Faculdade de Engenharia da Universidade do Porto

Ambiguity and Architectural Questions

Software Systems Architecture

Team T24:

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Part 0: Context

The Traffic Signal Control System is a sophisticated traffic management solution designed to optimize traffic flow, reduce energy consumption, and enhance overall road safety. The system aims to minimize the time and energy expended by vehicles at traffic signals, thereby saving fuel, reducing emissions, and improving the driving experience for commuters.

As arquitects, it's vital to clarify all requirements for the optimized traffic signal control project. We must ask specific questions to understand functional and non-functional requirements, system limitations, end-user expectations, and potential implications for security, scalability, performance, and maintainability. This collaboration with analysts is crucial for project success.

Part 1: List of Questions

1. What is the budget for the development and implementation of the system?
2. What is the timeline for the deployment of the system?
3. How will the system detect the speed and volume of oncoming traffic?
4. How will the traffic signal control system interface with existing traffic infrastructure?
5. What are the specific criteria for optimizing traffic flow?
6. How will the system prioritize different types of vehicles (e.g., emergency vehicles, buses)?
7. What is the expected response time of the system in changing traffic signals?
8. How will the system adapt to varying traffic conditions throughout the day?
9. Will the system require manual override capabilities for traffic operators?
10. How will the system ensure the safety of pedestrians and non-motorized traffic?
11. What are the data privacy and security measures for the collected traffic data?
12. How will the AI component of the system be developed and trained?
13. What are the maintenance requirements for the system?
14. How will the system be powered, and are there backup power solutions?
15. How will the system handle communication or data exchange between different traffic signals?
16. How will the system handle unusual traffic scenarios or accidents?
17. What are the environmental impact considerations for the system?
18. How will the effectiveness of the system in reducing emissions be measured?
19. Are there any legal or regulatory considerations for implementing such a system?
20. How will the system account for and manage pedestrian crosswalk signals in conjunction with vehicular traffic signals?

21. What kind of user interface will traffic operators have to monitor and control the system?
22. How will the system be tested and validated for accuracy and reliability before full-scale deployment?
23. How will the project milestones and deliverables be defined and tracked?
24. How will cross-functional teams (e.g., engineering, IT, urban planning) be coordinated throughout the project?

Part 2: Organizing the Questions

System Design
- ➢ How will the system detect the speed and volume of oncoming traffic?
- ➢ How will the traffic signal control system interface with existing traffic infrastructure?
- ➢ What are the specific criteria for optimizing traffic flow?
- ➢ How will the system account for and manage pedestrian crosswalk signals in conjunction with vehicular traffic signals?
- ➢ How will the system handle communication or data exchange between different traffic signals?

Functional Requirements
- ➢ How will the system prioritize different types of vehicles?
- ➢ What is the expected response time of the system?
- ➢ How will the system adapt to varying traffic conditions?
- ➢ Will the system require manual override capabilities?
- ➢ What kind of user interface will traffic operators have to monitor and control the system?

Safety and Compliance
- ➢ How will the system ensure the safety of pedestrians and non-motorized traffic?
- ➢ What are the data privacy and security measures?
- ➢ Are there any legal or regulatory considerations for the system?

Technical and Maintenance
- ➢ How will the AI component be developed and trained?
- ➢ What are the maintenance requirements for the system?
- ➢ How will the system be powered, and are there backup solutions?
- ➢ How will the system be tested and validated for accuracy and reliability before full-scale deployment?

Environmental and Social Impact
- ➢ How will the system handle unusual traffic scenarios?
- ➢ What are the environmental impact considerations?
- ➢ How will the effectiveness in reducing emissions be measured?

Project Management and Implementation

- ➢ What is the budget for the system?
- ➢ What is the timeline for deployment?
- ➢ How will the project milestones and deliverables be defined and tracked?
- ➢ How will cross-functional teams (e.g., engineering, IT, urban planning) be coordinated throughout the project?
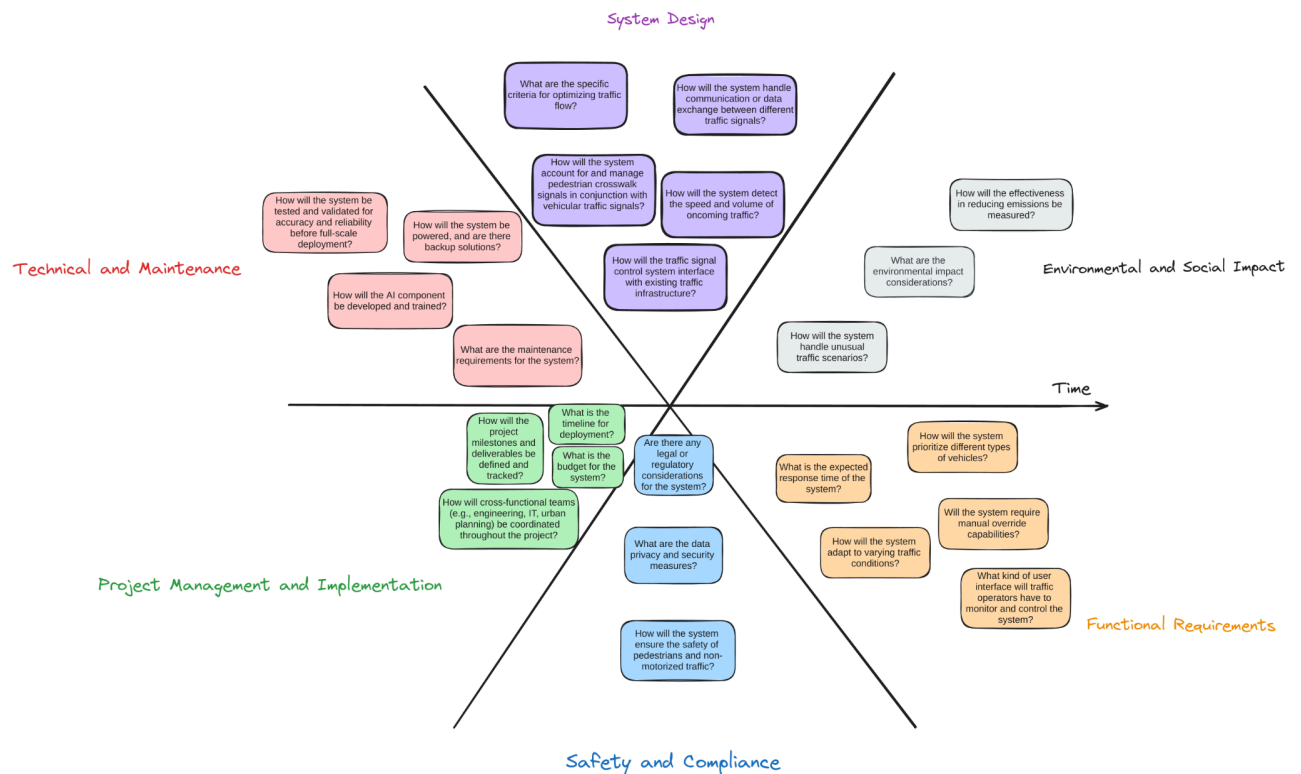

Fig. 1 - Spiderweb diagram

Part 3: Selecting 5 Important Questions

1. **What is the budget for the development and implementation of the system?**

   This question is crucial as it will let us know of the possible financial constraints for this project and, consequently, what human and physical resources will be available. These factors can highly influence the scale and timeline of the project, what features can be implemented and even whether the project is viable.
   This question impacts mostly the project stakeholders, the client and the development team.
   This should be one of the first questions to be posed, in the earliest stages of the project.

2. **How will the system detect the speed and volume of oncoming traffic?**

   This question is vital as the effectiveness of traffic signal optimization relies heavily on accurate and timely data about oncoming traffic.
   It impacts the development team, more concretely the developers in charge of implementing the detection system, in the case that this technology isn't already implemented.
   This question should be addressed during the early stages of system design and technology selection.
   The decision on traffic detection technology will impact the overall architecture and what resources need to be available for its implementation.

3. **What are the specific criteria for optimizing traffic flow?**

   To match the system's objectives with the client's expectations and the project's overall goals, it is essential to comprehend the precise criteria for optimizing traffic flow. This will provide clarity on what success looks like for the traffic signal control system.
   This question impacts both the development team and end-users, as it sets the foundation for system functionality and performance. Developers need this information to design algorithms and evaluate the system, while end-users benefit from a system that effectively improves traffic flow.
   This question should come up later than the previous two, as the more high-level design likely won't depend on it. It needs to be answered before the developers start working on any AI decision making component, and respective performance testing. The answer to this question guides the design of algorithms and decision-making processes within the system.

4. **Will the system require manual override capabilities for traffic operators?**

Determining whether manual override capabilities are needed ensures that the system can accommodate human intervention when necessary, providing flexibility and adaptability.

This question primarily impacts system operators, developers and UI/UX designers. Operators may need the ability to override automated decisions, and developers/designers must design and implement a user-friendly manual override interface.

This doesn't need to be among the first set of questions, as a considerable amount of the key features need to be designed and implemented regardless. Nonetheless, it must be posed timely as the design and implementation of this feature can take a significant amount of time.

The answer to this question influences the design of the system's control interface and decision-making processes. It may involve creating secure and intuitive manual override mechanisms, impacting the overall system architecture.

5. **What are the data privacy and security measures for the collected traffic data?**

As this system will likely handle large amounts of data, addressing data privacy and security is crucial to ensure compliance with regulations and to build public trust in the system. It should also address the potential for data sharing or collaboration with external entities and the corresponding security protocols.

This question impacts both the development team responsible for data handling and storage and the end-user. It might affect someone responsible for defining a privacy policy.

This should be considered during the early planning stages and continuously throughout the development process.

Data security measures will need to be integrated into the system architecture, influencing how data is collected, stored, and accessed.