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STUDENTS INC.

Project Plan

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# Project Overview and Objective

The primary objective of the undertaken project is to overhaul the existing static traffic light systems in favour of adaptive models. Unlike their traditional counterparts that operate on pre-set timers or other inefficient configurations, ITMS-equipped lights would analyse real-time traffic conditions to optimize green and red-light durations. This dynamic adaptability promises not just reduced waiting times at intersections but also improved overall traffic flow. The smart traffic lights will adapt to road conditions, effectively easing congestion during both peak and off-peak hours.

Another vital part of the project focuses on integrating the various data-collecting units like cameras, speed sensors, and emergency response systems. Currently, these operate in isolation, limiting their effectiveness in managing traffic optimally. Through ITMS, these units will be linked, as in interconnected, allowing for data sharing and better coordination. This integration is essential for implementing advanced features such as "green waves," that facilitate smoother flow and a more efficient road space distribution. Also, real-time data sharing will improve the responsiveness of emergency services, leading to faster and safer interventions when needed.

Security considerations are essential given the vulnerabilities exhibited by existing traffic management systems. The ITMS will incorporate advanced security protocols to protect against unauthorized activities. The objective is to ensure a robust and secure traffic management infrastructure, reducing the risk of manipulations that could compromise both system integrity and public safety.

Beyond the operational improvements, the project also seeks to make strides in the fields of environmental and economic sustainability. By minimizing idle times and optimizing traffic flow, the ITMS can significantly reduce fuel consumption. The consequent decline in vehicle emissions is a substantial step toward environmental stewardship, while the fuel and time savings translate to economic benefits for commuters and businesses.

Lastly, it's crucial to understand that the ITMS isn't merely a technological fix of any existing system; it's a strategic intervention aligned with broader urban planning objectives. Its successful implementation will serve as a cornerstone in creating more efficient, safer, and sustainable urban environments. Given the urgency of the challenges—ranging from ever-increasing urbanization to pressing environmental concerns—the need for a versatile and robust solution like ITMS has never been of more importance.

# Stakeholder Identification

Primary stakeholders

|  |  |  |  |
| --- | --- | --- | --- |
| Who | Role | Influence | Interest |
| Team members | Designers and developers of the project | High | High |
| Project manager | Leader/manager of the project team | High | High |
| Suzana Andova and Renáta Frenken-Liskova | Teachers and major assessors of the project | High | High |
| Sioux Technologies | Customers of the project / Advisers | Middle | High |
| ISSD | Major supplier of the project hardware | High | Low |
| Municipality / traffic authorities | Maintainers of the project when finished | Low | High |
| Traffic participants | End users of the project (e.g., drivers, pedestrians, cyclists) | Low | High |

Secondary stakeholders

|  |  |  |  |
| --- | --- | --- | --- |
| Who | Role | Influence | Interest |
| Regulatory bodies | Local and govermential policy makers | High | Middle |
| Local community | Residents and commuters in the areas where the project is deployed | Low | High |

# Roles and Responsibilities

|  |  |  |
| --- | --- | --- |
| Who | Role | Responsibilities |
| Pacera,Adrián A. | Project Leader | The group overall quality of work, progression made during sprints, deadline keeping and punctuality of the team |
| Stefanov,Vladislav V.R. | Scrum Master | Identifying tasks, maintaining the quality of the issue board every sprint (i.e, the To-Do list of the team), giving feedback on tasks open for review and answering questions about tasks in the issue board. |
| Zhechev,Iskren I.T. | Developer | Focussing on doing tasks in the issue board, communicating with the Project Leader and Scrum Master if needed, project participation in a professional and cooperative way and delivering work of sufficient quality. |
| Swinkels,Wouter W. | Developer |
| Kol,Tim T. Van | Developer |

# Availability

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Who | Mon | Tue | Wed | Thu | Fri | Sat | Sun |
| Adrián | At school  Or 6-10pm | 6 – 10pm | At school  Or 6-10pm | At school  Or 6-10pm | At school  Or 12pm-10pm | Available from 12pm | Available  From 12pm |
| Iskren | 9am-10:30pm | 9am-10:30pm | 9am-10:30pm | 9am-10:30pm | 9am-10:30pm | 9am-10:30pm | 9am-10:30pm |
| Vladislav | At school | 10 am – 5 pm | At school | At school | 10 am – 5 pm | 1 pm – 6 pm | 1 pm – 6 pm |
| Wouter | At school | At school (1PM-4PM) | At school | At school | 10AM – 10PM | 10AM – 6PM | ~12AM-10PM |
| Tim | At school | Available from  3 – 10pm | At school | At school | Available all day | Busy | Available |

# Work Breakdown Structure (WBS)

This section breaks down the project into smaller, more manageable pieces put together in a hierarchical tree structure to present the overall amount of work and assignments in the project. It is a hierarchical decomposition of the total scope of work to be carried out by the team to accomplish the project objectives and create the required deliverables.

* Project Plan
* System Design Document
* Problem Description
* System context
* Use cases and their respective scenarios
* Sequence diagrams of respective scenarios
* System Structure
  + Node system description (diagram with mesh of nodes)
  + TDC with its sensors and actuators
  + TFC that bridges intersections
  + TGMC being able to receive and send data to and from external stakeholders
  + Component diagrams
* System Behaviour
* Class diagrams of the given nodes and their variations
* State machines of the programmatic behaviour of the nodes
* Component diagrams depicting various low-level implementations of the nodes in the system
* Implementation of the node system
* Node structure simulation (see testing)
* Creating a simple node system using two nodes that effectively communicate
* Expanding upon the node system and having more nodes communicate within different mesh configurations
* Implementation of traffic sensors / actuators within the node system
* Implement several given traffic sensors into nodes
* Implementation of the system behaviour into the given nodes
* Implementation of a simple (classical) implementation inside the node system (to build upon)
* Implementation of specific algorithmic instructions to combined node systems to realize the intersection realization of the ITMS
* Reflection
* Adapting the node system to more complex traffic situations
* Updating the use cases with more situations as the system grows
* Restating the given scenarios as more knowledge is attained
* Testing
* Unit tests of any utilised software
* Beforehand simulation of traffic nodes to allow for rigorous testing of the mesh communication protocol in different scenarios
* Advancement of that simulation to visualize a given intersection with a traffic system that successfully handles the flow of traffic using simulated sensors and actuators.
* Creating a physical PoC that simulates a given intersection, with live sensors and actuators
* Testing the PoC and the simulations with every scenario depicted in the System Design Document, also comparing it to baseline comparisons of other known data about classical systems, that is, performance and efficiency.
* Quality assurance document
* Research
* Internode communication (forth-and-back mesh communication)
* Traffic sensors and the value of their information in algorithms
* Intersection safety calculations
* Determining the most appropriate protocol plus the implementation
* Research on the chosen protocol’s safety

## Moscow analysis

|  |  |  |
| --- | --- | --- |
| Priority | Feature/functionality | Requirement alignment |
| Must have | Real-time traffic control | UR-01, UR-02, FR-01, FR-04 |
|  | Traffic light indication | FR-03 |
|  | First-come-first serve (FIFO) policy | UR-03, FR-02 |
|  | Handling multiple traffic scenarios | FR-07 |
|  | System malfunction handling | UR-03 |
|  | Decentralized operation | NFR-04 |
|  | System safety insurance | UR-03 |
| Should have | Scalability | NFR-02 |
|  | Efficient coordination for continuous traffic flow | FR-06 |
|  | Continuous 24/7 operation | NFR-01 |
| Could have | Interface for traffic authorities | - |
|  | Communication with vehicle onboard systems | - |
| Will not have | Detailed logs and reports | - |
|  | Advanced analytical features | - |
|  | Security features |  |
|  | AI (Artificial Intelligence) | - |

# Quality Management

## Quality planning

In the Quality planning (QP) phase, the project are going to have quality objectives based on the performance measures outlined in the test case scenarios. This includes unit tests and simulation tests. The planning phase will, also incorporate the definition of various test scenarios like S01 to S10, which are described in the sequence diagrams in the system design document, to validate the system’s ability to adapt to real-time traffic conditions, handle unexpected incidents and ensure the smooth flow of traffic under varying conditions.

## Quality control

In the Quality control (QC) phase, testing will be conducted against the defined scenarios to verify that the system performs as expected across the varied scenarios. Furthermore, testing how the system handles hardware and software issues, and how it adapts to increased traffic or new requirements will be part of QC.

## Quality assurance

During the Quality assurance (QA) phase, there will be a continuous inspection process to ensure the alignment between the planned quality standards and the ongoing project deliverables. Regular group discussions and reviews of progress against the defined testing criteria and project milestones will be part of the QA process to ensure that the project is on the right track.

## Quality improvement

Lastly, in the Quality improvement (QI) phase, there will be an ongoing effort to improve the system’s performance and adaptability based on the learnings from the QA and QC processes. This will include refining the algorithms to better adapt to traffic conditions, manage sensor data, and ensure fluent communication among traffic management components. Improvements will be implemented to reduce emissions by optimizing the traffic flow and reducing blockage, aligning with the goal of improving traffic management and reducing some environmental impacts. Through these efforts in the QI phase, the testing’s goal is to follow the criteria in the testing system plan and ensure successful implementation and performance of the Intelligent Traffic Management System.

# Risk Management

|  |  |  |  |
| --- | --- | --- | --- |
| Risk | Description | Impact / Likelihood | Mitigation |
| Procrastination | Procrastinating on tasks and not keeping to the deadlines. | High / Medium | Communication and feedback sessions on a weekly basis between all team members, making sure deadlines are always taken seriously and having a professional attitude towards work. |
| Scope | Increasing the scope to a point where the project deliverables are impossible to deliver. | High / Medium | Making sure that the scope is well defined and feasible. It is very important that every team member is aware of the exact scope of the project to ensure that useless work is not made. When defining the scope, the team should also keep track of the timespan needed for the entire project. |
| Communication | The communication between group members is crucial. If this is not sufficient, it can mean that the project leader or other members have no idea of what their colleagues are doing. | Critical / High | Increasing the number of meetings on a weekly basis, taking responsibility to show up to school to ensure communication in person, being on time for scheduled meetings. |
| Hardware | The failing of hardware to test the system. This can happen at any time and most members will not be able to resolve this issue on short notice. This can lead to a delay of important work. | High / Low | Making sure that deadlines are not in the weekend or before school in weekdays in case of a hardware problem. Prior to actually using the hardware for testing, the members need to make sure that hardware works (e.g., LEDs, buttons, ESP32s, sensors etc). |
| Demo effect | When giving a demo at a presentation it is important to always have a backup plan if the hardware does not work. | High / Low | Making videos of demos before presentations. |
| Dependencies | Being dependent on other members’ work to continue a task. This means that some members can be stuck with making progress. | Medium / High | Making sure that work is well defined, and tasks have similar workload. Also, we have to make well thought out agreements on protocols and communication between functions and hardware. |

# Communication

Effective communication is essential for the success of the project. This section outlines the communication needs, methods, frequency, medium, and recipients for types of communication, considering our group's preferred platforms and communication frequency.

## Communication Needs

Understanding the specific communication needs of our project is crucial for keeping all stakeholders informed and engaged. The following communication needs have been identified:

* Project Progress Updates: Regular updates on the project's progress, milestones achieved, and potential issues.
* Change Requests: Clear communication and documentation of change requests and their status.
* Issue Resolution: Timely resolution of project-related issues.
* Risk Management: Communication regarding identified risks and mitigation strategies.
* Meeting Scheduling: Coordination of project meetings, including agendas.

## Communication Methods

To address the communication needs of the project, we will utilize the following methods, based on our group's preferences:

* WhatsApp: For quick text-based communications, sharing brief updates, and informal discussions.
* Discord: For team calls, code sharing, diagram distribution, and more structured discussions.
* Project Management Software (GitLab Backlog): For tracking issues, change requests, and project progress.

## Communication Frequency

Communication will occur at the following frequencies, considering the group's typical communication schedule:

* Project Progress Updates: 2-3 times a week, via WhatsApp or Discord, depending on workload distribution and complexity of tasks.
* Change Requests: As needed, with updates discussed personally or via Discord or Git Backlog.
* Issue Resolution: Ongoing, as issues arise and are resolved, primarily via Discord.
* Meeting Scheduling: As needed, with advance notice and agenda distribution via WhatsApp or Discord.

## Recipients

Communication will be directed to the following recipients based on the type and nature of the message:

* Project Progress Updates: Group members, stakeholders, personally discussed or through Discord.
* Change Requests: Group members, stakeholders, via Discord and GitLab Backlog.
* Issue Resolution: Group members and stakeholders involved in issue resolution, primarily personally or via Discord.
* Meeting Scheduling: Project team members, stakeholders, and attendees of scheduled meetings, using WhatsApp and Discord.

# Change Management

The change management process is vital for maintaining control over the project's scope, timeline, and resources. This section outlines the steps for handling changes to the project, with a focus on the collaborative approach and tools used within our group.

## Change Request Submission

Any team member or stakeholder can initiate a change request by creating a new issue in our Git backlog or proposing the problem to the group. This issue should provide a comprehensive description of the proposed change, the rationale behind it, and the expected impact on the project's scope, or resources.

## Initial Assessment

Upon the creation of a change request issue, the project team will review it to assess its potential impact on the project. Discussions within the team may be initiated to evaluate the feasibility and consequences of the proposed change.

## Change Evaluation

The change evaluation process involves group discussions. The project team, comprising five group members, will collectively assess the proposed change's benefits, risks, and alignment with project objectives.

Decisions will be reached through group consensus, ensuring that every member's input is considered.

If necessary, stakeholders will be consulted for their input, and their feedback will be incorporated into the decision-making process.

## Change Approval

Once a consensus is reached within the project team, and the change is approved, the project group will update the project plan, scope statement, and resource allocations accordingly. The Git backlog issue will be added and linked to the change request for documentation.

## Communication

Approved changes will be communicated to all relevant stakeholders by the Project Leader, who will provide a summary of the change's impact on the project, including any adjustments to project scope, documentation, impact on project or resources.

The Git backlog will serve as the primary repository for all change requests, including their descriptions, discussions, and decisions.

Change Approval Authority

The change approval authority is vested in the collaborative decision-making process of the project team, with input from stakeholders as needed. However, if the group cannot make a collective decision, the Project Leader may need to decide for the group.