

# INTELLECTUAL PROPERTY DISCLOSURE FORM (IPDF)

## DES646: AI/ML for Designers

Indian Institute of Technology, Kanpur

### 1. Title of Invention:

Reinforcement Learning for Autonomous Shuttle Simulation on the IIT Kanpur Campus

### 2. Inventor(s):

Name (Roll No.)	Team Name
Ayush Yadav (220273)	Legion of Nazgûl
Vibhanshu Choudhary (221189)	Legion of Nazgûl
Adiba Khan (230061)	Legion of Nazgûl
Vyom Pratap Singh (221211)	Legion of Nazgûl
Yash Giri (221218)	Legion of Nazgûl
<b>Instructor (as Co-Inventor):</b>	
[Instructor's Name Here]	Per DES646 Brief

### 3. Brief Description of the Invention:

This invention is a software system and methodology for training an autonomous navigation agent within a simulated campus environment. It combines a custom-built OpenAI Gymnasium environment (modeled after IIT Kanpur) with an enhanced Deep Q-Network (DQN) agent.

The agent is trained using a novel multi-objective reward function that balances:

- **Time Efficiency ( $R_{time}$ ):** Penalizes excessive steps.
- **Safety ( $R_{safety}$ ):** Applies a large negative penalty for collisions.
- **Energy ( $R_{energy}$ ):** (Conceptual) Penalizes high-cost moves.
- **Comfort ( $R_{comfort}$ ):** (Conceptual) Penalizes sharp turns or hard stops.

The core of the invention is this trained model, which can be deployed as a "brain" for a real-world autonomous shuttle.

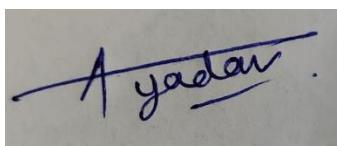
### 4. What is new or novel about this invention? (Compared to Prior Art):

While DQN and autonomous navigation are established fields, the novelty of this project lies in:

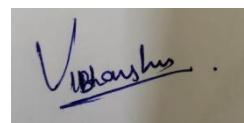
1. **The specific multi-objective reward function:** The engineered balance of competing rewards (speed vs. safety) is specifically tuned for a campus-scale "last-mile" transportation problem, which differs from highway driving or simple robotics.
2. **The scalable simulation framework:** The methodology of using map data to create a custom Gym environment is a rapid and efficient way to bootstrap training for any campus-like environment, making this a scalable solution.
3. **A "Publication Track" is being pursued:** This project is being simultaneously developed as a technical paper for the IEEE Intelligent Transportation Systems Conference (ITSC), which fulfills Deliverable 3 as per the course brief.

### 5. Inventor Signatures:

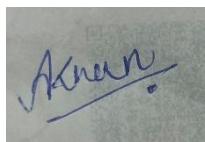
We, the undersigned, confirm that the information provided is accurate and complete to the best of our knowledge



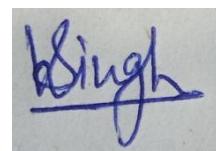
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*Instructor Signature*

