American Society of Civil Engineers (ASCE)
Computing Division
Visualization, Information Modeling, and Simulation (VIMS) Committee

4th Annual VIMS Datathon Competition 2023

Description: The VIMS Committee invites all interested parties to its 4th Datathon competition during the 2023 i3CE conference in Corvallis, Oregon, hosted by Oregon State University. The 2023 Datathon is focused on detection of objects in video streams that are of significance to the Architectural, Engineering, Construction, and Facilities Management (AEC/FM) community. Teams will start with pretrained models (e.g., YOLOv8) and retrain them for the objects of interest.

Team Formation: Teams will consist of 4 or 5 undergraduate and/or graduate students, who have vested interest in ASCE Computing Division, machine learning, and 3D data. Teams can be formed with students from the same institution or from multiple institutions. Each team must have a mentor, who is selected by the members of that team from full-time faculty members in one of the participating institutions. The faculty mentor should be a current member of any of the four ASCE Computing Division Committees (VIMS, DSA, EDU, Global). Only teams that are formed and registered through Google Form: https://forms.gle/JwHoStD4qVA5AjPBA on or before **11:59 p.m. EST on May 19, 2023** will be eligible to participate in the 2023 Datathon.

Benefits: Winners will be announced and formally recognized **(with monetary prizes)** during the VIMS Committee's 2023 annual meeting (June 27, 2023) at i3CE conference in Corvallis.
First place: $500
Second place: $300
Third place: $200

In addition, all the participating teams will have the right to utilize the generated work and initial data in the future. The winning teams will also be acknowledged at the 2023 ASCE VIMS Committee's annual meeting.

Dataset: Teams are tasked to find video streams that contain construction equipment and people (the list of specific equipment provided below) in any construction setting. The identified video streams should include the following object types: **Cranes (tower, mobile), Excavators (backhoe, front shovel), Bulldozers, Scrapers, Trucks,** and **Construction Workers.**. There is no minimum number of video frames specified in this datathon; however, the teams should work with datasets that improve their model performance.

Datathon tasks: Teams will utilize the released dataset to train machine learning models for automated detection of construction heavy equipment and construction workers in frames captured from related video streams. Teams are not constrained to use any specific software packages, platforms, or pretrained models throughout the process that includes video to frame conversions, labeling, and training (e.g., YOLOv8, MMdetection, OpenVINO, Labelme, Labelimg, etc.). Teams can choose to use any suitable pre-trained models to start their training process for the objects of interest. Specific tasks required from the teams are listed below:

- Gather a large dataset of video streams from construction settings where the objects of interest are present. Convert videos into frames to label objects of interest in those frames. The method of labeling should be at box level. The focus of this Datathon is only on construction equipment and humans. The labels will be: **(1) Cranes, (2) Excavators, (3) Bulldozers, (4) Scrapers, (5) Trucks,** and **(6) Construction Workers**. For excavators and cranes, if videos contain versions of these objects, map them to the parent label (e.g., a tower crane is labeled as a "crane", not as a "tower crane").
- Use this labeled dataset to train machine learning models (algorithms of your choice or pre-trained models of your choice such as YOLOv8, as the baseline models from github libraries) for the categories of objects using the correct labels.
- While training your models, teams are expected to use a 80-20% split to train and validate their models. This split should happen at a frame level, not at the video level.
- Judges will release a testing dataset of video frames on the evaluation day (June 20, 2023) and ask teams to provide their testing results online using the test dataset and share with the judges. IoU (intersection over union) as a metric. Show your IoU per label, mean IoU (mIoU), and mean average precision (mAP) across all the labels.

Important Dates:

- Call for participation: **April 13, 2023**
- Team formation and registration (official time frame): **April 13 - May 19, 2023, 11:59 p.m. EST.** Registered teams will receive additional information on the next steps.
- Datathon period: **May 19- June 19, 2023, 11:59 p.m. EST**
- Progress check point: **June 10, 2023**
- Releasing of the test dataset to teams: **June 20, 2023 10 a.m. EST**
- Evaluation/Review by the judges: **June 20, 2023 10 a.m. EST** (teams will sign in to specific 15 min time slots and will be notified ahead of time)
- Final announcement of results: **June 27, 2023**, **during VIMS annual meeting**

Evaluation Criteria: VIMS Officers (and ad-hoc experts, as needed) will evaluate all submissions, and identify the top 3 teams of this Datathon. Winners will be announced during the VIMS Committee's 2023 annual meeting at i3CE. The evaluation criteria are listed below:

1. Labeling accuracy (30%): Submitted labeled dataset will be checked randomly by the judges in terms of accuracy and completeness. Both of these criteria will have an impact on the overall model performance.
2. Model testing performance (55%): Online assessment. Teams will download the testing data to be released on the evaluation date (June 20, 2023) and have access to them when their team is up for evaluation on that day. Each team will receive a unique password-protected link to download the testing data right before the online evaluation time. Passwords to open the downloaded dataset will be released to the teams when a team is due for the testing performance. This will be a process to make sure each team has the same amount of time reserved for testing. IoU, mean IoU, and mAP will be the main evaluation metrics for this part.

3. Training/Validation effort (15%): Number and suitability of models trained, tuned, and evaluated before the final model is selected and submitted by the teams. *Note: This information should be clearly conveyed to the judges in the submitted .ppt or .pptx slides with the overview of their performances before the final selection of the submitted trained model.*

Interim Deliverable: Progress check point: June 10, 2023: A presentation in .ppt or .pptx format, showing the progress on each specific task listed under the datathon tasks section to be submitted to ASCE VIMS Secretary Eric Du (eric.du@essie.ufl.edu)

Final Deliverables: Teams will upload the following deliverables on the designated Google Drive folder (link will be provided to participating teams). The submission deadline is on or before **10 a.m. EST on June 20, 2023**. The deliverables are:

1. Published native github repository for access to the judges, URL of the repository, and also the corresponding notebook to rerun the code for testing by the judges (in case needed). Please use the following naming convention when creating your github repository: ASCE-VIMS-Datathon4-TeamName. Submit a zip file of your source code if your team does not utilize github.
2. Manually-labeled dataset by the teams.
3. A presentation in .ppt or .pptx format:
   - Overview of the trained models, baseline models (i.e., pre-trained models) utilized.
   - Overview of the dataset labeling process (e.g., statistics on total labels per class, platform utilized if any, time spent on the manual labeling task).
   - Final trained model selected (e.g., architecture of the model, model parameters, training times, high-performance computing specs).
   - Performance of the models built and evaluated using the IoU and mAP metrics calculated per label and averaged across the labels. Testing results submitted by the teams for the final trained model. The teams should use the evaluation code provided here: https://github.com/bilab-nyu/VIMS_datathon and https://github.com/bilab-nyu/VIMS_datathon/blob/main/eval.py

At the VIMS Committee's 2023 annual meeting in Corvallis, the winning teams of the 2023 VIMS Datathon will be invited to give a short presentation to attendees.

Disclaimer: ASCE VIMS Officers reserve the right to interpret the rules of the competition.

ASCE VIMS Officers: Semiha Ergan, NYU (VIMS Chair); Fei Dai, WVU (VIMS Vice-Chair); Jing Du, UFL (VIMS Secretary); Reza Akhavian, SDSU (VIMS Member-at-large).