Object Detection For Autonomous Vehicles

CHALLENGE

The challenge is to develop a real-time object detection model for autonomous vehicles using computer vision techniques and Intel® AI Analytics Toolkits its libraries, and SYCL/DPC++ Libraries. Participants are expected to create a deep learning model that can accurately detect objects such as pedestrians, vehicles, traffic signs, and traffic signals. The model should perform with high accuracy and low latency, ensuring safe navigation for autonomous vehicles.

END GOAL

1. Develop a deep learning model using Intel® AI Analytics Toolkit its libraries, and SYCL/DPC++ Libraries to detect objects on the road, with a focus on accuracy and speed.
2. Test the model on a dataset that includes real-world scenarios, including various weather conditions, lighting conditions, and road environments.
3. Optimize the model for low latency to enable real-time object detection in autonomous vehicles.
4. Provide a comprehensive report detailing the approach, methodology, results, and challenges faced during the development and testing of the model.

IMPORTANT NOTE

To achieve optimal performance and better models, it is required to use the Intel® AI Analytics Toolkits its libraries, and SYCL/DPC++ Libraries in the development of the interactive educational platform. Therefore, participants are advised to leverage the libraries and optimizations provided by oneAPI to enhance the efficiency of the application.

You can explore the Intel® AI Analytics Toolkits its libraries, and SYCL/DPC++ Libraries to find the related libraries and optimizations for improving performance which will make your solution stand out. Some of the useful links to explore more about oneAPI are mentioned below:

1. oneAPIDeep Neural Network Library
2. Intel® oneAPI Math Kernel Library (oneMKL)

3. Intel® oneAPI Threading Building Blocks
4. Intel® oneAPI Data Analytics Library
5. Intel® oneAPI DPC++ Library
6. Intel® Optimization for TensorFlow*
7. Intel® Optimization for PyTorch*
8. Intel® Distribution for Python*
9. Intel® Extension for Scikit-learn
10. Intel® Neural Compressor
11. Intel® oneAPI AI Reference Kit

SAMPLE DATASETS & CHALLENGE RESOURCES

1. Cityscapes Dataset: This dataset contains high-resolution images of urban scenes and it is specifically designed for the task of semantic urban scene understanding. The dataset contains 5,000 images with fine annotations for 30 classes of objects, including pedestrians, cars, buses, bicycles, and more. Link: https://www.cityscapes-dataset.com/

DELIVERABLES (Idea Submission Phase)

1. Presentation.pdf: Participants will have to submit a PPT presentation of their proposed idea which should clearly explain their idea, emphasising on the usage of Intel® AI Analytics Toolkits its libraries, and SYCL/DPC++ Libraries
   .
2. The submitted PPT must include a **Process Flow Diagram** and an **Architectural Diagram**

3. Exploring Intel® AI Analytics Toolkits its Libraries, SYCL/DPC++ Libraries and their usage in the product is an essential aspect.

4. Products/Projects without oneAPI as the core component will not qualify for the hackathon

DELIVERABLES (Prototype Development Phase)

1. Participants are required to fork this repository and update the README file, filling in the required details. Then upload their code in the forked repository and create a pull request to submit the code.

2. Presentation.pdf: Participants will have to submit a PPT presentation of their prototype, showcasing their prototype workings along with a **Process Flow Diagram** and an **Architectural Diagram**. It should clearly mention the usage of Intel® AI Analytics Toolkits its libraries, SYCL/DPC++ Libraries

3. Participants are required to submit a comprehensive write-up that details their chosen problem statement, approach to the problem, and the code used to build their solution. This write-up should be in the form of a technical article posted on medium.com. It will be evaluated by the judges for the functionality and creativity of the submitted solution. Therefore, it is crucial to submit a complete and clear write-up to increase your chances of winning the competition.

4. Participants are also required to submit a prototype demo video.

5. Implementation of Intel® AI Analytics Toolkits and its libraries, SYCL/DPC++ Libraries is a must for the POC completion.

6. Exploring the Intel® AI Analytics Toolkits and its libraries, SYCL/DPC++ Libraries and their usage in the product is an essential aspect.

7. Products/Projects without oneAPI as the core component will not qualify for the hackathon.

8. The prototype submission must lay down equal emphasis on the deployment/inference benchmarking for both, with and without Intel® oneAPI.

CODE SUBMISSION GUIDELINES

1. The **prototype submission** will be made by creating a pull request on this repository.

2. Participants are required to fork this repository, Push their prototype code and update its README file with all the required information to count as a valid submission. **The required information is mentioned below.**

    a. Team Name,
    b. Problem Statement,
    c. Team Leader Email,
    d. A Brief of the Prototype,
    e. Tech Stack the prototype is Built Upon (Clearly mentioning Intel® AI Analytics Toolkits its libraries and the SYCL/DCP++ Libraries used.)
    f. Step-by-Step Code Execution Instructions
    g. What I Learned

    *Here is a link to a Sample Submission

CRITERIA FOR SUCCESS

The prototype must meet the following success criteria -

1. Achieve high accuracy in detecting objects on the road, with minimum precision and a recall score of 90%.

2. Have low latency and be capable of real-time object detection.
3. Detects a variety of objects, including pedestrians, vehicles, traffic signs, and traffic signals, in different environmental conditions.
4. Be optimised for running on CPU and GPU using oneAPI Ai toolkits and libraries.
5. Provide a comprehensive report detailing the approach, methodology, results, and challenges faced during the development and testing of the model.

JUDGING CRITERIA

1. Code quality (9 points)
2. Technical implementation (9 points)
3. Creativity & originality (9 points)

RESOURCES

Videos
What is oneAPI
What is the Intel AI Analytics Toolkits
Introduction to oneDnn
oneAPI Deep Neural Networks Library Programming Model and Samples
oneAPI Video Processing Library Programming Model and Code Samples
oneAPI Collective Communications Library
oneAPI Video Processing Library Programming Model and Code Samples
oneAPI Threading Building Blocks (oneTBB)
The oneAPI Math Kernel Library (oneMKL)
oneAPI Collective Communications Library | oneCCL
oneDPL | oneAPI DPC++ Library
Direct Programming with SYCL
(SETUP) The Easiest, The Simplest C++ Parallel Library, oneTBB - SpinScoped MutexLock
Making banking secure via bio metrics application built using oneAPI and DPC++ based on
SYCL/C++
Parallel C++: Concurrent Containers

CUDA to SYCL Migration Tool and Method
Data Parallel C++ (DPC++) Programming Model
YouTube channel from an Intel innovator follow to know more

Toolkits & Library
AI Reffernce Kit
oneAPI Deep Neural Network Library
Intel® oneAPI Threading Building Blocks
Intel® oneAPI Data Analytics Library
Intel® oneAPI Video Processing Library
Intel® oneAPI Collective Communications Library
Intel® oneAPI DPC++ Library
Intel® Optimization for TensorFlow*
Intel® Optimization for PyTorch*
Intel® Distribution for Python*
Intel® Extension for Scikit-learn
Intel® Neural Compressor

HANDS-ON WORKSHOPS

Live Hands-on Workshops	Date
Accelerate AI workloads with Intel® oneDNN & oneDAL	19th April (5-7 PM)
Solving Operating System Concepts with SYCL	26th April (5-7 PM)