Warsaw University of Technology

FACULTY OF ELECTRONICS AND INFORMATION TECHNOLOGY

Bazy Danych II [BD2]

(Databases II)

Opis infrastruktury dla transportu Hyperloop

(Description of the Infrastructure for the Hyperloop Transport System)

Functional and Non-Functional Requirements

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Glossary

Hyperloop – is an open-source transportation concept where the idea is to build a tube over or under the ground, in which the environment in the tube can safely transport people at high speeds but at a cheaper cost.

Capsule – refers to the transportation object that will be used to transport people and cars between stations. Can also be called a **pod**.

Tube – refers to the part of the hyperloop system that is responsible for housing the capsule. It is in the tube that a capsule travel.

Pylon – refers to the structural tower that will be used to hold and support tubes above the ground.

Damper – refers to a device that is placed between tubes and pylons to dissipate kinetic energy, to act as a shock absorber to wind as well as earthquakes.

Route - refers to the course taken in order to get from a starting point to the destination.

Station - refers to a stop along the route or the destination of travel where a capsule can stop and load or unload passengers and cargo.

Tunnel - refers to the section along a route where tunneling has been utilized to avoid going over mountains in order to keep the route as straight as possible.

1 Introduction

The world of transportation has evolved so much ever since men started discovering new places. From riding the high seas using wind sails to crossing continents on fuel-powered ships. From slow propelled airplanes that could only fly short distances to commercial turbine jets that can cross the planet in half the time while carrying 500 plus passengers on average. However, as much as there has been advancement in transportation, the cost of using these services has been skyrocketing. In addition, the question of safety is still ever present and not forgetting of course, that there could be a better way to get from point A to B in a much cheaper, safer and faster way. These questions have given birth to a new open-source concept of transportation called the Hyperloop transport system.

The Hyperloop transport systems aims to provide a much safer and faster way of travel compared to today's means of transportation while also making it a lot cheaper. The idea is to make traveling possible using capsules employing a tube that is situated from point A to B. Using the tube's pressure, capsules can travel from one destination to the next by simple propulsion mechanisms and pressure of the tube. This research project aims to bring to light the Hyperloop system in terms of its infrastructure and its features. This project will discuss the physical components that help in making this system function.

1.1 Purpose

The Hyperloop system as mentioned above is a transport system that aims to revolutionize the way we travel. Thus, the purpose of this project is to identify and describe the infrastructural components of the Hyperloop transport system that make this system different from existing transport systems.

The project aims to include all aspects of infrastructure from the objects that will be used to transport passengers and vehicles to the structural objects that will act as the road from point A to point B.

1.2 Scope

As described above, the system aims to holistically involve and integrate every infrastructural aspect of the Hyperloop transport system. The project will be focused on evaluating the design and development features surrounding the infrastructural component of the system that allow the following:

1. The management of safe transportation from point A to point B using capsules
2. The management of shock and kinetic energy that may act on the system
3. The management of efficient powering of the system
4. The management of the tubes in which the capsules travel in.

All features of the infrastructural system of the Hyperloop transport system identified will fall in either one of the general scopes as listed above.

2 System Features – Functional Requirements

Below is a list of the features that the infrastructural component of the system will have, a little description of what the feature will be expected to do and how important that specific feature is to the system.

No	Name	Description	Priority
1	Propulsion feature	This feature allows momentum to be transferred to a capsule, allowing the capsule to travel faster.	High
2	Solar energy panels	This feature allows the system to be powered by solar energy, where solar panels cover the top of the tube(s).	Medium
3	Anti-earthquake effects feature	This feature allows the tubes to respond well in the event of an earthquake or strong wind, thus keeping the transportation system safe.	High
4	Anti-atmospheric pressure feature	This feature allows the control of atmospheric pressure that may pose a risk to passengers when the capsule is traveling at high speeds	High
5	Airlock area	Large areas on the ends of the tube signifying entry and exit points before coming/leaving the station. When entering a station, pressure is equalized to that of the station before the capsule comes in. When exiting into the tube, entering the airlock lowers the pressure of the capsule to that of the tube.	High
6	Real-time information flow feature	This feature allows a league management official to update a team's information. Ticketing and baggage tracking must be handled electronically. Negating the need for printing boarding passes and luggage labels.	High
7	Cargo capsule	One of two capsule types that allows for the transportation of 3 full size cars with 28 passengers	Medium
8	Passenger capsule	One of two capsule types that allows for the transportation of 28 people only.	Medium
9	Capsule rotatable docks	In order to not build long sections used for direction changes of capsules, a rotation feature is introduced allowing the capsule to be rotated on a turntable and ready for re-entry into the tube.	High
10	Have two tubes per pylon	To enable simultaneous travel in both directions, a pylon will hold in place two tubes in parallel.	High

11	Tubes segmentation	This feature allows easier tube production, assembly and repair. Thus, it will be easier to replace damaged tubes by removing the damaged tube segment.	High
12	Station isolation	Passenger stations are isolated from the Hyperloop tube itself in order to limit air leaks into the system. Vacuum pumps are placed at various locations along the length of the tube to maintain the required air pressure.	High
13	Tunnel	This feature is designed and developed if the route must cross over mountainous areas, thus tunneling through a mountain allows for maintaining a steady straight tube for transport.	High

3 Nonfunctional Requirements

Below is a table of Non-functional requirements which aim to justify how the infrastructure of the system should ideally function.

Non-functional Requirement	**Infrastructure(s)**	**Requirement(s)**	**Priority**
Reliability	Whole system	The system should be able to transport on average, 840 passengers every hour.	Medium
		Dampers and Pylons should be able to last 100 years before any repairs are needed.	High
Flexibility	Tube	The system's tubes should be easily maintainable by repairing/replacing only a segment of the tube instead of requiring the replacement of the whole tube.	High
	Damper	The system should be designed in such a way to ease the repair or replacement of a damaged damper in less than 12 hours.	High
Security	Station	The stations should be camera-monitored 24 hours a day.	High
	Capsule	Capsules should also be camera-monitored while active.	High
	Tube	The tube should also be monitored by camera to ensure the safety of the tube's surroundings as well as the solar panels located on it.	High

Safety	Capsule	The system should be able to keep passengers and other capsules safe in the event of a leakage or if the capsule becomes immobile.	High
	Pylons & Damper	The system should be flexible to withstand the motions of an earthquake or strong winds while maintaining the tube alignment.	High
Usability	Station/Platform	The system should be user-friendly as possible with signs and direction to aid passengers in around the transportation terminals, as well as in the capsules themselves.	High
		The system should have enough platforms to ensure the smooth flow of loading/unloading.	High
	Reporting system	The system should allow for passengers to easily report any faults or happenings inside the capsule by using the onboard radio system.	High
	Capsule	The capsule should be easily accessible during loading/unloading with clear directions to aid passengers. The capsule should also be accessible-friendly to people in wheelchairs.	High
Maintainability	Tube	Minor leaks should be repairable during standard maintenance and checks.	High
		Major repairs like replacement of sections of tubes should be repaired in under 12 hours.	High