HALS

(Human Aware Localization System)

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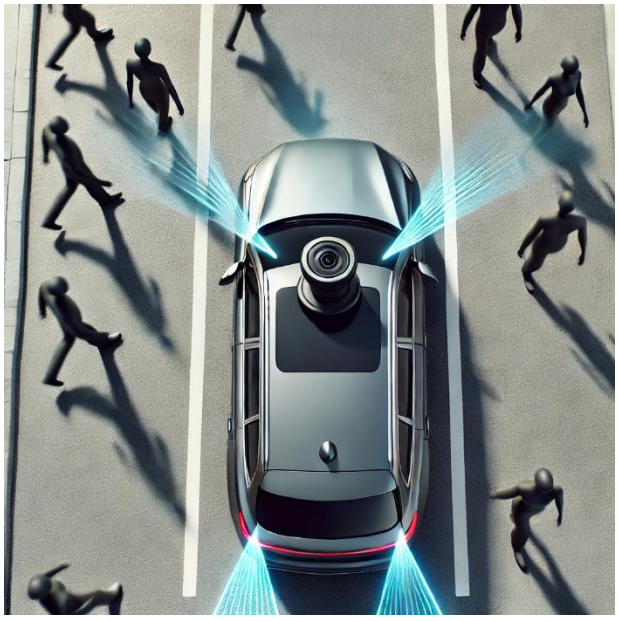
High-level Summary:

In response to the growing demands of modern transportation and the critical need to enhance road safety, we propose the adoption of autonomous cars equipped with advanced human detection capabilities. This innovative solution utilizes state-of-the-art pedestrian recognition and tracking technologies, enabling vehicles to navigate safely and efficiently alongside human road users in diverse environments. Equipped with cutting-edge sensors and real-time processing abilities, these autonomous cars ensure public safety by maintaining safe distances and preventing potential collisions with pedestrians and cyclists. By embracing this technology, communities can reduce traffic accidents, improve transportation efficiency, and advance toward a safer and more sustainable future in a professional and forward-thinking manner.



Project Description:

Throughout the project, we will adopt the Agile Iterative Process (AIP) to streamline our software development workflow. In the initial sprint, we will address backlog requirements, track and resolve bugs, and introduce new features, with daily stand-up meetings ensuring smooth progress and conflict resolution. At the end of each sprint, we will conduct an iteration review to assess the code and backlog, laying the groundwork for the next sprint. This approach allows for seamless integration with other modules, such as Controls and Motion Planning/Navigation, to develop a fully functional autonomous system.

Objectives & Deliverables

- Develop a pipeline for human detection.
- Develop a pipeline for human tracking.
- Iteration Review Reports for each sprint.
- A final presentation and demonstration of the module's capabilities

Assumptions

- Adequate computational resources are available for real-time processing.
- There is a shared understanding and agreement on the desired accuracy and FPS thresholds.
- The hardware and camera setup meet the project's technical requirements.
- Automobile configurations are known.
- The training and testing data(Humans) are from the same distribution with similar characteristics.

Methodology

In the context of autonomous vehicles, the approach for this project is designed to address the critical tasks of human detection and tracking. The process begins with precise, real-time identification and labeling of pedestrians from incoming image streams using Single-Shot Detection models like YOLO and its variations with performance evaluation based on metrics such as Intersection Over Union (IOU). Additionally, parallel testing explores alternative tracking algorithms like Medianflow, Goturn, or Lucas Kanade, as well as detection methods like Histogram of Oriented Gradients (HoG), to guarantee consistent and reliable detection and tracking, even in challenging environments. This robust approach ensures the safety and efficiency of human-vehicle interaction in dynamic urban and road conditions, supporting the overall effectiveness of autonomous driving systems.

Project Timeline

1. Phase 0: October 9 2024 - October 16 2024
   - Software development project plan submission.
2. Phase 1: October 16 2024 - October 23 2024
   - Develop and test single human detection and tracking pipeline.
3. Phase 2: October 23 2024 - October 30 2024
   - Develop and test multiple human detection and tracking pipeline

Softwares and Tools:

1. OpenCV 4.5.0 and higher versions are licensed under the Apache 2 License.
2. C++ version 11 or above.
3. CMake
4. Google Test
5. CodeCoverage
6. CppCheck
7. cpplinT
8. Doxygen
9. Valgrind

Risk Assessment:

Ensuring the human detection and tracking model consistently meets high accuracy threshold may be challenging. Mitigation involves rigorous testing, frequent model updates, and exploration of alternative algorithms.

References:

1. Patel, Hitesh A., and Darshak G. Thakore. ”Moving object tracking using kalman filter.” International Journal of Computer Science and Mobile Computing 2.4 (2013): 326-332.
2. Redmon, J., Divvala, S., Girshick, R., & Farhadi, A. (2016). You Only Look Once: Unified, Real-Time Object Detection. In 2016 IEEE Conference on Computer Vision and Pattern Recognition (CVPR) (pp. 779–788)https://doi.org/10.1109/CVPR.2016.91
3. “OpenCV - Open Computer Vision Library.” OpenCV, 11 Oct. 2023, opencv.org.