Lydia Ruiz Martínez
Pablo Tuñón Laguna
Bachelor's Degree in Mathematical Engineering and Artificial Intelligence

AirTrackPad

Description

The Airtrackpad is an innovative gesture-based control system that uses computer vision to emulate the functions of a conventional touchpad. Designed to operate in low-power environments, such as the Raspberry Pi, it combines tools like MediaPipe, Lucas-Kanade optical flow algorithms, and lightweight neural networks to deliver optimal performance.

The project focuses on:

- Accurately detecting and tracking hand gestures.
- Optimizing computational resources for limited hardware.
- Providing a seamless interaction through natural gestures.
- Potential applications include contactless navigation, enhanced accessibility, and remote control for low-power systems.

Development

The structure of the project is as follows:

- **Camera Calibration**: Scripts to correct distortions using chessboard pattern images.
- **Hand Tracking**: Utilizes MediaPipe to detect 21 key points on the hand.
- **Sobel Filters**: Mark the models accuracy
- **Lucas-Kanade Optical Flow**: Tracks landmarks across frames to assure a continuous and smooth performance.
- **Gesture Classifier**:
  - Lightweight neural network with 10 neurons and ReLU activation.
  - Trained with contextual and continuous movements
- **Action Management**:
  - Translates gestures into actions such as moving the cursor or clicking.
  - Implements a locking system to ensure sequential execution.
- **3d printed frame**
  - Aiming for an easy mounting of the module 3 of the Raspberry Pi.

Results

- **Accuracy**: High robustness in detection and tracking thanks to the integration of MediaPipe, Sobel filters, and optical flow.
- **Performance**:
  - Efficient processing for real-time interaction.
  - Adapted response for devices with limited resources.
- **Classification**: Effective recognition of 10 gestures with an optimized neural network.
- **Evaluation**: Successful testing under different lighting conditions.

Github: https://github.com/Drakit0/AirTrackPad