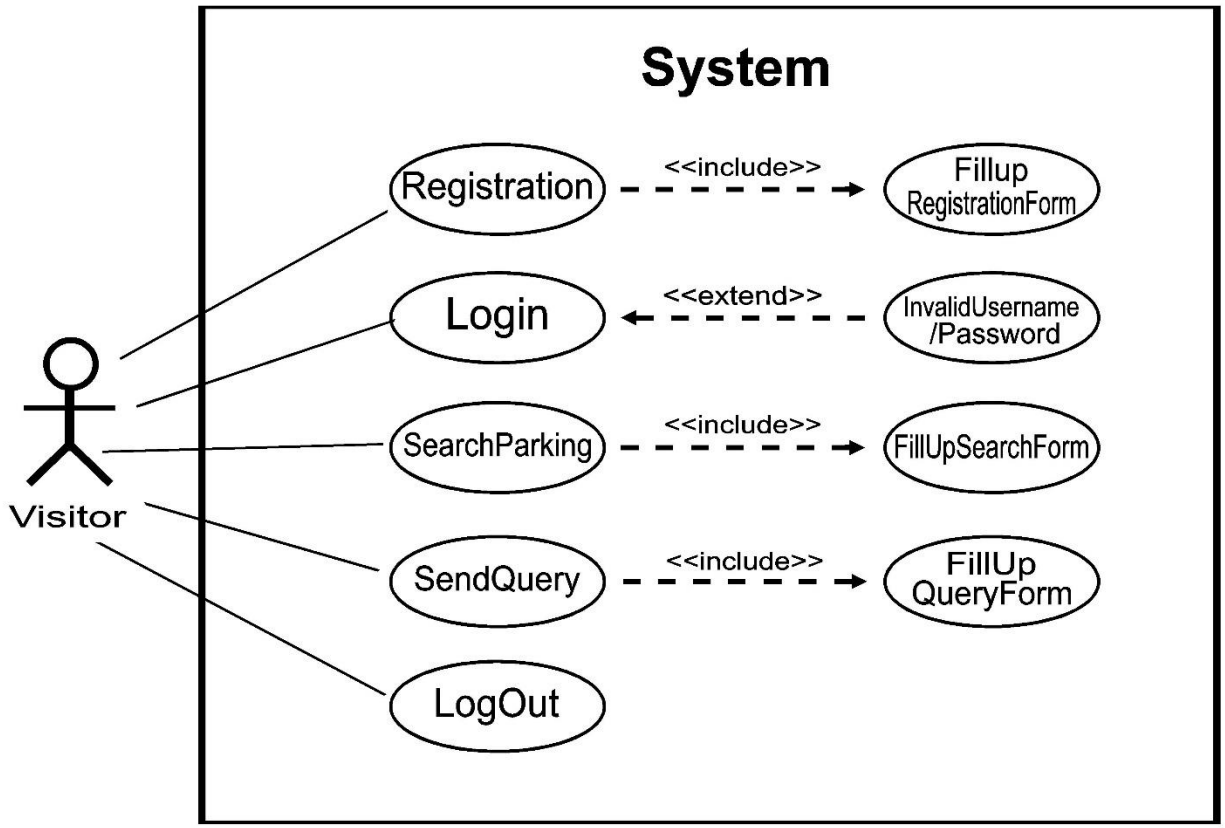

Fig 1.2 Usercasediagram_visitor

Public user

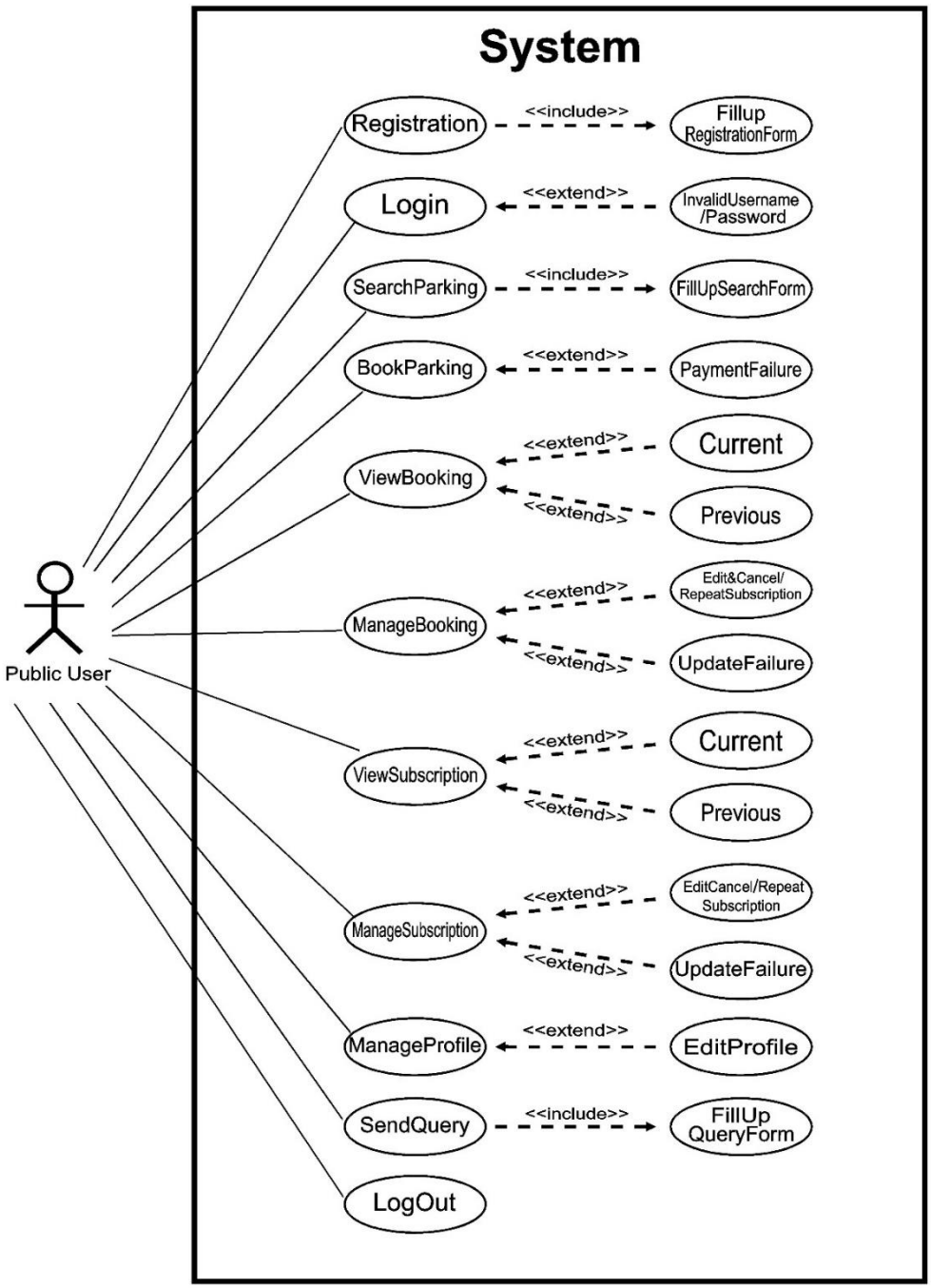

Fig 1.3 Usercasediagram_public user

Provider

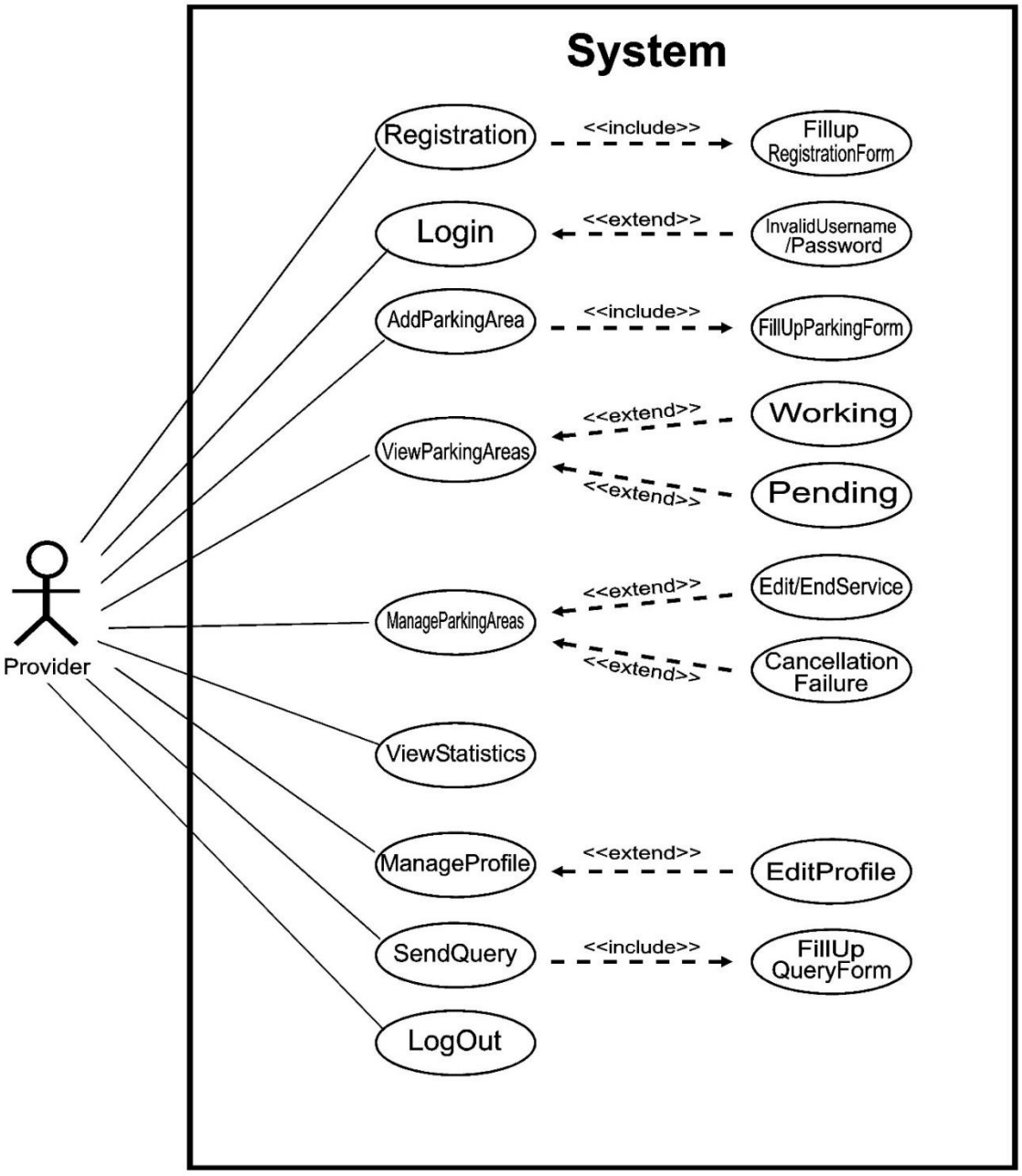

Fig 1.4 Usercasediagram_provider

State Diagram

Visitor

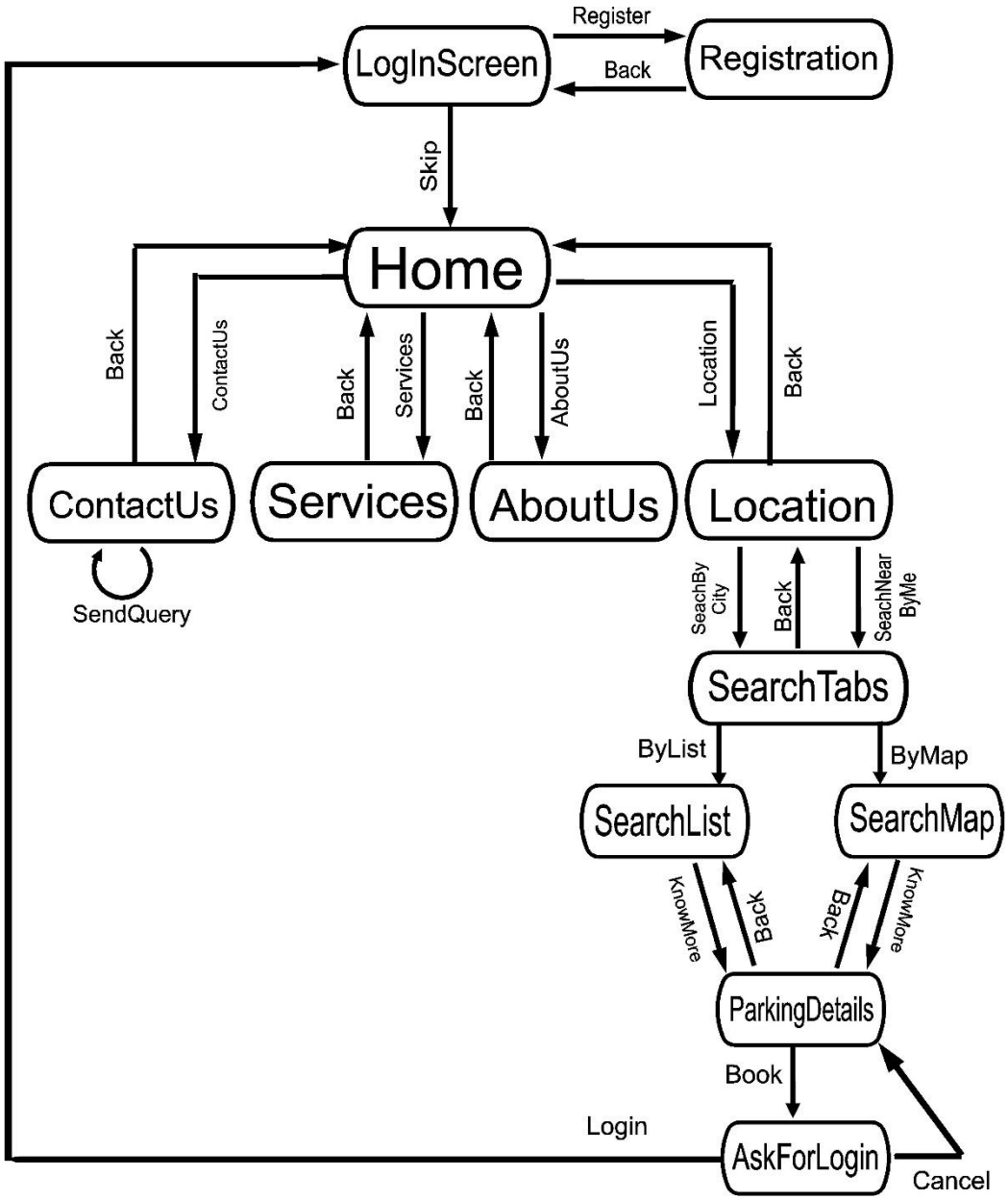

Fig 1.5 Statediagram_visitor

Public user

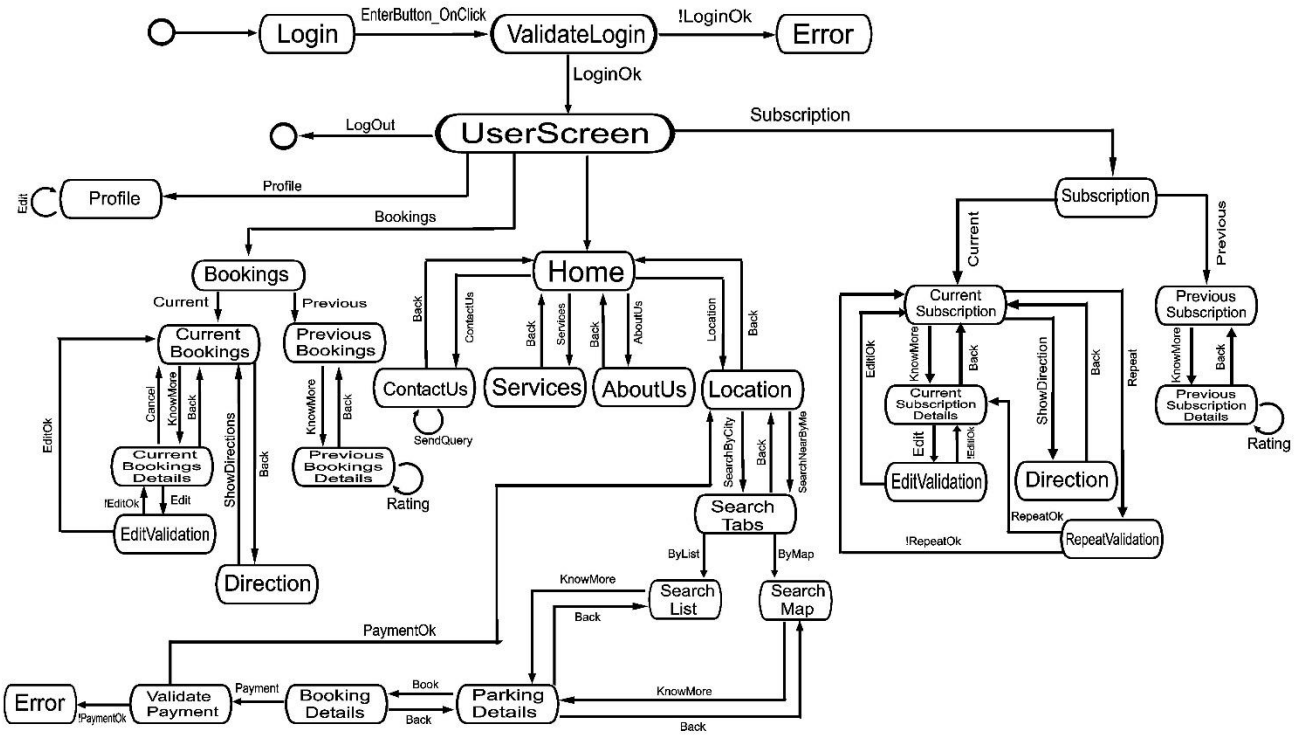

Fig. 1.6 Statediagram_public user

Provider

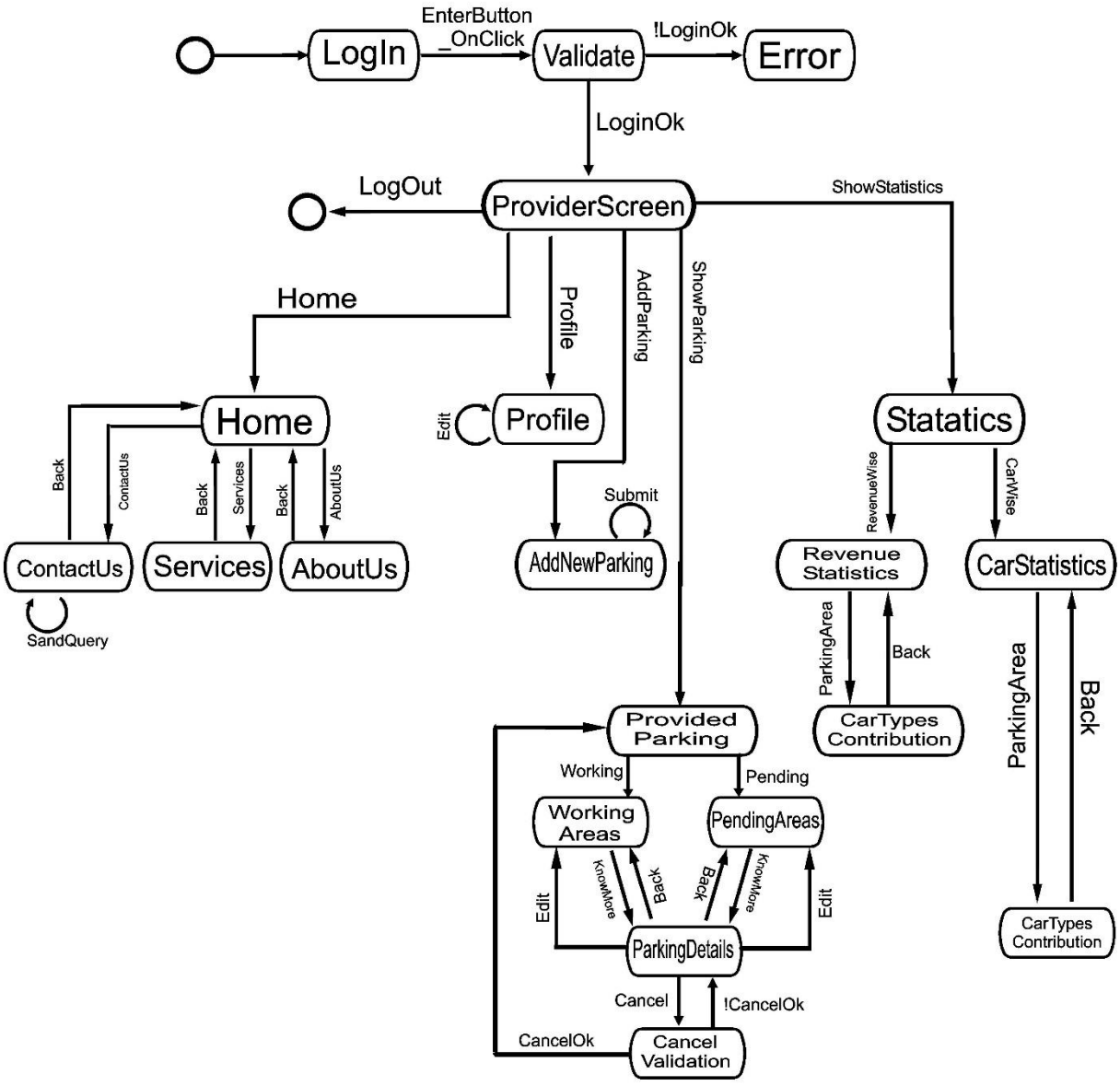

Fig. 1.7 Statediagram_provider

Activity Diagram

Visitor

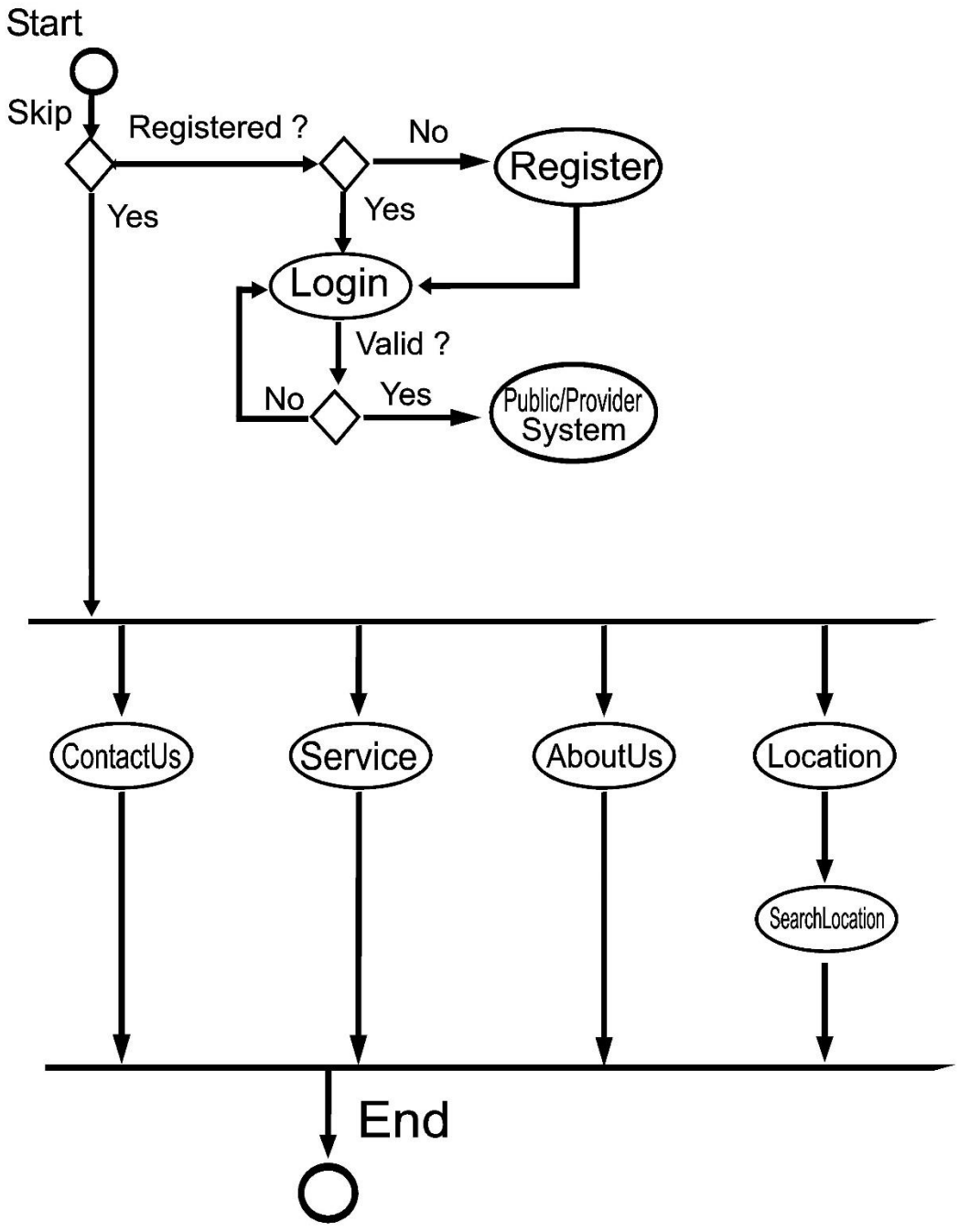

Fig. 1.8 Activitydiagram_visitor

Public user

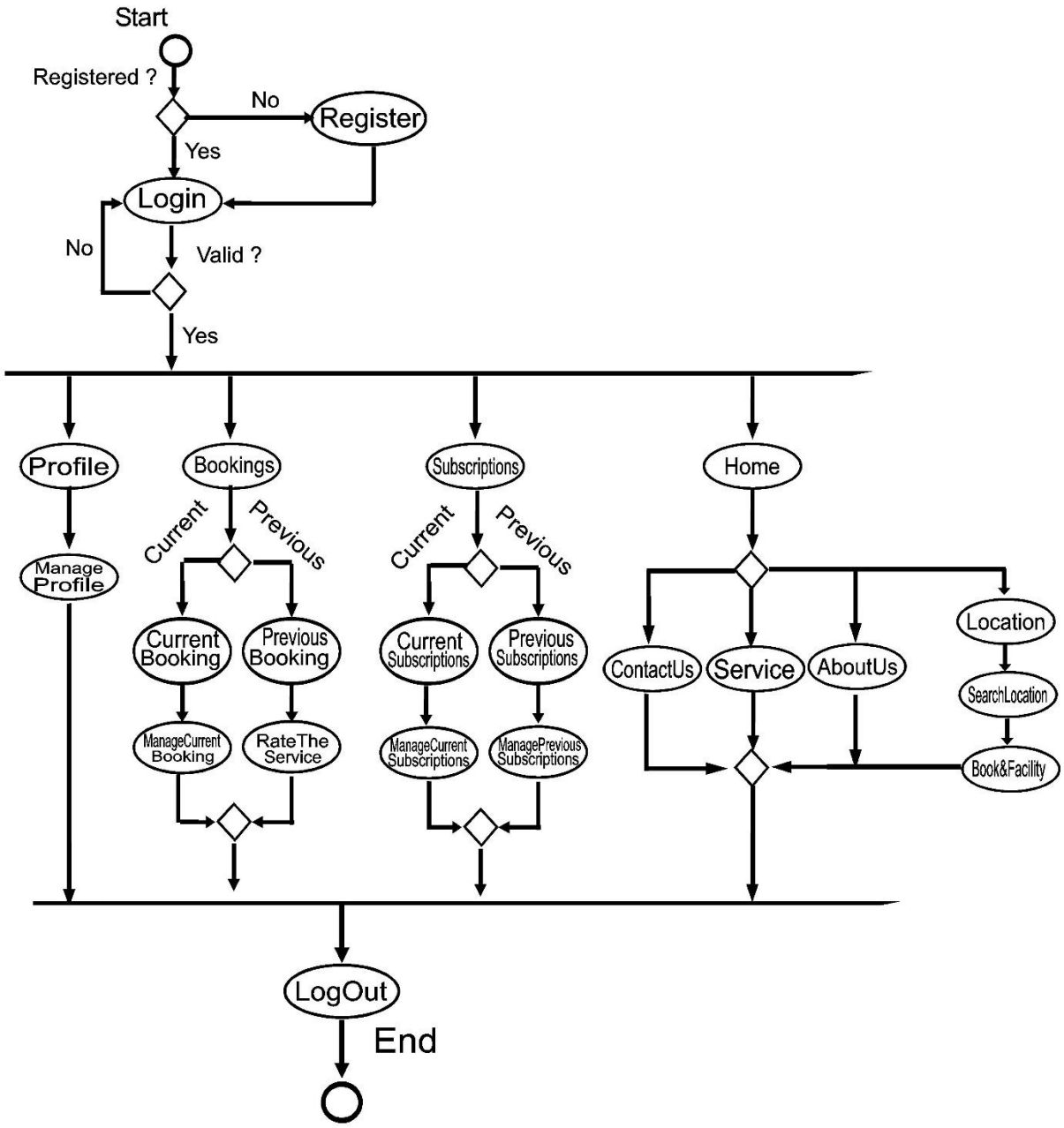

Fig. 1.9 Activitydiagram_public user

Provider

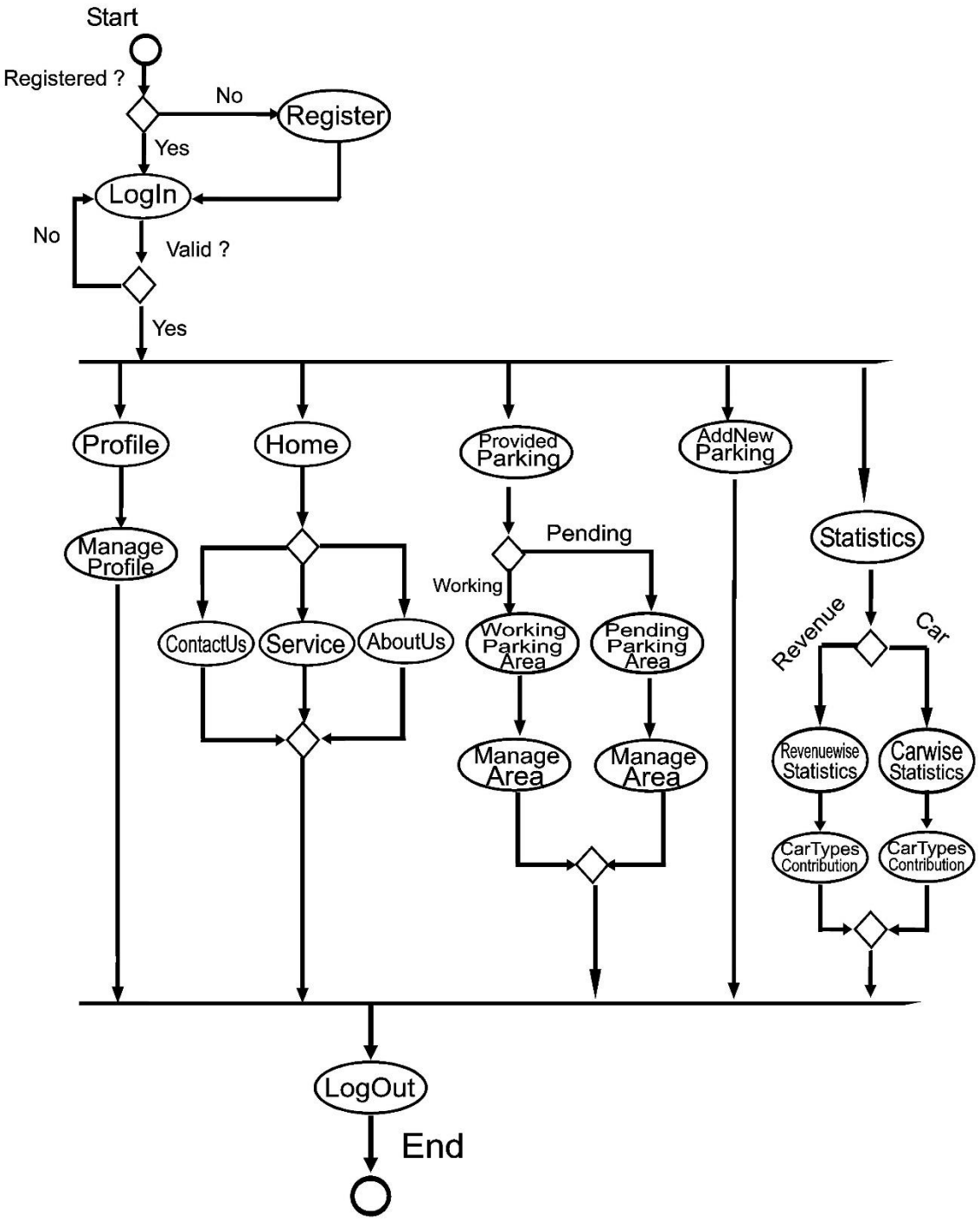

Fig. 1.10 Activitydiagram_provider

Data flow Diagram

Visitor

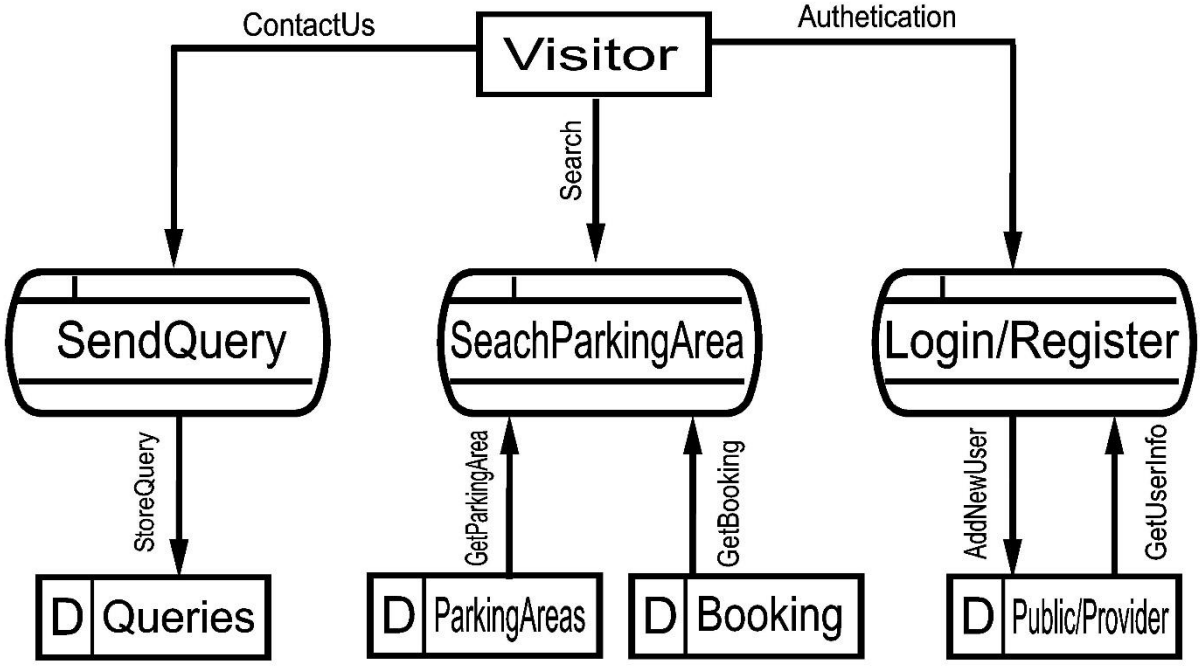

Fig. 1.11 Dataflowdiagram_visitor

Public user

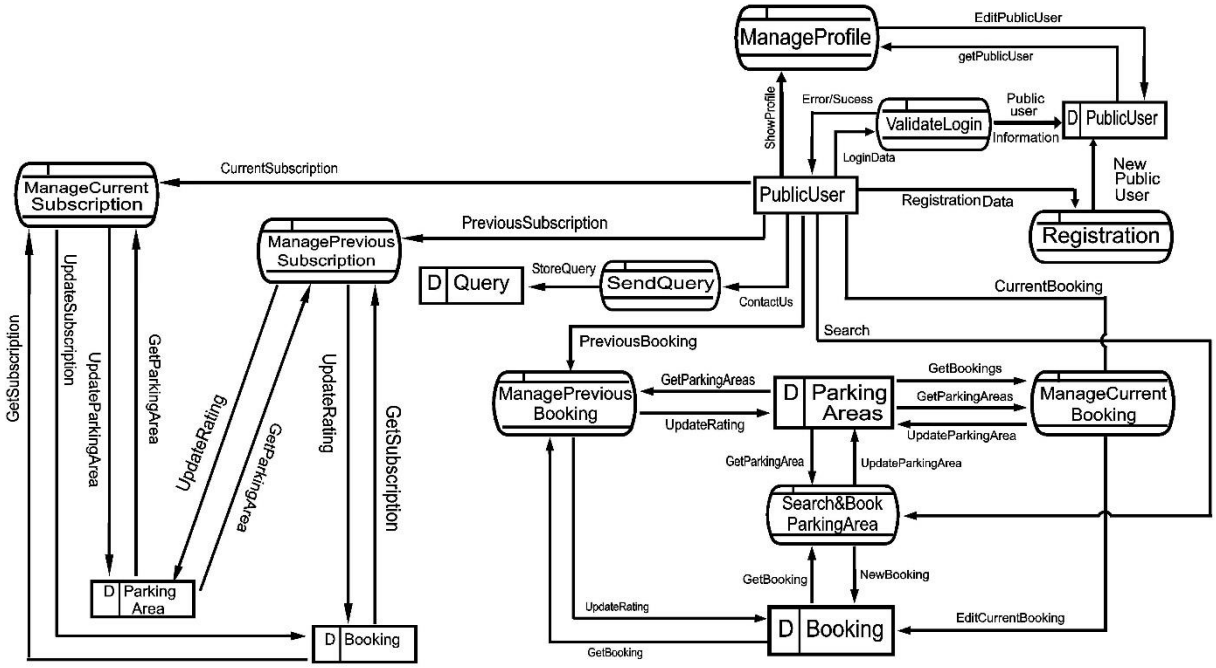

Fig. 1.12 Dataflowdiagram_public user

Provider

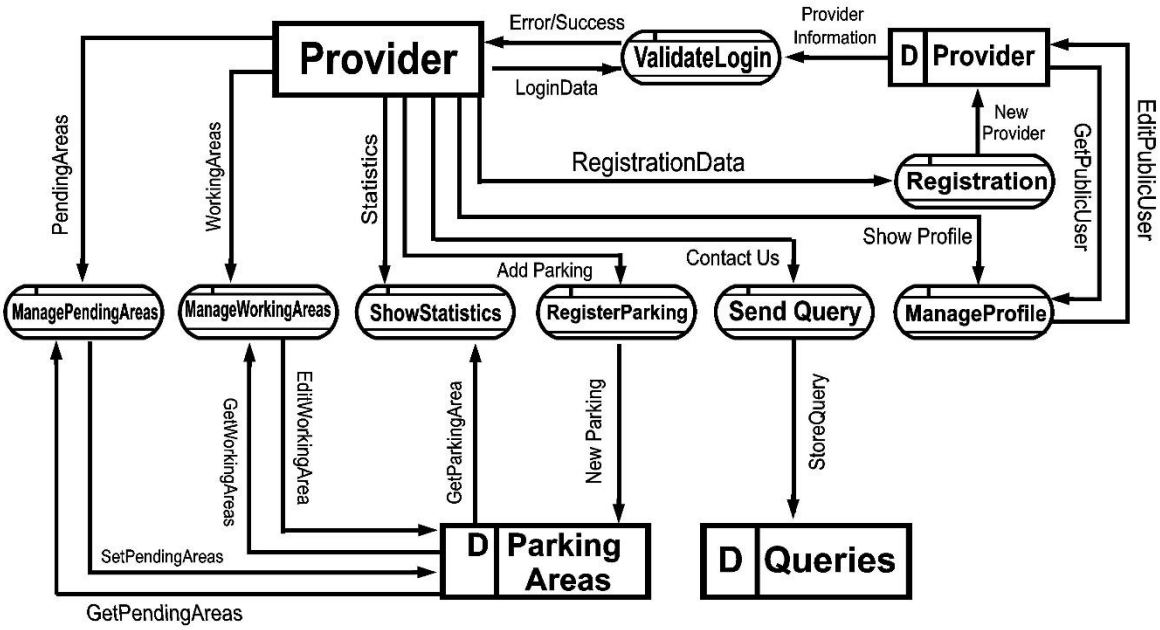

Fig. 1.13 Dataflowdiagram_provider

Sequence Diagram

Visitor

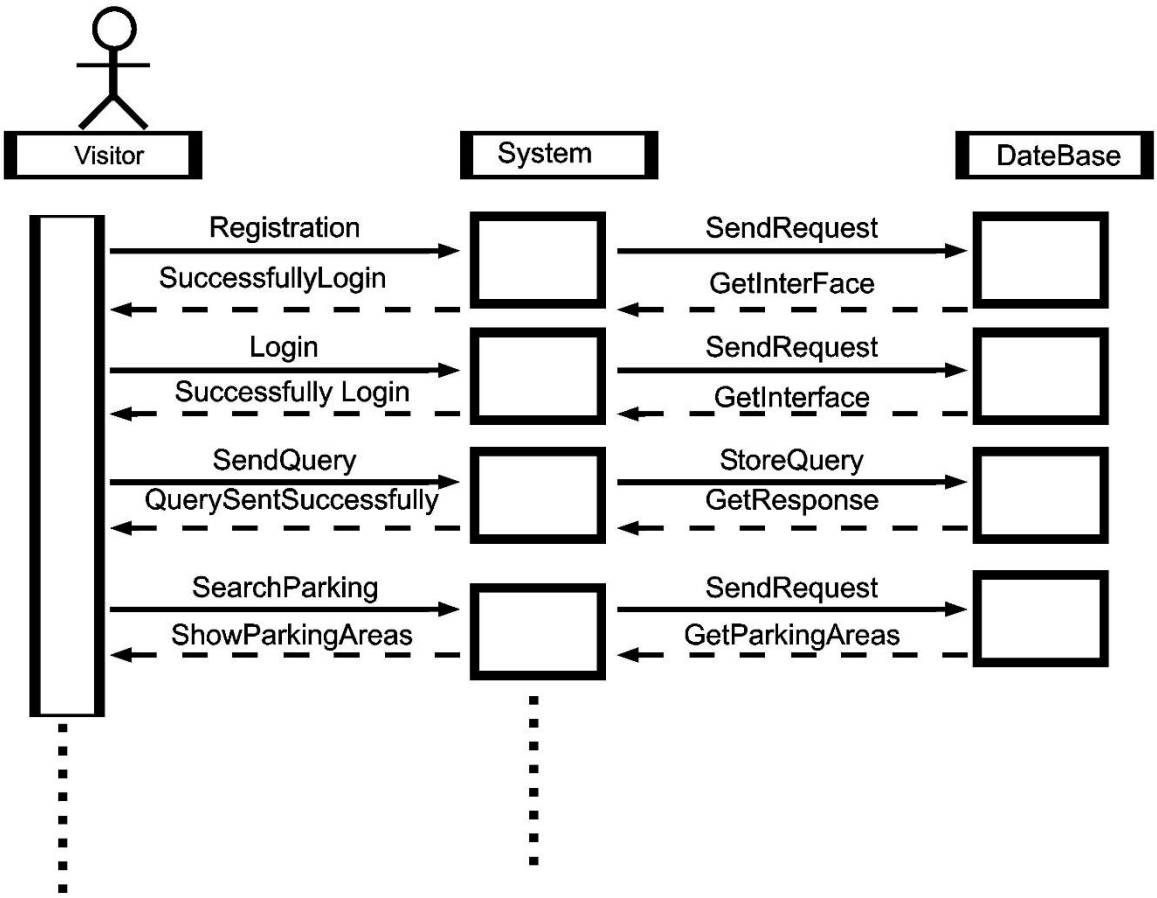

Fig. 1.14 Sequencediagram_visitor

Public user

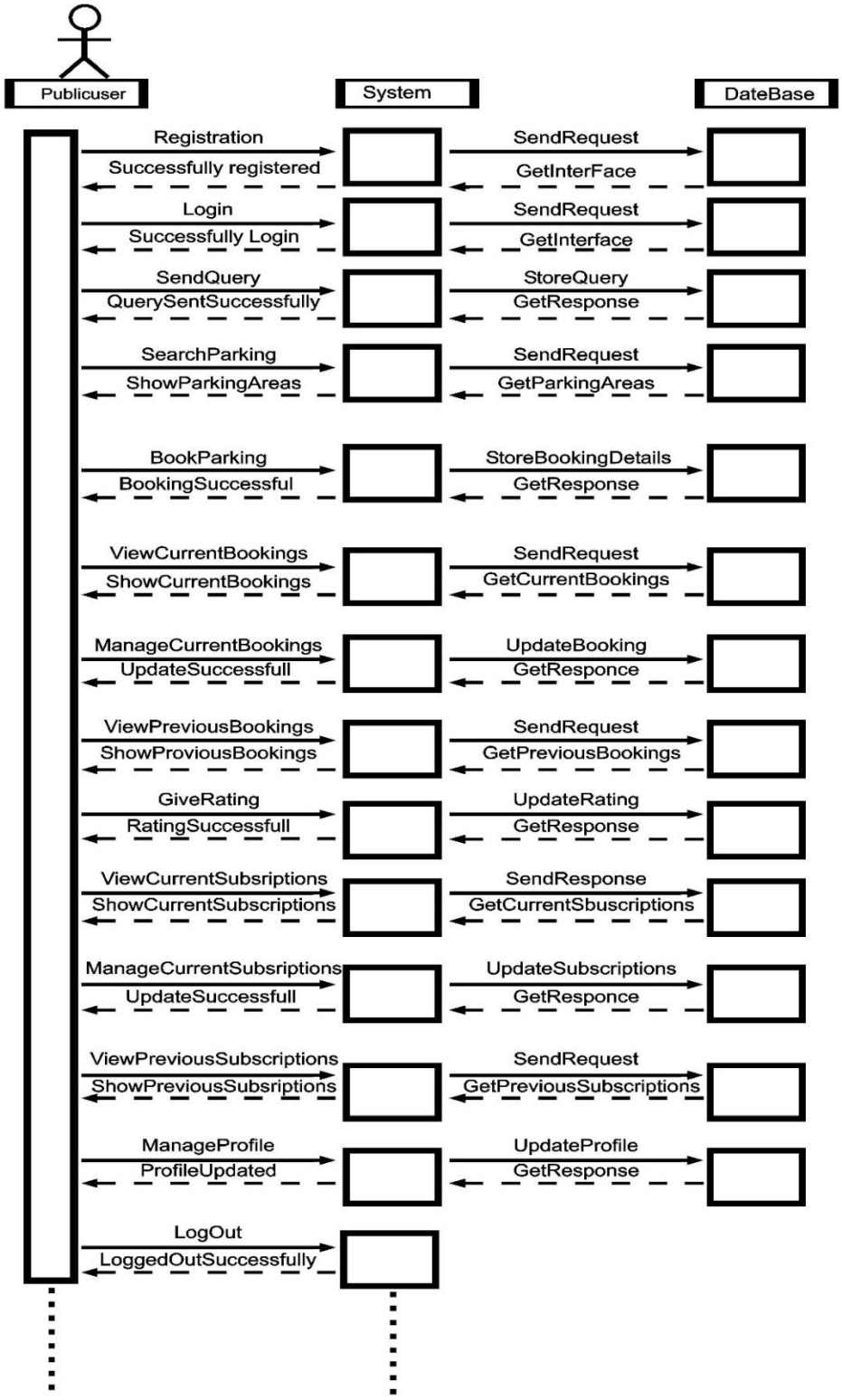

Fig. 1.15 Sequencediagram_public user

Provider

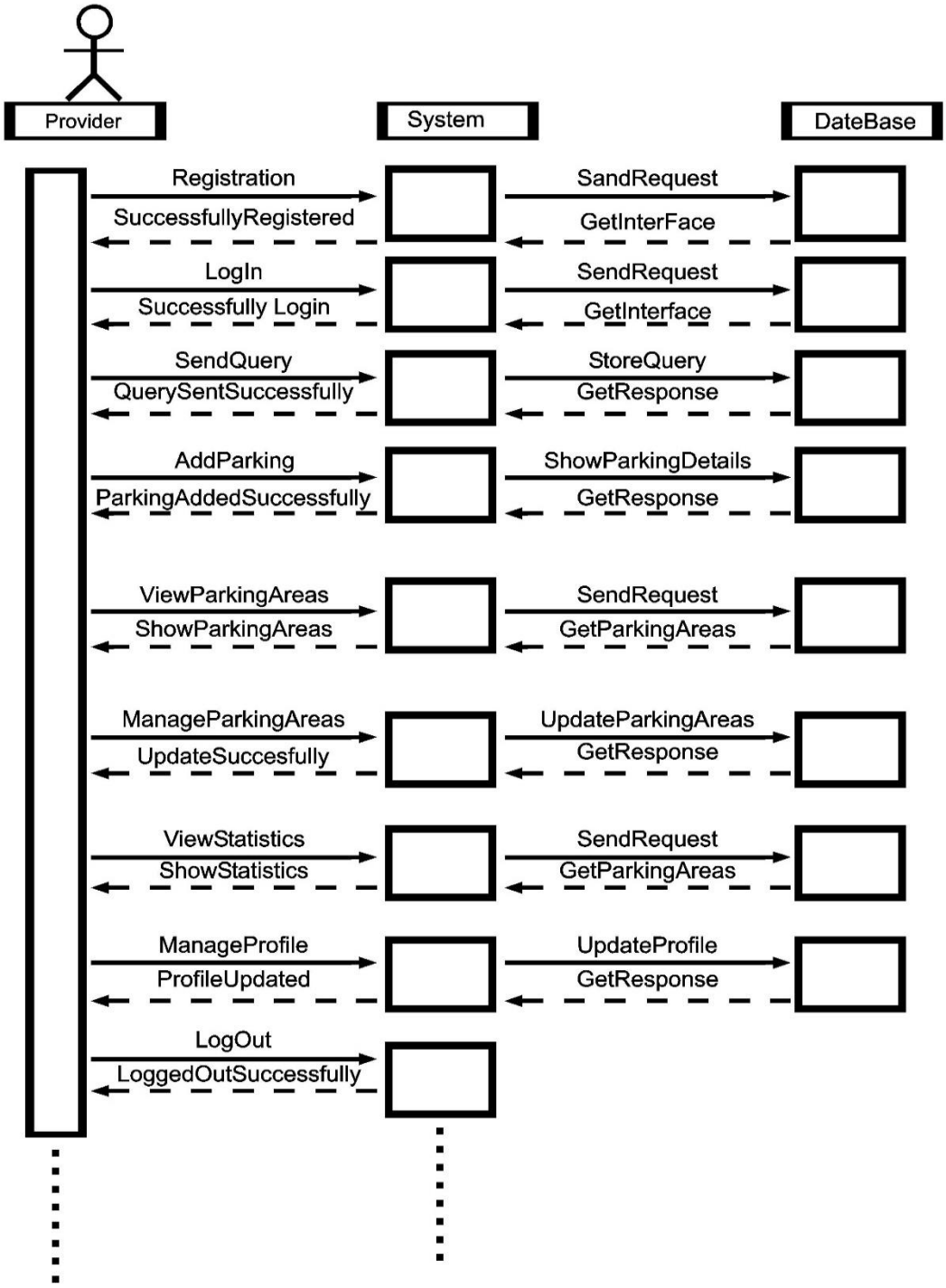

Fig. 1.16 Sequencediagram_provider

Conclusion

Overall, the project is very useful to revolutionize the traditional parking system. It provides people with a more convenient and time-saving way of parking their cars in their busy life. Also, from the parking provider’s view money and vehicle management becomes very easy through the application. Along with that, statistics provide a new way to think and take decisions regarding the parking area of the provider. The different features given in the application give the user overall the best user experience and reliability.

Documentation

Project: ParkMate

Members
Anshul Prajapati (110189295)
Nisthaben Patel (110184308)
Om Siddhapura (110187008)
Ved Prajapati (110186761)

Introduction
The ParkMate application aims to support normal user to find and reserve parking area effectively. Also, the provider user can manage generated revenue with analysis. This proposal showcases the structure approach taken to develop the project, including research methodologies, processes followed, and task allocations.

Involvement and productivity of the members
Anshul Prajapati:
I review the different websites regarding cost estimation. I did not know about how to estimate the cost, so I searched on Google. I carefully read some websites like GFG and project manager blog websites. This reading helps me to understand how to measure the cost, which are the objectives we choose to estimate the cost like software and hardware requirements cost, human resource cost, maintenance cost and many other parameters, which we take to analyze the cost. Additionally, I learn the formatting of the document in a professional way. So, this helps to improve the readability of the document.

Nisthaben Patel:
I have learned to work in collaboration while working with the diverse team members to achieve the objectives of the proposal. Additionally, I learned how to design the Quality Management Plan and ensure that the final project will meet the user expectations and system fulfil the technical requirements. Furthermore, I enhanced my skills to ensure that the project is feasible from all perspectives and gained deeper understanding about the thorough analysis in the documentation.

Om Siddhapura:
I was involved in literature review, diagram generation and over technical feasibility or the report. This project proposal helped me a lot because I learnt too many new things in a practical setting. The tasks that were assigned to me were not new to me. Hence, I decided to keep my deadline for the tasks within 5 hours. Eventually I was happy that I could complete the task within the time bound along with accuracy. I got feedback from my teammates and improved my work during this creation. Also, I reviewed tasks that were done by other members where I got to know about accurate formatting ways to find out related resources to study information. Overall, I gained a lot of new skills along with delivering my tasks on time.

Ved Prajapati:
I improved the readability and flow of key sections, including the problem statement, solution description, and implementation plan, ensuring that complex ideas were clearly conveyed.

Additionally, I worked on aligning the formatting, terminology, and structure throughout the document, creating a more cohesive and professional proposal. My refinements helped maintain clarity, making it easier for readers to understand the project.

Scientific organized approach to produce the proposal

Approach Followed:

1. **Requirement Analysis**
   Firstly, the main problem was identified along with connected smaller issues in society. Later the scope of the problem was discussed followed by possible market study. And expected results are acknowledged with accordance with the problems.

2. **Research & Feasibility Study**
   In this phase we collected several possible reports and research papers to figure out the literature review and know the technicality of the project. Furthermore, listed out the feasibility of the project for the client's requirements.

3. **Design & Planning**
   The problem was identified. The solutions were figured out and then we created data flow diagrams and development timelines to complete the project the desired timeframe.

4. **Proposal Drafting**
   Once the major points were cleared the initial draft was made according to standard structure with maintaining clarity and overall meaning.

5. **Review & Refinement**
   Performed multiple iterations to enhance quality before submission.

Processes and Methodologies to write the proposal

To ensure an effective proposal, the following procedures and methodologies were applied:

Meetings
Several Microsoft Teams meeting and physical meetings were done prior to the project proposal creation to make it accurate and standard. Here we improved our communication skills along with technical abilities.

Doubt Solving
Resolved the issues coming in the running time for the team mates at frequent time.

Articles related to project
Different online resources were analyzed and studied deeply before the report for better understanding of the problem.

Taking Notes
While analysis and study of the project notes were taken down in order to improve personal knowledge and maintained it for the drafting.

Tasks allocation to produce the proposal

Task	Assigned Member	Responsibility
Literature Review	All	Need to go through the problem, identify potential risks, background study of other applications through online resources.
Diagrams	Om Siddhapura and Ved Prajapati	Data flow diagrams indicating the basic flow of working project.
Proposal Drafting	Nistha Patel and Anshul Prajapti	Structure the content in order, maintain grammar and write the content in meaningful way
Technical Feasibility	Om Siddhapura and Nistha Patel	Need to Ensure the overall technical meaning of project
Final Formatting & Review	Anshul Prajapti and Ved Prajapti	Refine, format and decision of the final version of the project.

All the distributed tasks were analyzed and verified by other members of the group once it was completed. Suggestions were made by each member and again in next iteration the mistakes were removed, and the document was refined.

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- **Diagrams**
  - https://www.canva.com/en_gb/
- **Notes**
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  - https://www.parkwhiz.ca/