**Week 1 Project Report**

**Project Title: Urban Heat Island Detection and Mapping using Deep Learning**

**Internship: Shell–Edunet Skills4Future AICTE Internship**

**Theme: Sustainability using AI Technologies**

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**1. Problem Statement**

Urban Heat Islands (UHIs) are regions within cities that experience significantly higher temperatures compared to surrounding rural areas. This occurs due to excessive use of concrete, asphalt, and other heat-retaining materials, along with a lack of vegetation and green spaces.  
Traditional UHI detection relies on manual surveys and weather stations, which are time-consuming, costly, and geographically limited. With increasing urbanization and climate change, there is a growing need for automated systems that can monitor, analyze, and predict heat concentration patterns on a large scale.  
This project aims to develop a **deep learning-based Urban Heat Island Detection System** that uses satellite imagery to automatically identify and map heat-intense zones, supporting data-driven, sustainable city planning.

**2. Project Description (Brief)**

The proposed system utilizes **Convolutional Neural Networks (CNNs)** to analyze satellite imagery and identify areas with high surface temperature. The CNN model will process both RGB and thermal data to detect patterns related to urban heat accumulation.  
The system will then generate **heat maps** that visually represent temperature variations across urban landscapes. These maps can be used by city planners, environmental agencies, and researchers to implement effective cooling interventions such as urban greening, reflective roofing, and smart material planning.  
By leveraging AI and remote sensing, this project promotes sustainable urban growth and contributes to climate adaptation strategies.

**3. Objectives**

**Primary Objectives:**

* Design and train a CNN-based deep learning model for thermal intensity detection from satellite imagery.
* Analyze and process multi-band satellite data to identify high-risk heat accumulation zones.
* Generate visual heat maps to represent temperature distribution across different city regions.

**Secondary Objectives:**

* Classify urban areas into heat intensity categories (low, moderate, and high).
* Support sustainable city design by recommending areas for green infrastructure development.
* Demonstrate a scalable prototype that can analyze data for any urban location.

**4. Technical Overview**

**Technology Stack:**

* **Programming Language:** Python 3.x
* **Libraries & Frameworks:** TensorFlow/Keras or PyTorch, OpenCV, GDAL, Rasterio, NumPy, Matplotlib, Folium
* **Data Type:** Multi-band satellite imagery (visible + thermal infrared)
* **CNN Architecture:** Custom regression-based CNN or pre-trained models (ResNet/VGG) modified for temperature prediction

**Proposed Methodology:**

1. **Data Collection:** Gather satellite imagery containing both RGB and thermal bands for selected urban areas.
2. **Preprocessing:** Normalize data, extract relevant bands, and prepare CNN-compatible input images.
3. **Model Training:** Train the CNN model to predict temperature intensity from image features.
4. **Validation:** Test the model on unseen data and measure accuracy using metrics such as RMSE or MAE.
5. **Visualization:** Generate color-coded heat maps showing urban hotspots and cooler zones.
6. **Recommendation:** Identify key intervention areas for tree planting, cool roofs, or reflective materials.

**5. Expected Outcome**

* A trained CNN model capable of predicting surface heat intensity from satellite imagery with high accuracy.
* Automated generation of visual heat maps showing temperature distribution across urban regions.
* Identification of top heat-vulnerable zones for sustainable planning.
* Demonstration of how AI can enhance urban climate resilience and reduce energy consumption.

**6. Sustainability Impact**

**Environmental Impact:**

* Promotes climate adaptation and urban cooling strategies.
* Encourages expansion of green cover and reduction of carbon footprint.

**Social Impact:**

* Improves urban livability by identifying heat-prone residential areas.
* Supports public health initiatives by minimizing heat-related risks.

**Economic Impact:**

* Helps reduce energy usage in high-heat regions through proactive planning.
* Optimizes investment in urban cooling projects and green infrastructure.

**7. Conclusion**

This project combines the power of **deep learning** and **remote sensing** to address a critical sustainability challenge—urban heat management. By enabling data-driven urban planning and climate-resilient decision-making, the system demonstrates how AI can contribute meaningfully to environmental sustainability and smart city innovation.