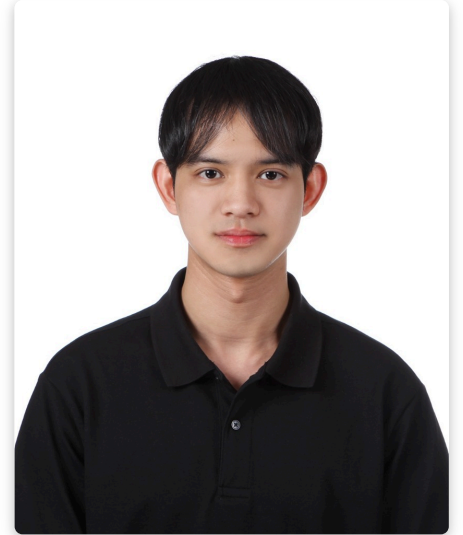


Kritnipit Phetanan

AI Engineer | Computer Vision | Geospatial Intelligence

I am a **Data-Driven AI Engineer** combining a background in **Computer Vision** and **Geospatial Intelligence (GIS)** with practical capabilities in building **end-to-end systems**. My current focus is on developing advanced **RAG applications** and **LLM orchestration workflows**.

A **GKS Scholar** holding an M.S. in Environmental Science & Engineering from **UNIST**, I am **trilingual** (English, Korean, Thai) and dedicated to bridging the gap between **advanced research and production engineering**, seamlessly integrating academic insights with modern architectures.



My research and technical interests include:

- Advanced RAG applications and LLM orchestration
- Remote sensing and satellite imagery analysis
- Urban change detection and compliance monitoring
- UAV/drone navigation and localization
- Deep learning for environmental monitoring



Feel free to reach out via email or connect with me on LinkedIn.

About

Experience

AI Engineer / Computer Vision ∨

Data Design Engineering (DDE)

**Sep 2024 - Jan
2026**

Seoul, South Korea

Research Assistant ∨

Water-Environmental Informatics Laboratory (WEIL)

**Sep 2022 - Aug
2024**

Ulsan, South Korea

Internship Trainee ∨Environmental Management Department, Airports of Thailand Public
Company Limited**Jun 2020 - Aug
2020**

Bangkok, Thailand

Education

Master of Science in Environmental Science & Engineering ∨

Ulsan National Institute of Science and Technology (UNIST)

**Sep 2022 - Aug
2024**

Ulsan, South Korea

Korean Language and Literature ∨

Jeju National University

**Aug 2021 - Jul
2022**

Jeju, South Korea

Bachelor of Science in Environmental Science ∨

Chulalongkorn University

**Aug 2017 - Jul
2021**

Bangkok, Thailand

</> Languages & Frameworks

Python MATLAB SQL R ROS PyTorch TensorFlow Keras Scikit-learn OpenCV NumPy Pandas GeoPandas
Rasterio GDAL PCL PyTest

🔗 Algorithms

YOLO CNN LSTM VIO/SLAM Depth Estimation Kalman Filter Change Detection Feature Matching (SIFT/ORB/xFeat)
Image Segmentation (SAM, U-Net)

🔧 Tools

Git AWS (S3, EC2) Docker Linux RunPod (GPU Cloud) QGIS ArcGIS SNAP Open3D Nginx ONNX TensorRT
SWAT

Publications

Type to filter

2025

Taylor & Francis

SAR remote sensing for monitoring harmful algal blooms using deep learning models

Kritnipit Phetanan and others

GIScience & Remote Sensing, Jul 2025

DOI

BIB

HTML

2024

Elsevier

Enhancing flow rate prediction of the Chao Phraya River Basin using SWAT–LSTM model coupling

Kritnipit Phetanan and others

Journal of Hydrology: Regional Studies, May 2024

DOI

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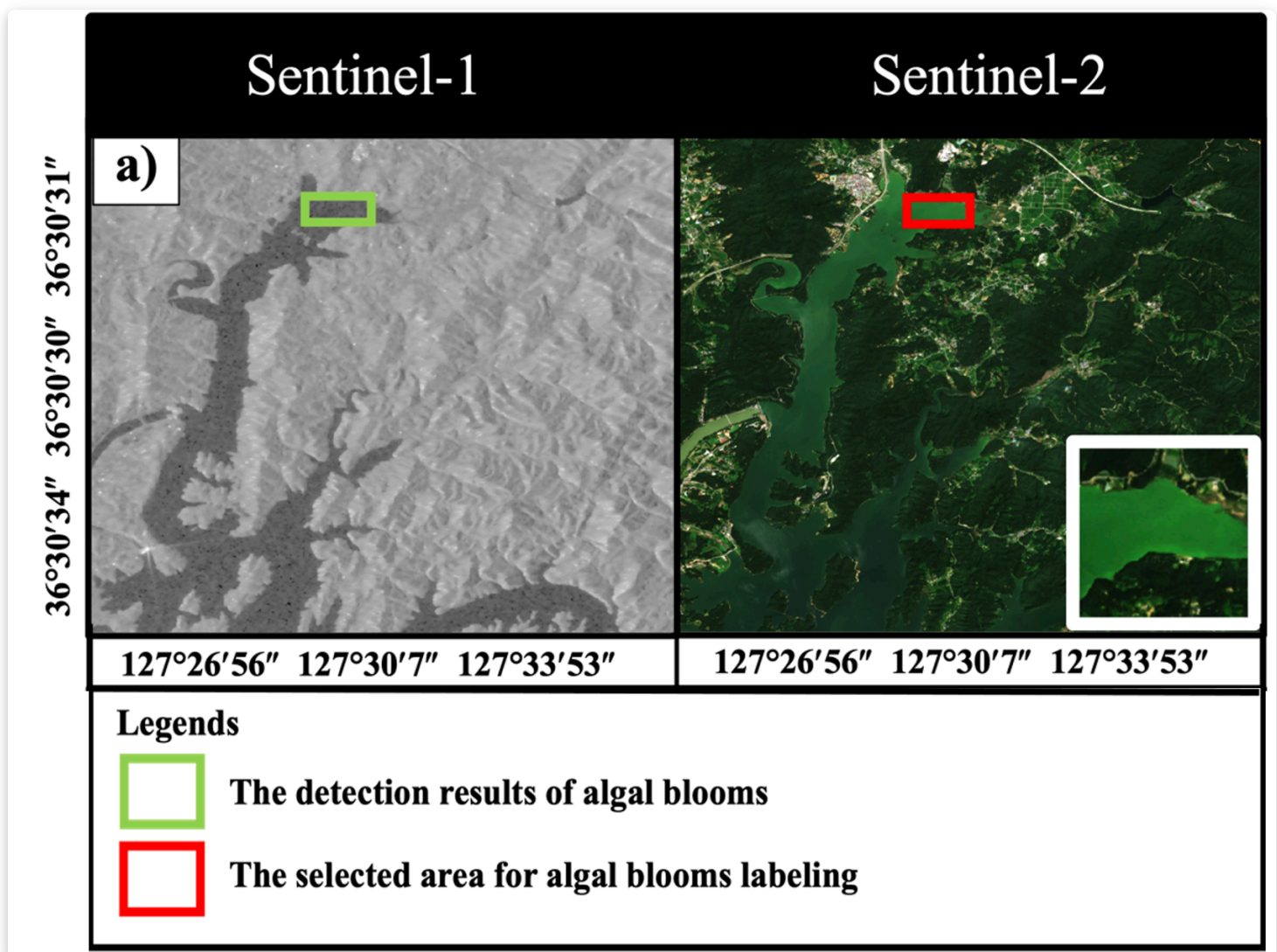
HTML

Algal Blooms & Trace Contaminants Monitoring

Deep learning-based algal bloom & trace contaminants detection using SAR imagery

Overview

Developed an **AI-driven monitoring system** for detecting harmful algal blooms and trace contaminants in water systems using Sentinel-1 SAR imagery and deep learning models. This research was conducted in collaboration with **K-water (Korea Water Resources Corporation)**, with the primary study area focused on the **Geum River** basin in South Korea.



At **UNIST**, I worked on implementing deep learning techniques on Sentinel-1 SAR imagery for precise change detection and localization of algal blooms & trace contaminants in Korean reservoirs.

Technical Approach

- **SAR Image Processing:** Utilized Sentinel-1 C-band SAR data for all-weather monitoring capability
- **Deep Learning Models:** Implemented Faster R-CNN for bloom & trace contaminant detection
- **Multi-temporal Analysis:** Developed algorithms for tracking bloom seasonality
- **Multi-source Data Fusion:** Combined satellite imagery with in-situ sensor data

Key Results

- **High Detection Accuracy:** Achieved bloom detection even under cloud cover conditions with a recall ~0.70
- **Complementary Tool:** Developed a complementary tool for monitoring blooms and the basic development of automatic detection algorithms.
- **Published Research:** Contributed to paper published in **GIScience & Remote Sensing** (Taylor & Francis)

Technologies Used

Category	Tools
Deep Learning	PyTorch, Faster R-CNN
Remote Sensing	Sentinel-1 SAR, SNAP, GDAL
GIS	QGIS, GeoPandas, Rasterio
Languages	Python, MATLAB

Publications

This research contributed to:

- **SAR remote sensing for monitoring harmful algal blooms using deep learning models** - GIScience & Remote Sensing, 2025

DOI: [10.1080/15481603.2025.2524202](https://doi.org/10.1080/15481603.2025.2524202)

Automated 3D Conflict Damage Assessment & Visualization System

Monocular depth estimation pipelines for urban change detection and conflict damage assessment

Overview

Developed an **Automated 3D Damage Assessment System** using monocular depth estimation model to detect changes in 3D for urban and conflict zone damage assessment. The primary study areas focused on the **Ukraine-Russia border regions**, including heavily impacted cities such as **Marinka** and **Mariupol**.



Project Context

At **Data Design Engineering**, I engineered end-to-end pipelines for damage assessment using monocular imagery from UAVs and satellites.

Technical Architecture

Input RGB Image → Depth Estimation Model → Change Detection Model → Web Dashboard

Key Features

-
- Implemented state-of-the-art depth models (Depth-Anything)
 - Generated depth maps for change detection

Change Detection Model

- Implemented state-of-the-art change detection models (Bandon)
- Generated change maps for change detection

Web-Based Dashboard

- **Deployed via Nginx** for remote access
- Interactive visualization of damage areas in 3D
- Labeling interface for damage assessment

Applications

Application	Description
Urban Compliance	Detection of unauthorized construction
Conflict Assessment	Structural damage quantification
Disaster Response	Post-event infrastructure evaluation
Asset Management	Inventory and monitoring of assets

Technologies Used

Category	Tools
Depth Models	Depth-Anything, Bandon
3D Processing	Open3D, Three.js
Deployment	Nginx, Docker, FastAPI
Languages	Python, JavaScript

UAV State Estimation in GNSS-Denied Environments

Sensor fusion pipeline combining Visual-Inertial Odometry (VIO) and Visual Positioning System (VPS) for reliable navigation in GPS-challenged environments

Overview

Developed a modular **Visual-Inertial Odometry (VIO)** framework integrated with **Visual Positioning System (VPS)** using a custom **Error-State Extended Kalman Filter (ESKF)** for UAV navigation in GNSS-denied environments. This system is designed primarily for **conflict zones** and areas affected by **GPS jamming or anti-spoofing attacks**, enabling reliable autonomous flight where satellite navigation is unavailable or compromised.

Project Context

I developed a complete sensor fusion pipeline for UAV localization without GPS dependency. The system combines high-frequency IMU data with camera-based visual updates to maintain accurate pose estimation in challenging environments such as urban canyons, indoor spaces, and areas with GPS jamming or interference.

The implementation follows the **OpenVINS** methodology with custom extensions for VPS integration, terrain-referenced navigation, and magnetometer-based yaw correction.

System Architecture

Key Components

Error-State Kalman Filter (ESKF)

- **18-state formulation:** Position (3), Velocity (3), Quaternion (4→3 error), Gyro Bias (3), Accel Bias (3), Mag Bias (3)
- **Manifold-based error representation:** Uses rotation vector ($\delta\theta$) for minimal orientation error
- **Covariance propagation** with camera clone management for MSCKF

VIO Frontend (OpenVINS-style)

- **Grid-based feature distribution:** Ensures uniform spatial coverage
- **Shi-Tomasi corner detector:** Better tracking quality than ORB/FAST
- **Multi-stage KLT tracking:** Coarse-to-fine optical flow with quality scoring
- **RANSAC-based outlier rejection:** Essential matrix validation

Multi-State Constraint Kalman Filter (MSCKF)

- **Camera pose cloning:** Maintains sliding window of past camera poses

IMU Preintegration

- **On-Manifold preintegration** following Forster et al. (TRO 2017)
- **Bias-corrected deltas:** ΔR , Δv , Δp with first-order Jacobian correction
- **Covariance propagation:** Tracks uncertainty through integration period

Visual Positioning System (VPS) Integration

- **Absolute position updates:** Correct accumulated drift periodically
- **Adaptive innovation gating:** Multi-tier acceptance based on drift time
- **DEM-based altitude constraint:** Uses terrain data for Z-axis correction

AGL (Above Ground Level) Estimation

- **Barometer-DEM fusion:** Computes $AGL = MSL(\text{Barometer}) - DEM \text{ height at current position}$
- **Height constraint update:** Provides Z-axis correction to EKF for altitude drift mitigation
- **Adaptive noise scaling:** Adjusts measurement uncertainty based on DEM availability and terrain variation

Magnetometer Processing

- **Hard-iron/soft-iron calibration:** Corrects sensor distortions
- **EMA filtering:** Smooth yaw estimates with outlier rejection
- **Gyro consistency check:** Validates mag readings against gyro integration

Hardware Deployment

Platform	Specs
Raspberry Pi 5	ARM Cortex-A76, 8GB RAM
Orange Pi 5	RK3588S, 8GB RAM

Technologies Used

Category	Tools
State Estimation	Custom ESKF (filterpy-based), NumPy, SciPy
Visual Odometry	OpenCV (KLT, RANSAC), Shi-Tomasi corners

Key References

1. **OpenVINS**: Geneva et al., "OpenVINS: A Research Platform for Visual-Inertial State Estimation", IROS 2020
2. **IMU Preintegration**: Forster et al., "On-Manifold Preintegration for Real-Time Visual-Inertial Odometry", TRO 2017
3. **MSCKF**: Mourikis & Roumeliotis, "A Multi-State Constraint Kalman Filter for Vision-aided Inertial Navigation", ICRA 2007

Urban Compliance Monitoring System

Height change detection for unauthorized structure identification using depth-based analysis

Overview

Developed an **end-to-end surveillance system** to identify unauthorized urban structures by analyzing height variations rather than just visual differences. The study area was **Mertzig, Luxembourg**, utilizing aerial imagery and point cloud data provided by the **Government of the Grand Duchy of Luxembourg** — specifically the *Cadaastre and Topography Administration, Territorial Information Department, and Geodata Management Service*.

Problem Statement

Conventional change detection methods primarily utilize RGB data, making them vulnerable to radiometric inconsistencies such as:

- varying illumination
- cast shadows
- seasonal contrast

These artifacts often obscure actual physical changes on the ground.

Our Approach: We address this limitation by converting 2D images into **depth-derived height maps**. This approach decouples structural information from visual appearance, allowing the system to robustly detect vertical displacement caused by unauthorized construction, regardless of lighting or weather conditions.

Technical Pipeline

Process Breakdown

1. Reference Flow (Left Branch):

- **Input:** Point Clouds (e.g., historical LiDAR or Photogrammetry data).
- **Process: DSM Generation (Rasterization)** - Converting massive point cloud data into a grid-based Raster format to align with the current period's data format for subtraction.
- **Output: Reference DSM** (Digital Surface Model) representing the baseline surface including structures.

2. Current Flow (Right Branch):

- **Input:** RGB Images (Current monitoring photos).
- **Process: Depth Estimation Model** (utilizing **Depth-Anything**) to predict depth from 2D images.
- **Output: Height Map** (AI-predicted DSM).

3. Analysis Flow (Integration):

- **Height Difference:** Calculating the differential between the Reference DSM and the Current Height Map.
- **Segmentation:** Utilizing **OpenCV Connected Components** (Blob detection) to identify clusters of pixels with anomalous height differences, distinguishing actual structural objects from random

Detection Capabilities

Type	Description	Example
Vertical Extensions	Additional floors	Rooftop structures
Horizontal Extensions	Building expansion	Side annexes
New Structures	Completely new builds	Warehouses, Sheds
Height Violations	Exceeding limits	Antenna, Tank installations

Key Results

- **Quantitative Analysis:** Fine-grained height estimation enabling precise unauthorized structure identification
- **False Positive Reduction:** 80% reduction by eliminating visual noise (shadows/seasons)
- **Automated Pipeline:** End-to-end processing with autonomous anomaly detection

Technologies Used

Category	Tools
Depth Estimation	Depth-Anything, OpenCV
Point Cloud & 3D Processing	Open3D, PDAL, NumPy
Geospatial Analysis	GDAL, Rasterio, GeoPandas
Visualization	Three.js, QGIS, Matplotlib
Languages	Python

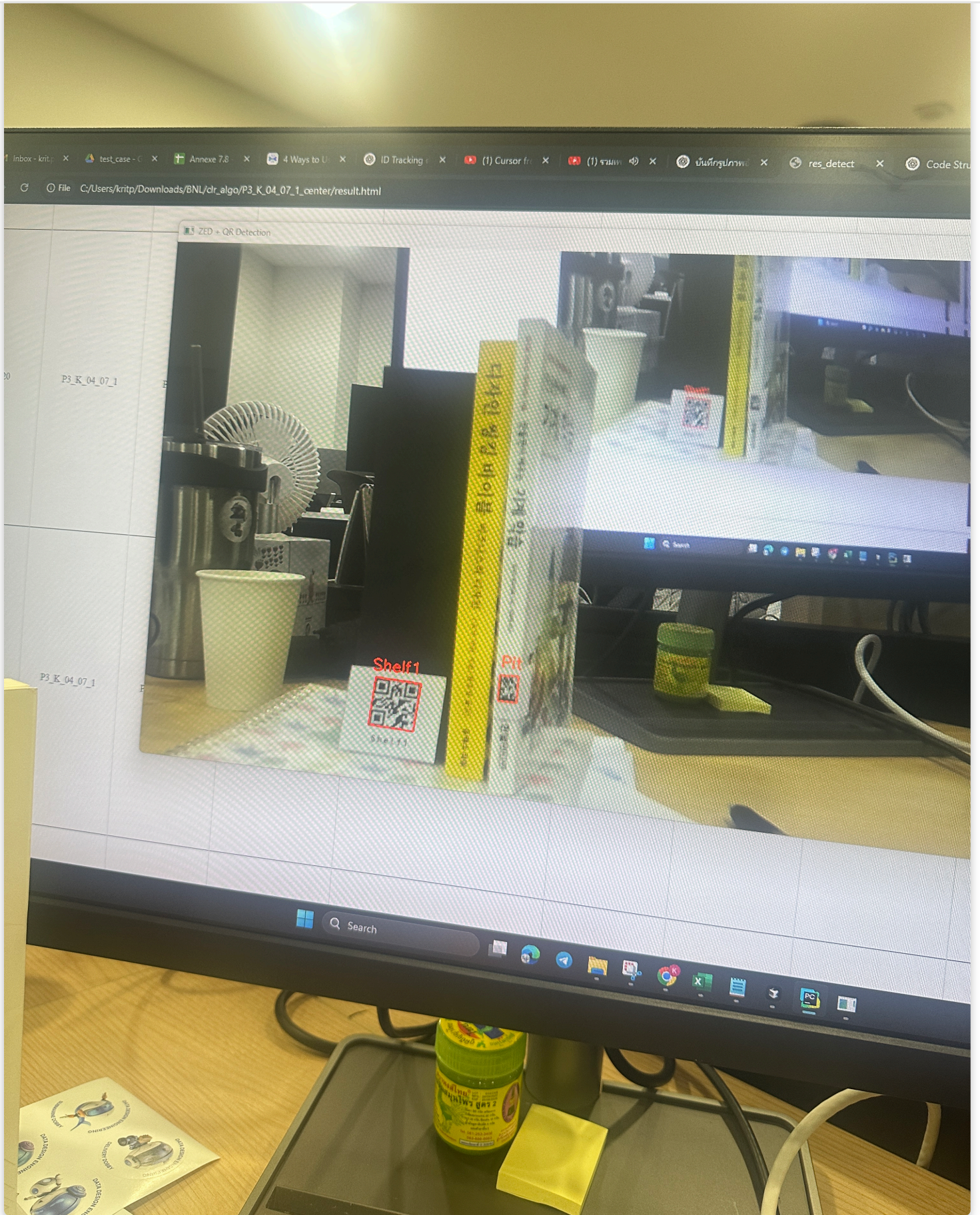
Smart Library Shelf Auditing System

Automated book identification and placement verification using YOLO and multi-feature analysis

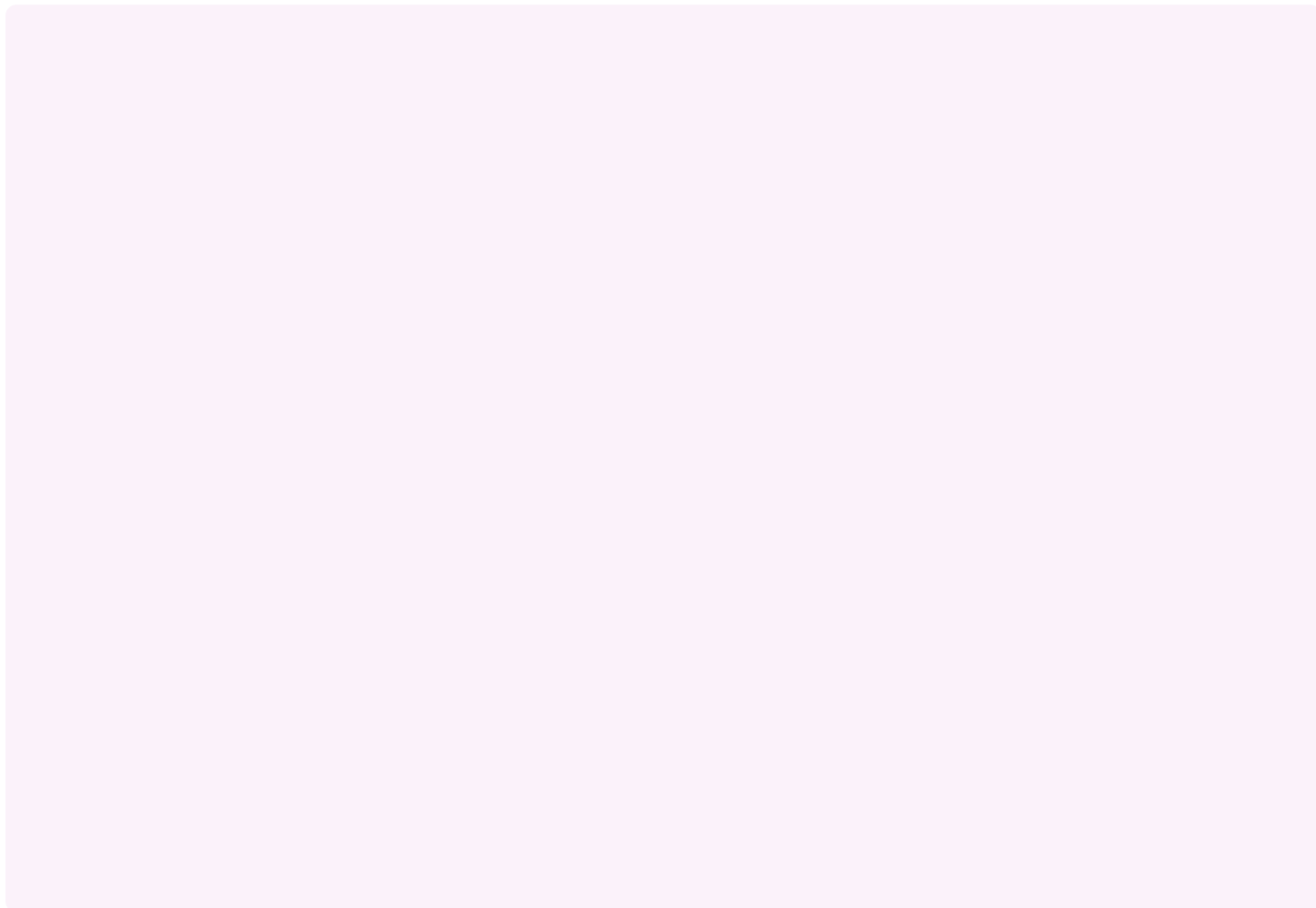
Overview

Contributed to the development of an **automated library shelf auditing system** using computer vision for real-time book detection, identification, and shelf auditing. This project was developed for the **National Library of Luxembourg**, enabling efficient visual inventory management across their extensive collection.





System Architecture



Detection Pipeline

Primary Path: Barcode Decoding

- **Data Matrix** / ISBN barcode detection
- Direct database lookup for instant identification
- Works best for books with visible, undamaged barcodes

Fallback Path: Feature Matching

When barcodes are unreadable, the system uses **multi-descriptor matching** with books in database:

Gabor	Frequency/orientation	Pattern recognition
HOG	Shape gradients	Structural features

Inventory Status Detection

Status	Description	Action
✔ Present	Book in correct location	No action needed
✘ Missing	Book not found on shelf	Alert librarian
✘ Wrong Order	Book in wrong order	Alert librarian
⚠ Misshelved	Book in wrong location	Alert librarian
⚠ Extra	Unlisted book detected	Alert librarian

Technologies Used

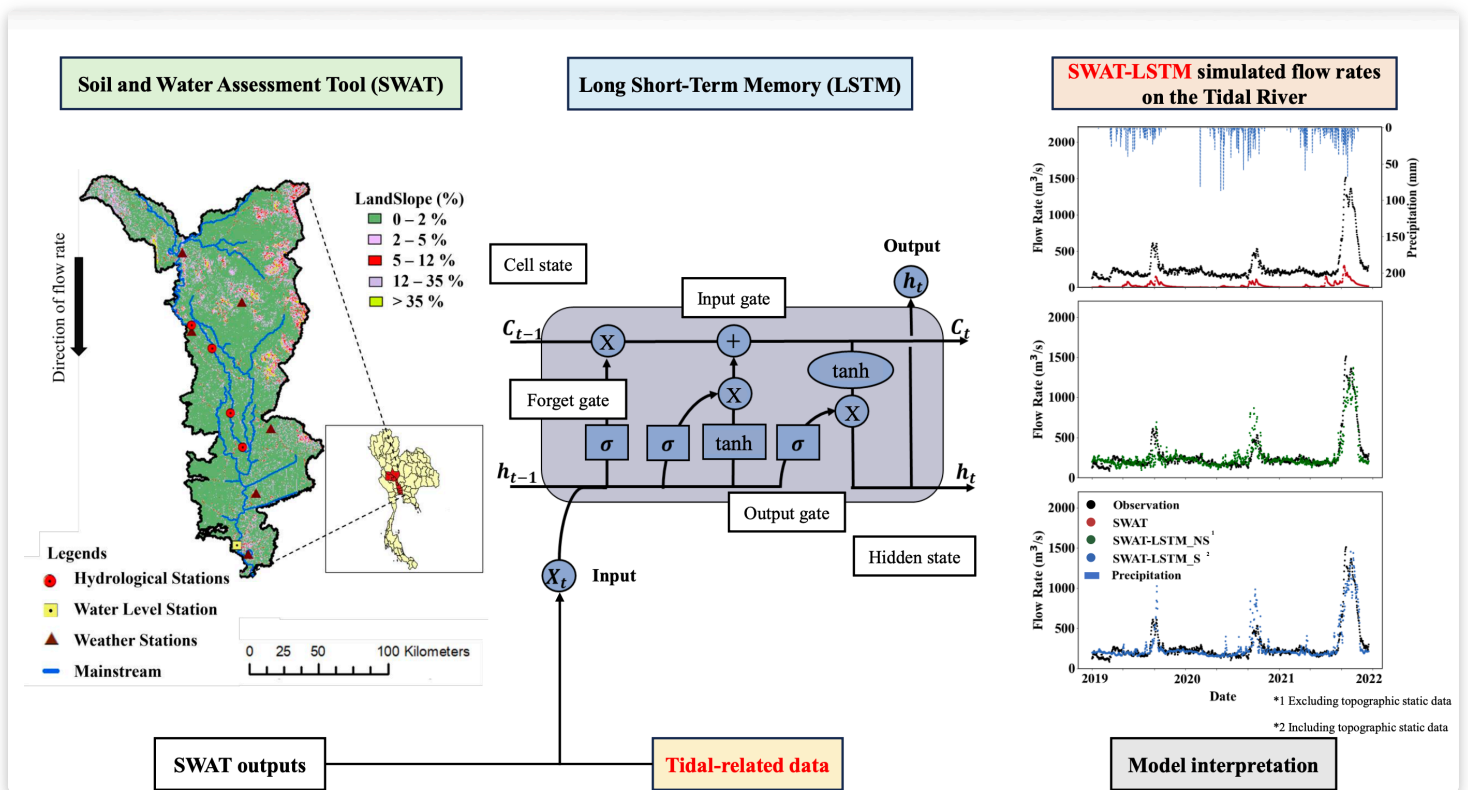
Category	Tools
Object Detection	YOLO
Feature Extraction	SIFT, ORB, LBP, HOG, Gabor
Barcode	Data Matrix
Framework	OpenCV, PyTorch
Languages	Python

SWAT-LSTM River Flow Prediction

AI-Enhanced Hydrological Modeling for the Chao Phraya River Basin

Overview

Developed a **hybrid hydrological modeling approach** combining the Soil and Water Assessment Tool (SWAT) with Long Short-Term Memory (LSTM) neural networks for enhanced river flow prediction. The study focused on the **Chao Phraya River Basin**, Thailand's most significant watershed, to improve flood forecasting and water resource management.



Research Context

This research addresses the limitations of traditional process-based hydrological models by integrating physics-based SWAT simulations with data-driven deep learning techniques. The hybrid SWAT-LSTM approach leverages the strengths of both methodologies to achieve more accurate and reliable flow rate predictions.

Accurate flow prediction in this basin is critical for:

- Flood early warning systems
 - Agricultural water management
 - Hydropower optimization
 - Urban water supply planning
-

Technical Approach

Model Architecture

1. **SWAT Component:** Physics-based watershed modeling for:
 - Rainfall-runoff simulation
 - Evapotranspiration estimation
 - Groundwater interactions
 - Land use/land cover effects
2. **LSTM Component:** Deep learning for:
 - Temporal pattern recognition
 - Non-linear relationship modeling
 - Error correction of SWAT outputs
 - Long-term dependency capture

Coupling Strategy

The hybrid model uses SWAT outputs as input features for the LSTM network, allowing the deep learning component to learn and correct systematic biases while preserving the physical interpretability of the hydrological model.

Key Results

- **Improved Prediction Accuracy:** The coupled SWAT-LSTM model outperformed standalone SWAT and pure LSTM approaches
 - **Enhanced Peak Flow Capture:** Better performance in predicting extreme flow events
 - **Reduced Systematic Bias:** LSTM effectively corrected SWAT model deficiencies
 - **Operational Applicability:** Demonstrated potential for real-time flood forecasting
-

Deep Learning

LSTM (Long Short-Term Memory), TensorFlow/Keras

Data Processing

Python, Pandas, NumPy

GIS & Remote Sensing

QGIS, ArcGIS, GDAL

Visualization

Matplotlib, Seaborn

Publication

This research contributed to:

- **Enhancing flow rate prediction of the Chao Phraya River Basin using SWAT–LSTM model coupling** - Journal of Hydrology: Regional Studies, 2024

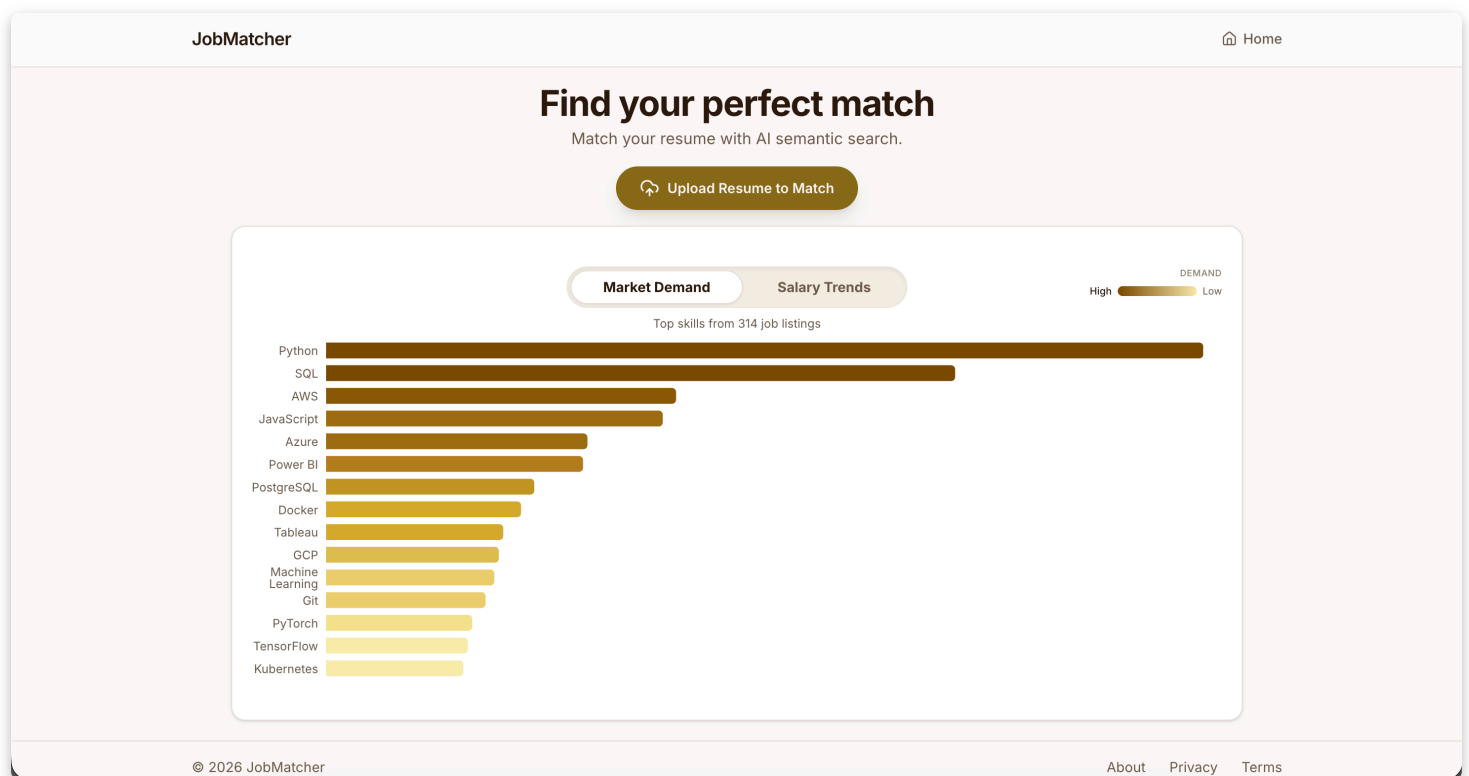
DOI: [10.1016/j.ejrh.2024.101820](https://doi.org/10.1016/j.ejrh.2024.101820)

JobMatcher

AI-Powered Resume to Job Matching & Analytics Platform

Overview

Developed **JobMatcher**, a full-stack automated pipeline that scrapes real job listings, analyzes them using AI, and provides a smart platform for users to upload their resumes. The system calculates match scores, identifies skill gaps, analyzes market demand/salary trends, and automatically generates personalized cover letters.



Project Context

This project bridges the gap between advanced RAG (Retrieval-Augmented Generation) applications and robust data engineering. It demonstrates a complete end-to-end system capable of automated continuous data collection, semantic analysis, and user-facing intelligence.

Technical Approach

- **Automated Cloud Scraping Pipeline:** Engineered Playwright-based scraping with advanced Anti-Detection techniques (stealth mode, UA rotation), automated via GitHub Actions
- **Robust ETL Workflow:** Extracted and structured job data (skills, experience) using the Groq API, and generated semantic embeddings with Google Gemini
- **Market Analytics Dashboard:** Visualized real-time tech skill demands and salary trends mapped against specific tools and technologies

Key Features

- **Skill Gap Analysis:** Precisely highlights which required skills from a job description are missing from an applicant's resume
- **Cover Letter Generation:** Automatically drafts highly tailored cover letters referencing specific job requirements and user experience
- **Data Freshness:** Fully automated nightly scraping ensures the platform's job market analytics represent current industry realities

Technologies Used

Category	Tools
Frontend	Next.js 15 (React), TailwindCSS, Recharts
Backend & DB	Python, FastAPI, Supabase (PostgreSQL + pgvector)
AI / LLMs	Google Gemini (Embeddings/Generation), Groq (Fast JSON Extraction)
Automation	GitHub Actions, Playwright

Source & Links

- **GitHub Repository:** [kritnipit-phetanan/job_match](https://github.com/kritnipit-phetanan/job_match)

Contact

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🐙 **GitHub:** [kritnipit-phetanan](https://github.com/kritnipit-phetanan)

🎓 **Google Scholar:** [Kritnipit Phetanan](https://scholar.google.com/citations?user=Kritnipit Phetanan)

📄 **CV:** Available upon request

Let's Connect

Feel free to reach out via email for any inquiries!