

MID-TERM PROJECT PROPOSAL- ENPM808X

HUMAN OBSTACLE DETECTOR AND TRACKER

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Project Description:

We will be contributing to Acme Robotics by developing a Perception module for Human Obstacle Detection and Tracking in real time.

Importance of Human Obstacle Detection and Tracking in Warehouse Environment:

The "Human Detection and Tracking" project holds significant importance in the real world, where the presence of multiple individuals within a single frame can introduce hazardous conditions. Such scenarios make the industrial environment impede the automation of the industries. With the implementation of human detection and tracking software developments, Acme Robotics can enhance the safety and efficiency of the warehouse operations and make its environment machine friendly. By enabling the real-time tracking of human movement, the organization can minimize the risk of collisions between humans and autonomous robotic equipment. Moreover, this development has potential to optimize resource allocations and facilitate more effective workflow management. Further, by such applications the historical data of the human trafficking patterns can be used to identify the peak activities and the dynamic resource allocation can be done.

In a nutshell, the proposal aligns with the burgeoning demand for enhanced automation and elevated safety standards across diverse industries, making it an asset in addressing real-world challenges while enhancing productivity and workers' safety.

Deliverables:

- C++ module to detect and track humans using continuous monocular camera feed.
- UML diagrams, timeline, risks, and mitigation for proposed project.
- Software version control with GIT.
- Unit tests using Google Test Framework and integration with GitHub CI.
- Code Coverage with CodeCov.
- Google C++ Styleguide with cpplint validation.
- Static code analysis with cppcheck.
- Developer level documentation (Doxygen).

Proposed Pipeline:

The initial step is to entail the acquisition of a comprehensive data set comprising video depicting humans in a warehouse environment. Subsequently, meticulous data cleaning and preprocessing procedures are employed, encompassing operations such as resizing, normalizing, and the precise annotation of bounding boxes around the human subjects within the frames.

Post the initial phase, the curated dataset is systematically harnessed for the training of the model - YOLO. YOLO's suitability for this task is based on its efficacy in human detection and tracking applications.

Once the model has been trained, the human detection and tracking will be done by forming bounding boxes. As the last stage, the depth of the human from the robot will be calculated.

Software Strategies and Technologies:

Strategies:

Pair Programming, Test-Driven Development, AIP

Technologies:

- **Programming Language and OS:** C++, Ubuntu 22.04
- **Other tools for testing and development:** Git, Valgrind, GoogleTest, cpplint, cppcheck, clangd, CMake
- **Continuous Integration and Code Coverage:** CodeCov, GitHub CI
- **Libraries:** OpenCV
- **Software Documentation:** Doxygen

Potential risks and mitigations:

1. Inaccurate labeling and ineffective training of the model can lead to incidents that might harm humans present in the warehouse.
2. Inaccurate tracking of the humans can lead to wrong predictions and harm the trajectory of the robot, ultimately causing an issue in the environment of the warehouse.
3. To mitigate such problems, we are planning to validate the model to check the accuracy of the model and see how well the model is performing.
4. 2 humans crossing each other may confuse the model and inter-change the detection ids. By improving the depth estimation, such situations can be avoided.

References:

1. M. Ahmad, I. Ahmed and A. Adnan, "Overhead View Person Detection Using YOLO," 2019 IEEE 10th Annual Ubiquitous Computing, Electronics & Mobile Communication Conference (UEMCON), New York, NY, USA, 2019, pp. 0627-0633, doi: 10.1109/UEMCON47517.2019.8992980.
2. S. R. C. De Guzman, L. C. Tan and J. F. Villaverde, "Social Distancing Violation Monitoring Using YOLO for Human Detection," 2021 IEEE 7th International Conference on Control Science and Systems Engineering (ICCSSE), Qingdao, China, 2021, pp. 216-222, doi: 10.1109/ICCSSE52761.2021.9545098.