1. **Student Name: Hriday Khubchandani**
2. **Candidate Registration Number: 1000257**
3. **CRS Name: Artificial Intelligence**
4. **Course Name: IDAI1**
5. **School Name: Ryan Global School, Kharghar**
6. **Github Link:** [**Summative-3**](https://github.com/Hriday65/IDAI101-1000257--Hriday-Khubchandani-Summative-Assignment-3) **(**[**https://github.com/Hriday65/IDAI101-1000257--Hriday-Khubchandani-Summative-Assignment-3**](https://github.com/Hriday65/IDAI101-1000257--Hriday-Khubchandani-Summative-Assignment-3)**)**

**Project Report: Development of a Generative AI Platform for Urban Green Space Design**

**Introduction**

EcoCity Innovations seeks to ‘green’ underutilised urban space, making it more sustainable, more live-able, and more biodiverse. In this project we develop a generative AI platform that uses such real time geographical data as city maps and infrastructure details to generate green space designs that tackle urban environmental and social issues.

* **Research & Analysis**

1. **Current Trends in Green Space Development**
   * **Green Infrastructure:** Urban areas are integrating green infrastructure such as parks, rooftop gardens and vertical greenery into their designs as places to mitigate the urban heat island effect, cleanse the air and provide biodiversity.
   * **Smart Urban Design:** Using GIS, real time data analysis and AI technologies, green space planning is now more data driven and responsive to urban changes.
2. **Challenges in Urban Planning**
   * **Limited Space:** Due to the constraint of resources of land available in dense urban areas for large green spaces, innovative designs such as vertical gardens and roof top parks are required.
   * **Infrastructure Constraints:** Planning for green spaces must take account of existing infrastructure (roads, utilities, buildings).
   * **Accessibility:** A key challenge is that green spaces must be accessible to residents in densely packed neighbourhoods.
3. **Benefits of Green Spaces**
   * **Heat Island Mitigation:** They help to cool the polluted and high temperature urban areas also reducing the island effect
   * **Biodiversity:** The local wildlife which was destroyed for the development of these urban cities can now be restored by the help of parks and green roofs
   * **Public Health:** The green spaces created provide an escape from the daily hustle-bustle creating a peaceful and calm environment for your mental and physical health
4. **Types of Green Spaces**
   * **Public Parks and Gardens:** These will help the community to know each other better while providing an area for a stroll or some simple exercises/yoga
   * **Rooftop Gardens & Vertical Greenery:** This will develop a uniqueness in the city making it different from the others while improving the air quality.
5. **Objective of the AI Platform**
   * **Real-time Data Analysis:** It will analyse urban data and will further suggest areas which can be potential green space projects
   * **Sustainability Focus:** This will help the city develop while keeping the core SDG goals which will further help the city to have clean water and air access, also supporting the local biodiversity while reducing the carbon footprint effect.
   * **Feasibility:** Practical designs that consider the land availability, accessibility and existing infrastructure are required.

* **Model Integration and Hyperparameter Tuning**

1. **Integrating Gemini 1.5 Model:** To come up with green space design, the geographical data consisting city maps will be fed to the Gemini 1.5 AI model. Through dynamic analysis of input data, it will propose locations for green spaces using parameters such as space availability and ecological impact.
2. **Hyperparameter Tuning:** Hyperparameters such as temperature and top k sampling will be tuned to balance creativity with practicality in order to guarantee effective and feasible design outputs, this leads to model output that is viable and sustainable green space design.

**Prompt Engineering**

1. **Sample Prompts for Model Input**
   * **Vacant Space Identification:** "Analyse the provided city map image and list all potential vacant spaces that could be converted into green areas. Consider factors like the current land usage, proximity to urban areas, and potential for transformation. For each vacant space, provide a brief description of the surrounding environment and potential benefits of converting it into a green area."
   * **Best Space Selection for Impact:** "From the identified vacant spaces, select the most suitable one for conversion into a green area. Provide detailed information about the location, including the area name, neighbourhood, and geo coordinates (latitude and longitude). Justify your selection based on population density, accessibility, and its potential impact on the urban environment, such as improving air quality or biodiversity."
   * **Accessibility Analysis:** "Examine the city's layout and divide it into distinct regions. For each region, provide the region name and suggest the best transportation methods to reach the proposed green space. Consider public transportation routes, walking paths, cycling lanes, and any other convenient means of travel. Include the expected travel time for residents from different parts of the city to the green space."
   * **Sustainable Infrastructure Proposal:** "Propose infrastructure for the selected green space, ensuring the design is sustainable and fits with the local geography and climate conditions. Consider building features like water-conservation systems, native plant gardens, or renewable energy sources for lighting. Provide a rationale for each recommendation, ensuring that the infrastructure supports environmental sustainability and public usability"
   * **Community-Centric Design:** " Identify the best vacant space for developing a green area that fosters community engagement. Provide the location details for the selected site. Justify your choice by considering factors like population density, ease of accessibility, and the potential for social interaction and recreational use. Additionally, suggest infrastructure like seating areas, playgrounds, or fitness stations to encourage public use"
   * **Building Blueprint Modification for Energy Efficiency:** *“*Analyze the provided building blueprint and suggest modifications to improve energy efficiency. Consider factors like insulation, window placement, and the potential for integrating renewable energy sources like solar panels.”
   * **Traffic Flow Analysis and Pollution Reduction:** “Examine the traffic flow throughout the city and recommend strategies to reduce traffic congestion and air pollution. Consider promoting public transportation use, creating car-free zones, and optimizing traffic light timing.”
   * **Rainwater Runoff Management Solutions:** "Identify areas with high rainwater runoff and propose solutions for sustainable water management. Consider implementing green roofs, permeable pavements, and rainwater harvesting systems."
   * **Waste Management System Improvement:** "Analyze the city's waste management system and suggest improvements to reduce waste generation and increase recycling rates. Consider promoting composting programs, implementing extended producer responsibility schemes, and educating residents about waste reduction strategies."
   * **Noise Pollution Reduction Strategies:** *"Evaluate the city's noise pollution levels and recommend strategies to create quieter and more peaceful urban environments. Consider installing noise barriers, promoting the use of electric vehicles, and designating quiet zones in residential areas."*

**Model Validation and Optimization**

1. **Validation Process:** Urban planners and sustainability experts will evaluate the designs generated to check whether they are feasible, practical and will feature in accordance with urban planning standards. The model’s output will be used to refine feedback.
2. **Optimization:** Here, based on feedback, hyper parameters will be tuned to optimize the design suggestion quality and relevance. This guarantees the platform provides innovative but earthbound green space designs.

**Conclusion**

EcoCity Innovations developed generative AI platform will enable urban planners to generate sustainable and accessible green spaces in cities. To help cities tackle environmental challenges, reduce their footprint and improve livability the platform will leverage real time geographical data along with AI powered design suggestions. Through this innovative tool, the greener, and sustainable urban environments for the future generation will be created.