SCSJ3553 ARTIFICIAL INTELLIGENCE

Artificial Intelligence Project

Project Title: AI Parking Finder

Submitted to: Dr Shahrum Shah Abdullah

Submitted by: Group 2

Overview

In today's rapidly evolving technological landscape, the integration of Artificial Intelligence (AI) has become essential for addressing a wide range of challenges and opportunities. This proposal seeks to explore the application of AI in the context of healthcare, agriculture, smart education, smart city and sentiment analysis. The following sections will provide an in-depth analysis of the project, including empathizing with stakeholders, defining requirements, proposing an AI solution, and outlining the goals and scope of the solution.

This project employs the design thinking approach. As a part of the approach, multiple problems have been considered and the team has empathized with the stakeholder base of the relevant problem areas. Thus, the proposal will report the findings of the empathization process from the perspectives of the different problems. Finally, the solution chosen will be elaborated upon.

Design Thinking Based Proposal

Empathization

Healthcare

In the realm of healthcare, a pressing issue is the timely detection and management of chronic diseases, such as diabetes. Patients diagnosed with diabetes often face the daunting task of monitoring their blood glucose levels, adhering to a strict medication regimen, and making lifestyle adjustments. This daily responsibility not only strains the patients but also places significant demands on healthcare professionals, who must provide continuous support and guidance. If there is an AI that can help users create medication regimen, diets, and lifestyle alterations, it would take pressure off of the healthcare system and streamline the whole process.

Smart Education

In the domain of smart education, a significant challenge lies in the struggle that students face in staying engaged with online learning, personalized content, and timely feedback. Students often find it challenging to maintain their motivation and grasp the material effectively, resulting in suboptimal learning experiences. Empathizing with these students, one can appreciate the frustration of feeling disconnected and isolated in digital learning environments. To alleviate these issues, a potential solution could involve the development of an AI-driven, personalized learning platform. This platform would adapt to each student's unique needs, offering tailored content, interactive lessons, and instant feedback. By fostering a sense of connection and engagement, such a platform could significantly enhance the overall learning experience for students in the digital age.

Smart City

An AI-powered Parking Space Management system is acutely aware of the varied needs and concerns of urban stakeholders. Drivers' daily search for an available parking spot frequently results in tiredness and irritation as they navigate congested streets, spending valuable time and fuel in the process. By solving this issue, the AI system provides real-time monitoring and dynamic guidance, guaranteeing that drivers are efficiently led to open parking spaces, minimizing the inconvenience of circling blocks in search of a spot. Simultaneously, city planners must deal with the serious issue of urban traffic congestion, which is aggravated by insufficient parking facilities. Their mission is to improve urban mobility, alleviate traffic congestion, and promote environmentally friendly transportation solutions. The AI technology supports this objective by optimizing parking space allocation, reducing search times and contributing to less congested roads.

Definition

The AI-based Parking Space Management system is a pioneering solution designed to tackle urban parking challenges in Smart Cities, with a primary focus on enhancing efficiency, user experience, and sustainability. Utilizing real-time monitoring through a network of sensors and cameras, the system continuously assesses parking space availability, feeding this data into a centralized AI platform. This platform employs intricate algorithms and machine learning models to optimize parking space distribution, considering factors such as time, day, special events, and historical usage patterns. By providing drivers with real-time information through mobile apps and digital signage, the system empowers them to make informed parking decisions. Additionally, features like a reservation system, dynamic pricing, and incentives for environmentally friendly transportation contribute to a comprehensive approach that addresses the diverse needs of stakeholders, from individual drivers to city planners and businesses.

Proposed Solution

To fulfill the varying needs of numerous stakeholders, the AI-based Parking Space Management system takes a holistic approach. It all starts with real-time monitoring, in which an array of sensors and cameras are strategically placed to track parking space availability in real time. This data is routed to a centralized AI platform, where it is processed in real time. The AI then communicates with drivers via mobile apps or digital signage, giving them up-to-date information on available parking spaces and allowing them to make an informed parking choice.

Furthermore, the system uses complex algorithms and machine learning models to optimize parking space distribution. To estimate demand and assign spaces effectively, it takes into account a variety of criteria such as time of day, day of week, special events, and past usage patterns. This reduces the amount of time vehicles spend looking for parking, thus lowering traffic congestion and improving urban mobility.

For an even more simplified experience, drivers can reserve parking spaces ahead of time using specific mobile apps or websites. This feature ensures that a parking space is waiting for you when you arrive, saving you the stress of looking for an available space. Reservations can be personalized to specific time slots or prolonged periods, allowing for a wide range of driver requirements.

The system also employs dynamic pricing mechanisms, which modify parking fees based on supply and demand. Prices may rise during peak hours or high-demand periods to encourage alternate transit means or off-peak usage, fostering balanced space utilization throughout the day.

To comply with sustainability aims, the system promotes environmentally efficient transportation methods. It may provide discounts or preferential parking for electric automobiles, bicycles, or ridesharing services. It can also encourage people to use public transportation by providing information about nearby bus stops or train stations and integrating with existing public transportation networks.

The AI-based Parking Space Management system efficiently revolutionizes the parking experience for drivers, optimizes urban mobility for city planners, and maximizes customer footfall for businesses with these comprehensive solutions. This comprehensive approach helps to minimize congestion, increase accessibility, and create a more sustainable urban environment.

Project Goals

1. Develop a Parking System Powered by AI:
    - Use AI to solve urban parking issues in Smart Cities.
    - For effective parking space management, use real-time monitoring.
2. Improve Allocation Using AI Techniques:
    - Optimize parking allocation by using knowledge representation and state space search.
    - Consider numerous aspects when implementing machine learning models.
3. Improve the User Experience:
    - Create a working prototype app for real-time parking information.
    - Introduce a reservation system for stress-free parking.
4. Implement Dynamic Pricing:

- Use dynamic pricing to encourage balanced space utilization.
- Fees should be adjusted based on demand to maximize utilization.

5. Encourage environmentally friendly transportation:
   - Offer incentives and discounts.
   - Connect to public transit networks to provide smooth commuting.
6. Design Thinking:
   - Apply design thinking to create a thorough and user-centric prototype.
   - Address the demands of many stakeholders.
7. Create a Proof of Concept:
   - Create a prototype that demonstrates the system's practicality.
   - Demonstrate urban transportation optimization and congestion reduction.
8. Facilitate Stakeholder Communication:
   - Use mobile apps and signs to enable effective communication.
   - Inform users about reservations, dynamic pricing, and incentives.
9. Contribute to Urban Planning:
   - Assist city planners in achieving mobility and sustainability goals.
   - Optimize parking distribution aligned with city planning objectives.

10. **Final Objective**:
    - Create Fully Functional Prototype:
    - Develop and deliver a fully functional prototype.
    - Demonstrate the system's capability to revolutionize urban parking and enhance overall urban mobility.

Scope

The scope of the project is to develop a fully functional AI-powered Parking Space Management system, aimed at transforming the urban parking landscape in Smart Cities. The project encompasses the implementation of real-time monitoring for enhanced space management, utilizing advanced AI techniques like knowledge representation and state space search to optimize parking allocation. User experience takes center stage, involving the creation of a prototype app that offers real-time parking information and a user-friendly reservation system. Dynamic pricing mechanisms are integrated to encourage balanced space utilization by adjusting fees based on demand. Incentives for environmentally friendly transportation methods, along with seamless integration with public transit networks, contribute to the project's overarching sustainability goals. The application of design thinking ensures a user-centric approach, and the project aims to showcase its practicality through a proof of concept, demonstrating the optimization of urban transportation and congestion reduction. Effective communication with stakeholders, including drivers and city planners, is facilitated through mobile apps and signage. The ultimate goal is to deliver a fully functional prototype, showcasing the system's capacity to revolutionize urban parking and enhance overall urban mobility.

Knowledge Representation

Please Note

x: Parking space

A(x): Availability of x according to sensors

Dist(x): Distance of x in meters

Nav(x): Navigate to x

R(x): Reserved x

H(x): High Demand x

Find Nearest Parking Space

KR1: IFF Parking Sensor = available AND Parking sensor distance <= 350m THEN Navigate to Parking.

Vx, [A(x) Λ Dist(x) <= 350] <=> Nav(x)

Expand Search Radius if there are no parking spaces

KR2: IFF Parking sensor distance <= 350m AND Parking Sensor = unavailable THEN Parking sensor distance = Parking sensor distance - 350m

Vx, [Dist(x) <= 350 Λ ~A(x)] <=> Dist(x) = Dist(x) - 350m

Dynamic Pricing for High Demand:

KR3: IFF Parking Sensor = available AND Dynamic Pricing = true AND High Demand = true THEN Increase Pricing.

Vx,[A(x) Λ P(x) Λ H(x)] ⇔ Increase Pricing

Reserve Parking Space in Advance:

KR4: IFF Reservation = true THEN Reserve Parking.

Vx,R(x) ⇔ Reserve(x)

Optimal Distribution Based on Past Usage Patterns:

KR5: IFF Past Usage Patterns indicate high demand for a specific time slot, THEN prioritize allocating parking spaces for that time slot.

Vx, [H(x) Λ PastUsagePattern(x)] <=> OptimizeAllocation(x)

Encouraging Sustainable Transportation:

KR6: IFF Vehicle Type = Electric THEN Provide preferential parking or discounts.

Vx, [A(x) Λ ElectricVehicle(x)] <=> PreferentialParking(x)

Real-time Traffic Information:

KR7: IFF High Traffic Congestion AND No available parking spaces THEN Suggest alternative Parking.

Vx, [HighTrafficCongestion(x) Λ ~A(x)] <=> SuggestAlternativeParking(x)

Adaptive Dynamic Pricing during Special Events:

KR8: IFF Special Event = true AND Parking Sensor = available THEN Adjust pricing dynamically.

Vx, [A(x) Λ SpecialEvent(x)] <=> AdjustPricing(x)

Weather-based Parking Recommendations:

KR9: IFF Inclement Weather AND Parking Sensor = available THEN Provide indoor or covered parking suggestions.

Vx, [InclementWeather(x) Λ A(x)] <=> ProvideCoveredParkingSuggestions(x)

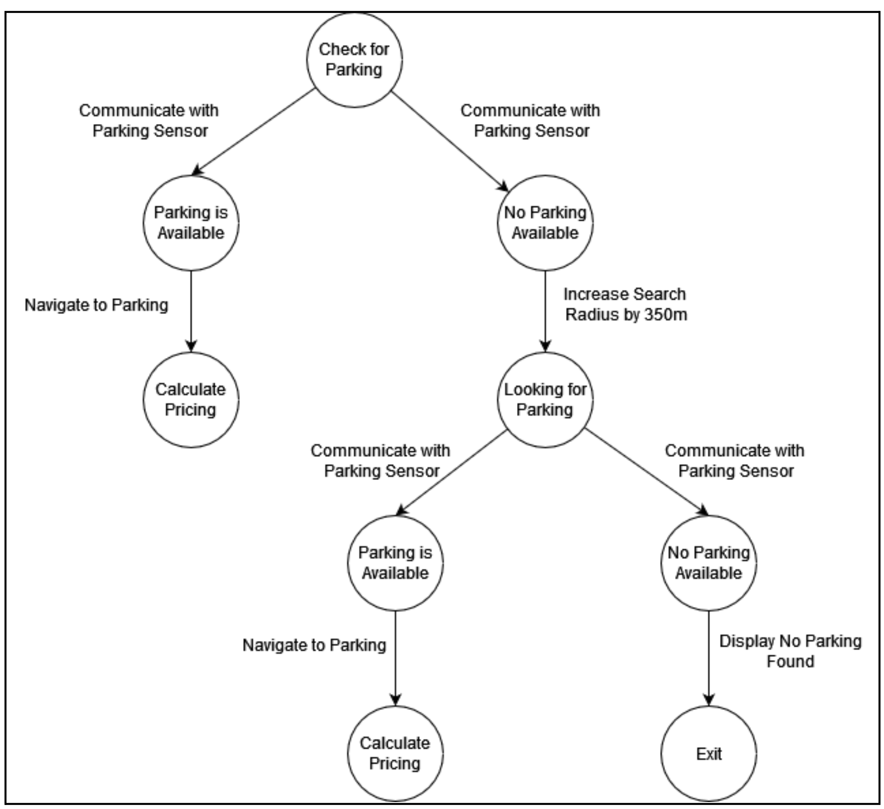
Real Time Traffic Congestion Monitoring:

KR10: IFF Traffic Congestion Level = High THEN Provide alternative parking suggestions.

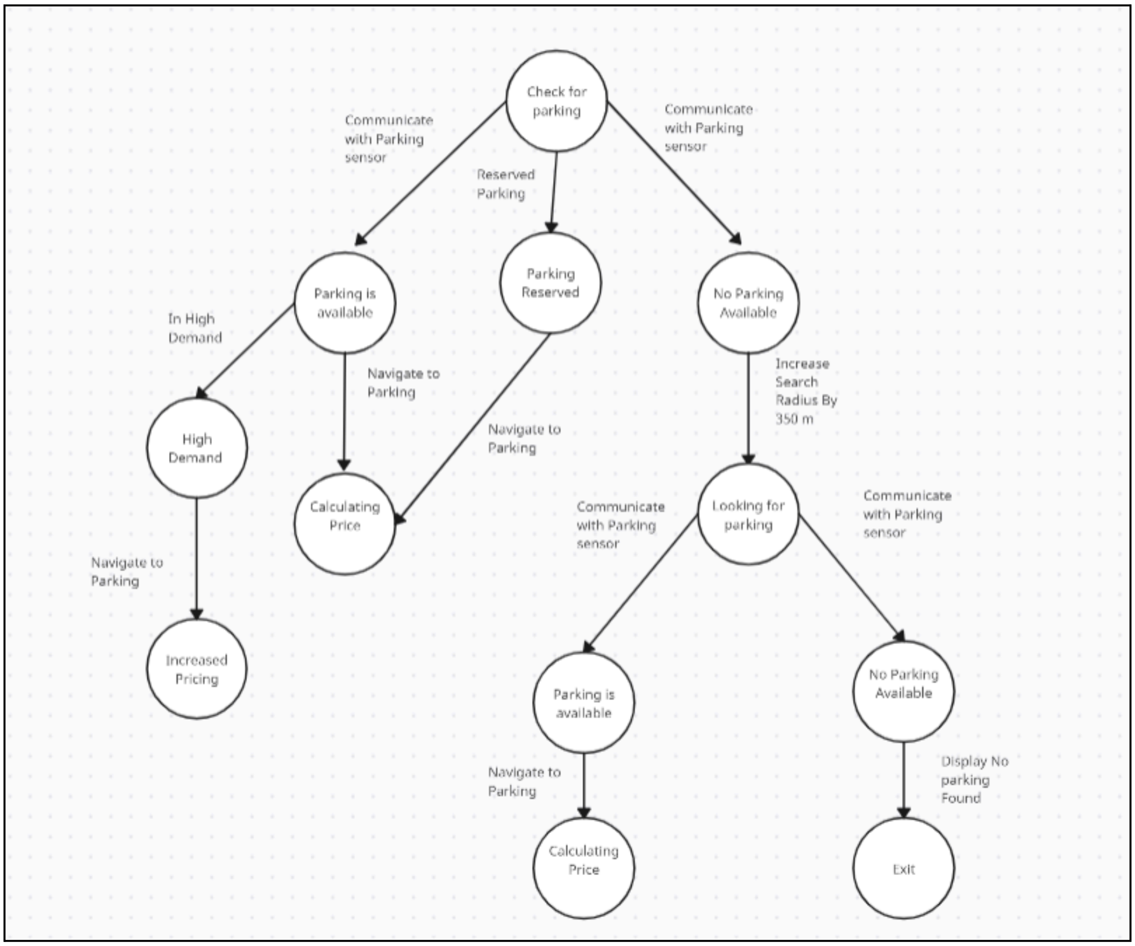
Vx, [HighTrafficCongestion(x)] <=> ProvideAlternativeParkingSuggestions(x)

State Space

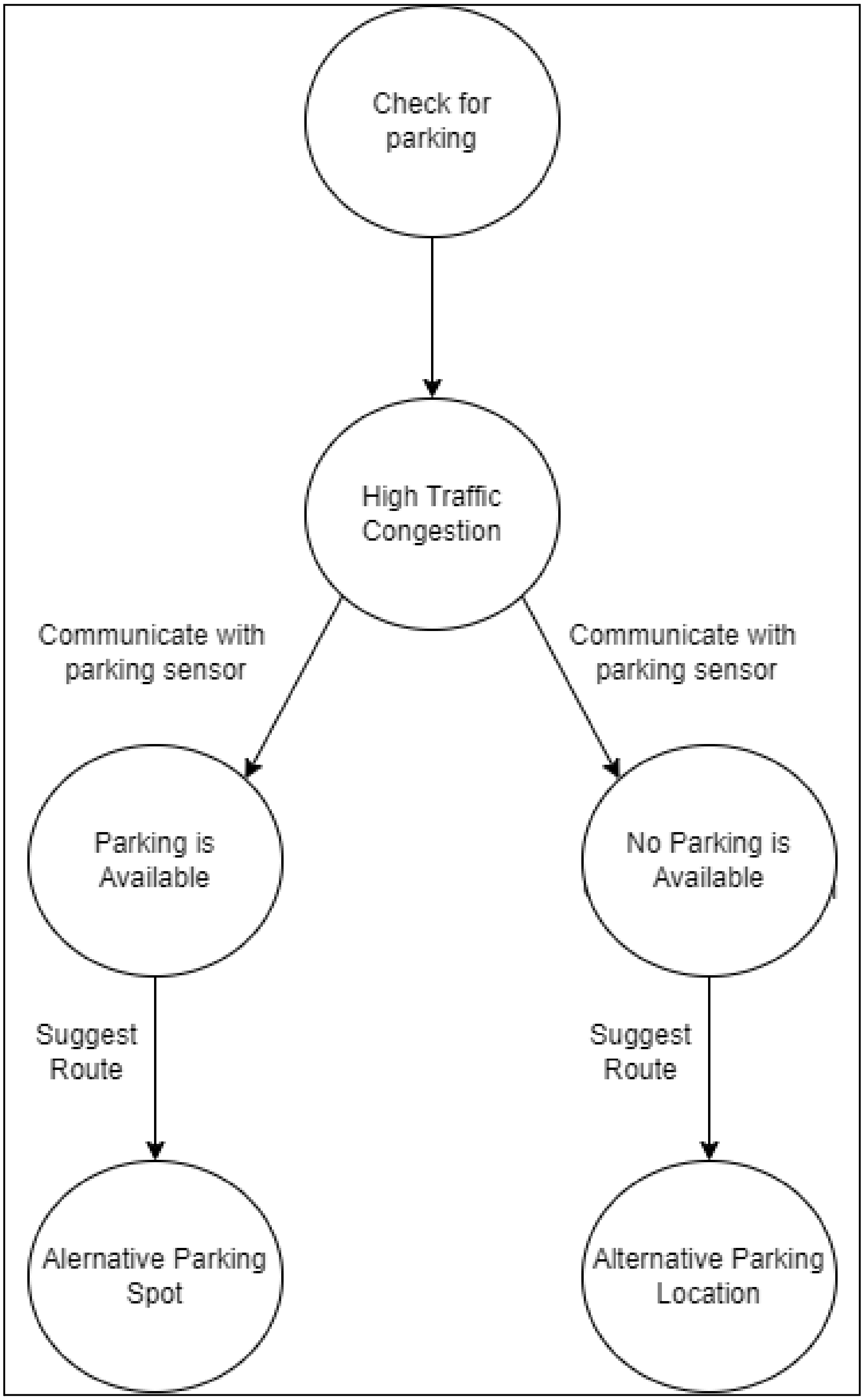
State space graph based on KR1 and KR2:



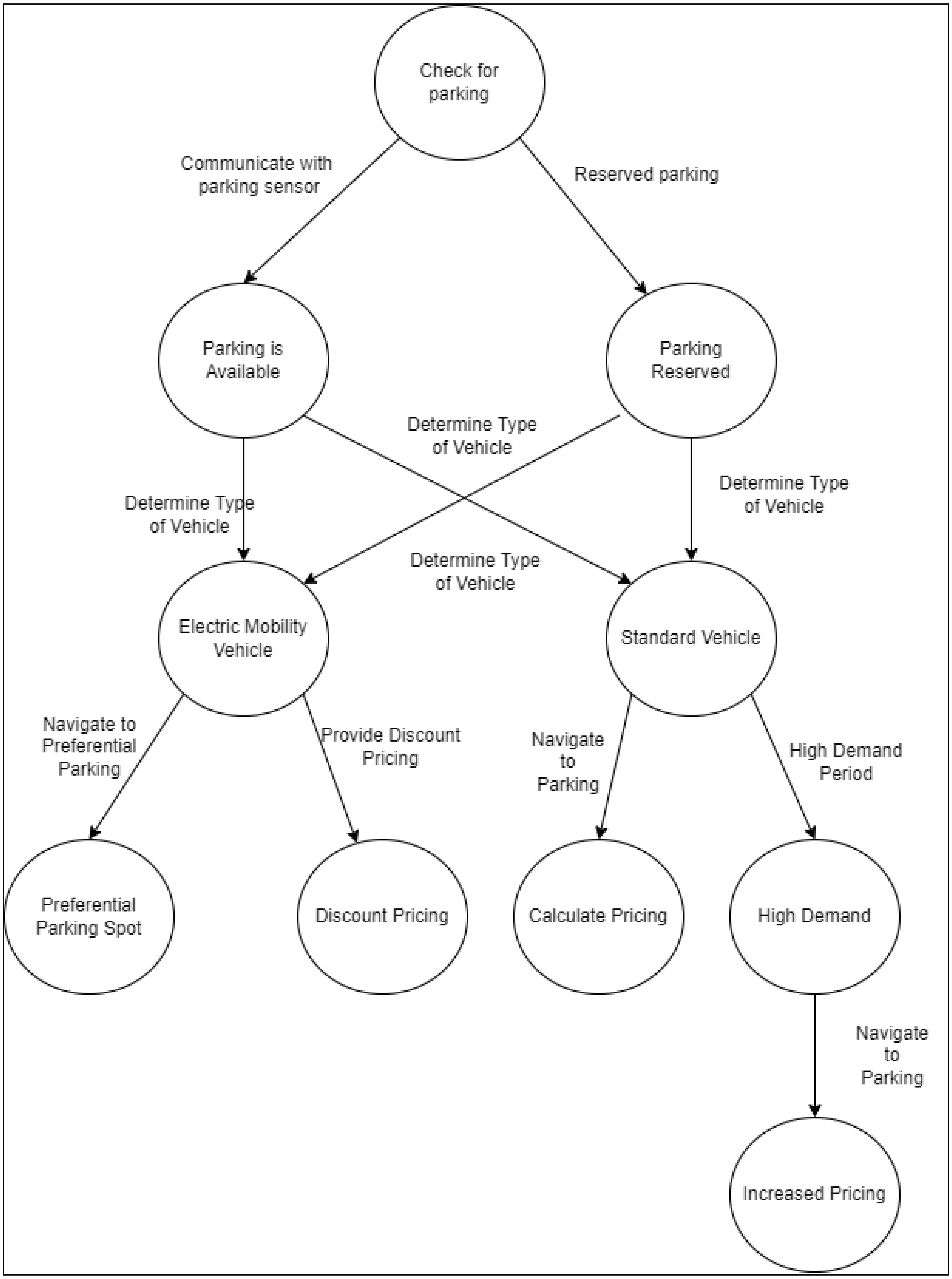
KR3 AND KR4 linked to KR1 and KR2



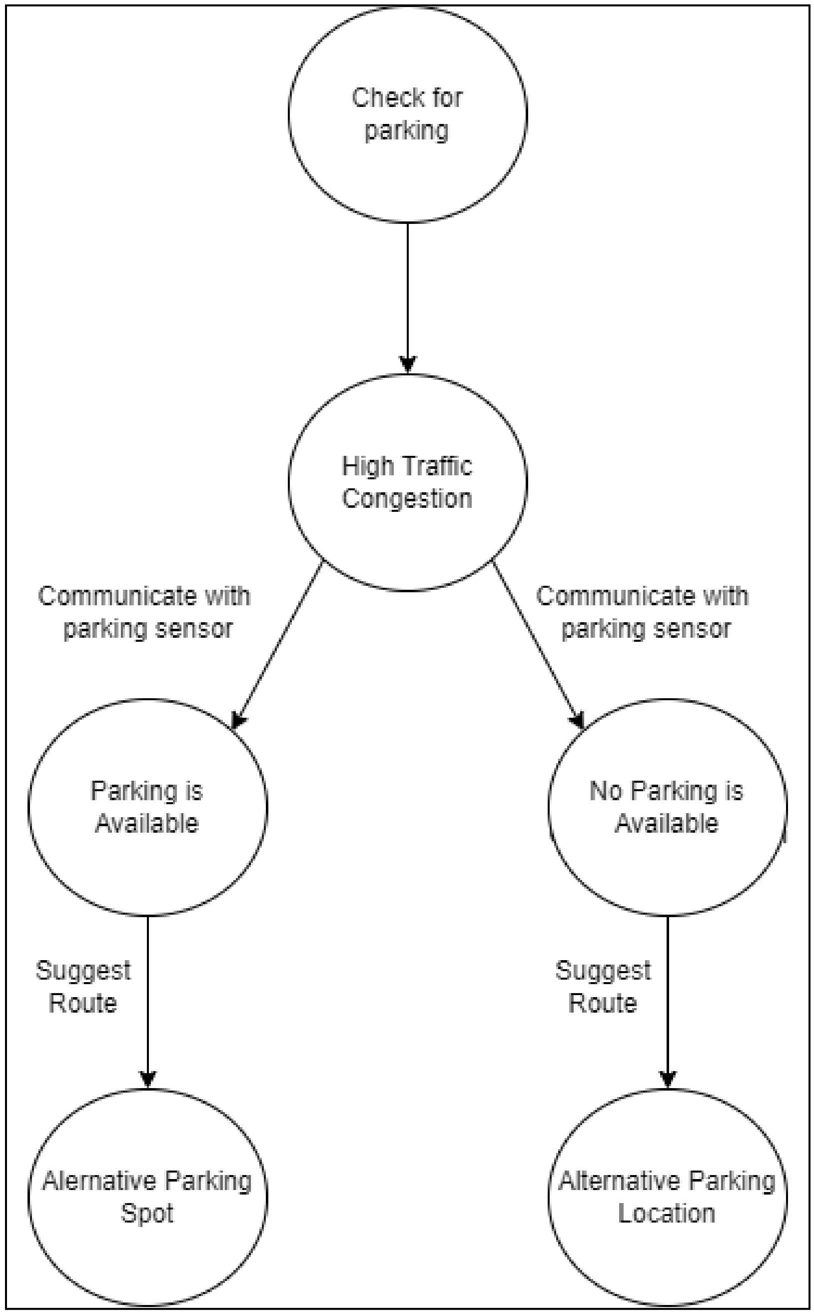
State space graph based on KR5 (unlinked view)



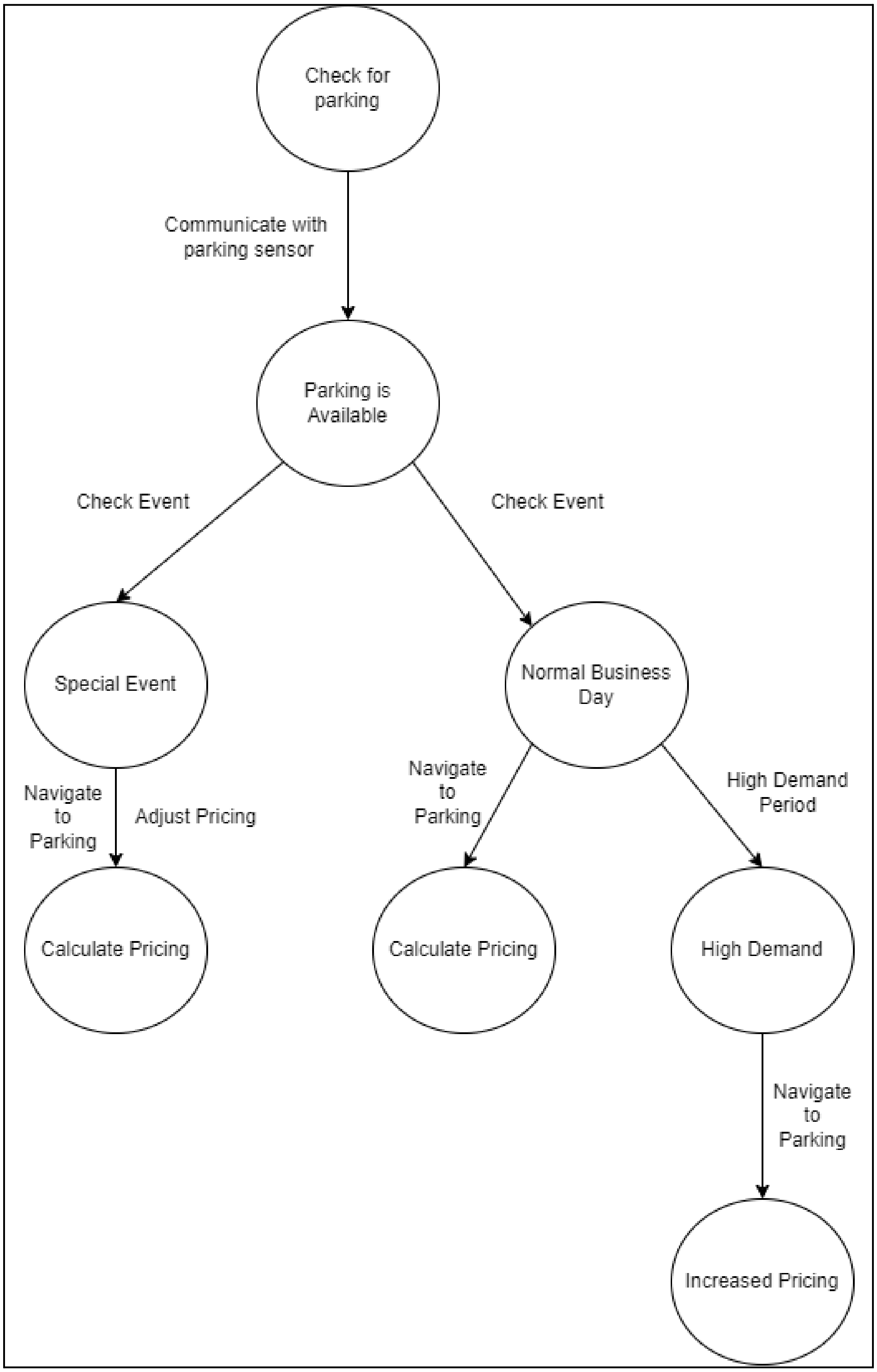
State space graph based on KR6



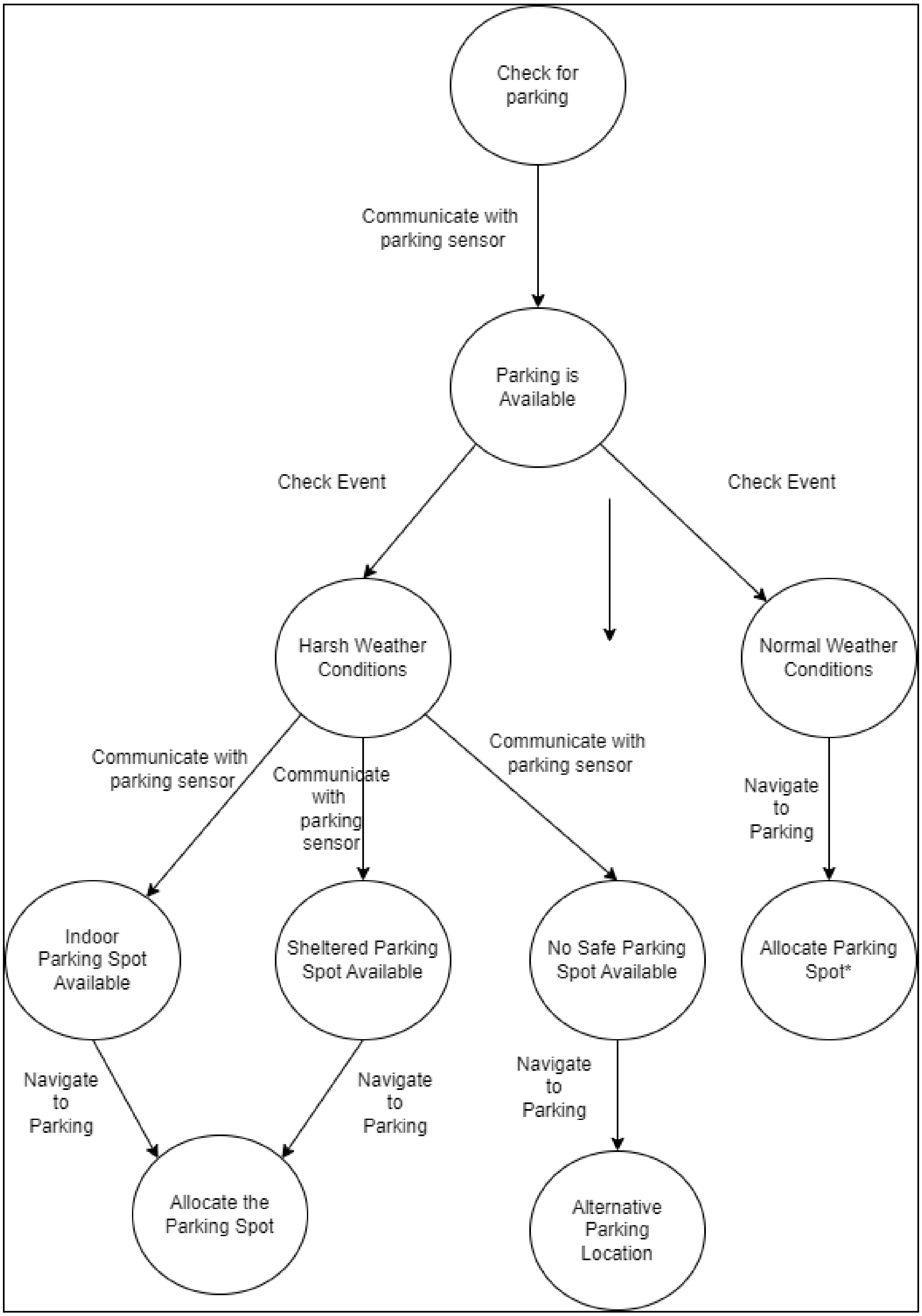
State space graph based on KR7 and KR10 (unlinked view)



State space graph based on KR8 (unlinked view)



State space graph based on KR9 (unlinked view)



Proposed AI Solution using PEAS Model:

1. Performance Measure (P):

Definition: The AI system's success metric.

Explanation: The major purpose is to improve the parking experience for consumers by taking into account elements such as time efficiency, user satisfaction, and resource use. Key performance indicators will include metrics such as reduced search time, increased reservations, and favorable user feedback.

2. Environment (E):

Definition:The external environment in which the AI system functions.

Explanation: The environment consists of metropolitan areas with parking spots, road networks, and parking users. It also includes elements such as traffic conditions, previous usage patterns, and events that influence parking demand. AI must overcome problems posed by the dynamic nature of urban areas.

3. Actuators/Effectors (A):

Definition:Mechanisms via which the AI system interacts with its surroundings.

Explanation: Actuators have the potential to reserve parking spaces, dynamically alter pricing, give incentives, optimize space allocation, and improve the user experience. By dynamically guiding drivers, offering bookings, and modifying price based on demand and sustainability requirements, the system will have an impact on the environment

4. Sensors (S):

Definition:Devices that collect data from their surroundings

Explanation: Sensors include detectors for parking space availability, dynamic pricing indicators, reservation status monitors, and data sources for prior usage patterns. These sensors give real-time environmental information, allowing the system to make intelligent judgments.

Representation in the Proof of Concept (POC):

In the POC, each property in the PEAS model will be implemented as follows:

Performance Measure (P):
Metrics for reducing search time, increasing reservation rates, and improving customer happiness will be tracked and analyzed.
Environment (E):
The proof of concept will be an urban environment with variable parking demand, traffic conditions, and events.
Actuators/Effectors (A):
Modules for implementing actuators such as the reservation system, dynamic pricing adjustment, and space allocation optimization will be included in the POC.
Sensors (S):
Simulated sensors will offer real-time information on parking availability, pricing conditions, and usage patterns in the past.

How the Agent Behaves:

In this case, the AI agent acts by continually monitoring the environment via sensors, making decisions based on the defined knowledge representation statements, and affecting the environment via actuators in order to maximize the parking experience for users. It adapts to changing situations dynamically, prioritizes actions based on high demand and past patterns, and promotes sustainable mobility behaviors. The agent's purpose is to attain ideal performance metrics by navigating the challenging urban environment and serving user needs as effectively as possible.

Prototype

Figma was used to create the high-fidelity prototype. Here is the link https://www.figma.com/file/1sJ1cJEyKEQT4k00W8n9Nv/AI-PARKING-ASSISTANT?type=design&mode=design&t=os8gz8OTqqWVNOu8-0

Conclusion

In conclusion, the AI Parking Finder project aims to address urban parking challenges in Smart Cities through a comprehensive and innovative AI-based Parking Space Management system. The proposal, rooted in the design thinking approach, identifies and empathizes with stakeholders in healthcare, smart education, and smart city contexts. The proposed solution leverages real-time monitoring, dynamic pricing, reservation systems, and sustainability incentives to revolutionize the parking experience for drivers, optimize urban mobility for city planners, and maximize customer footfall for businesses.