PATTERN IDENTIFICATION FOR THE STUDY OF INDIVIDUALS ON UPY CAMPUS USING COMPUTER VISION

Computer Vision

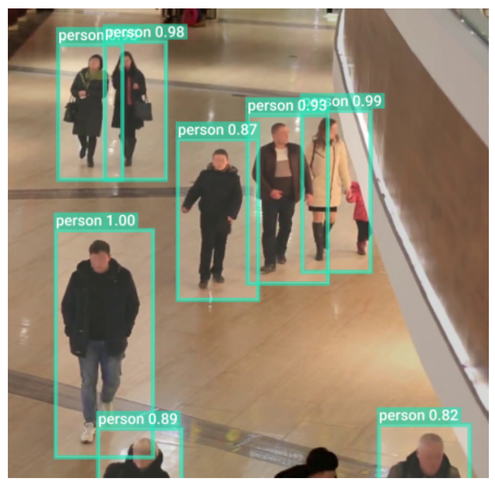
Computer vision is a field of artificial intelligence that enables computers and systems to derive meaningful information from digital images, videos, and other visual inputs. It involves teaching machines to interpret and understand the visual world.

Project Objective

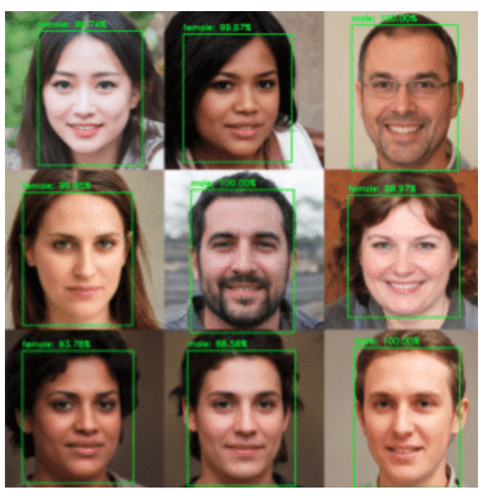
This project focuses on the development of an advanced computer vision system implementing YOLOv3 (You Only Look Once, version 3), a powerful real-time object detection tool. The main objective is to analyze and understand the movement patterns of individuals within the campus of the Universidad Politécnica de Yucatán (UPY).

By focusing on the study of individuals at the UPY campus, the project can provide a comprehensive understanding of student life, behaviors, and needs. This information can be invaluable for enhancing the overall campus experience, improving safety and health measures, like counting the number of steps an individual takes, and calculating the benefit this brings to his or her health, and also making informed decisions about campus development.

While the primary goal of this project is to enhance the understanding and management of individual movement patterns on campus, its implications are far-reaching.



Human Detection


Face Recognition

YOLOv3

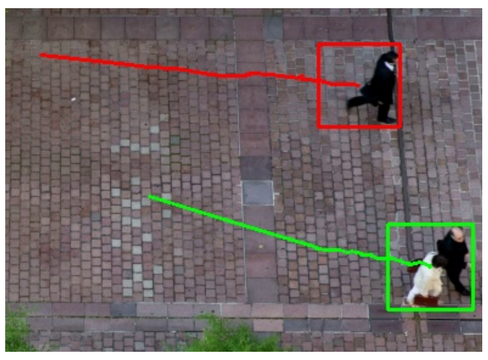
YOLOv3, which stands for "You Only Look Once version 3," is a popular algorithm in the field of computer vision, particularly for tasks like human detection and face recognition.

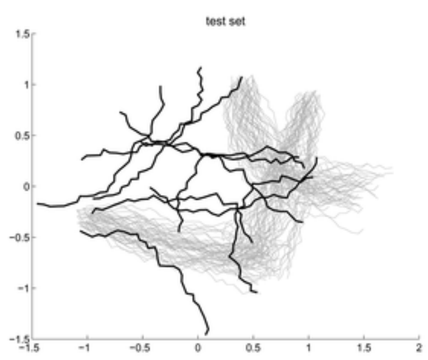
Human Detection

- **Single Neural Network Architecture:** YOLOv3 uses a single convolutional neural network (CNN) to detect objects. Unlike traditional methods that use separate models for object proposal and classification, YOLOv3 does both in one go.
- **Dividing the Image:** The image is divided into a grid. Each grid cell predicts a certain number of bounding boxes for objects and the confidence scores for those boxes.
- **Bounding Box Prediction:** For each bounding box, the model predicts the coordinates (x, y, width, height), a confidence score indicating the likelihood of an object being present, and class probabilities.
- **Class Probability:** In the case of human detection, the model identifies which bounding boxes contain humans based on the class probabilities.
- **Non-Maximum Suppression:** YOLOv3 uses this technique to eliminate overlapping bounding boxes, choosing the one with the highest confidence score.

Face Recognition

- **Face Detection:** First, YOLOv3 is used to detect faces in an image. The process is similar to human detection, but the model is trained or fine-tuned specifically to recognize faces.
- **Feature Extraction:** After detecting faces, a separate neural network is often used for feature extraction. This network is trained to understand and encode facial features.
- **Face Recognition:** The encoded features of a detected face are compared against a database of known faces. This step usually involves measuring the distance between feature vectors to determine the closest match.


Path Detection



Results

Detailed Movement Profiles: The system can generate detailed profiles of individual movement patterns across the campus, showing common routes, times, and durations.

Behavioral Insights: Analysis of these patterns can reveal insights into student behaviors, such as preferred study areas, busiest times of day, and most frequented campus facilities.

Social Interaction Patterns: The data might reveal social dynamics, like popular areas for socializing or how students move between classes and social spaces.

Space Optimization: Understanding how spaces are used will allow campus administration to make adjustments to improve efficiency and comfort.

Algorithm Design

Merging face recognition and human detection algorithms to create a unified system for tracking individual displacement paths involves several steps. The system would need to detect individuals, recognize their faces, and then track their movement over time.

Human Detection

- **Initialization:** Implement YOLOv3 to detect humans in real-time.
- **Camera Setup:** Utilize the campus's CCTV network. The cameras should cover key areas to ensure comprehensive monitoring.
- **Processing Input:** The video input from these cameras is fed into the YOLOv3 algorithm, which scans each frame for human figures.

Face Recognition

- **Selection of Face Recognition Algorithm:** After detecting a human, the system zooms in on the face and uses a face recognition algorithm.
- **Training the Model:** Train the face recognition model with a database of known faces. This includes faces of students, faculty, and staff at UPY.
- **Integration:** Integrate this model with the YOLOv3 output. When YOLOv3 detects a human, the face recognition model analyzes the face to identify the individual.

Tracking and Data Management

- **Tracking Movement:** Once an individual is identified, the system continues to track their movement across different camera feeds. This is achieved through an object tracking algorithm, which maintain the identity of the individual across different frames and cameras.
- **Mapping the Campus:** Implementation of a mapping system to translate the camera feed coordinates into real-world locations within the UPY campus.
- **Recording Displacement Paths:** The system records the time-stamped locations of each individual to construct their unique displacement paths.

Christopher Aaron Cumi Llanes
Data Engineering - 6B
Professor Victor Alejandro Ortiz Santiago