7th International Conference on Internet of Things and Connected Technologies (ICIoTCT) 2022

Paper Title : M-Lens An IoT based Deep Learning Device

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PAPER ID: 035

Introduction

- Aim of an inspection is to reduce number of defects.
- Current inspection techniques are expensive and inspection devices are specialized.
- Such device and technique fails in dynamic environment where novel defects are the norm
- M-Lens is a hand-held device that automatically classifies defective parts even if the defects are novel and previously uncategorized.

Objectives

- The objective of this paper is to show the designing, development and working capabilities of such a generic hand-held device.
- The features, technical specification and user interface of the device are specified.
- Transfer learning technique is used for time optimization.

Existing System

- Portable object detection devices:
  - AWS DeepLens - Not user friendly, on-machine inference, portable but heavy, no on-screen display.
  - Google Glass - Custom detection is not possible.
- Real-time portable training
  - Intel Movidius - Real-time inference is not possible.

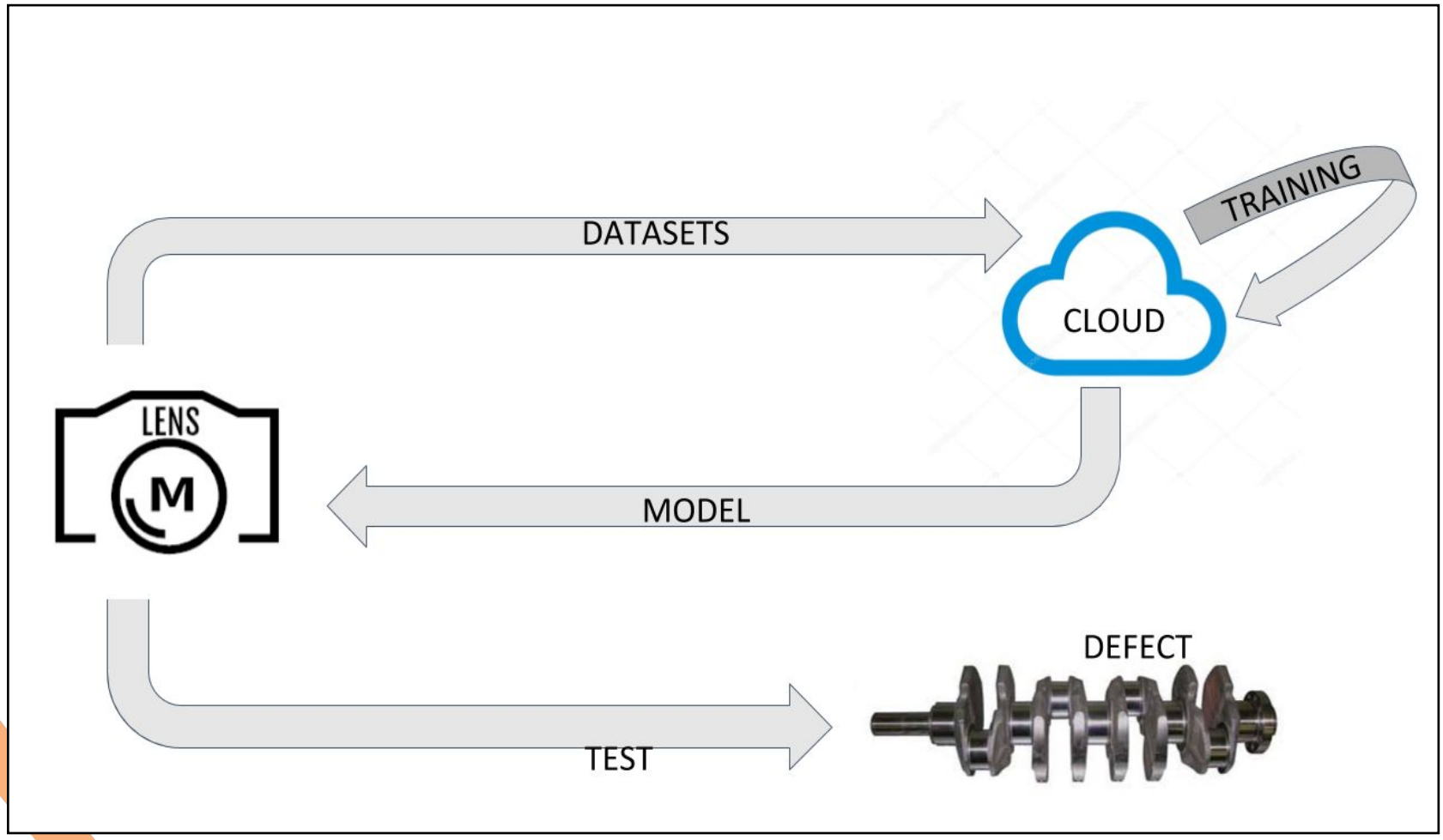
Proposed System

- Architecture considered were edge and server-side computing. Servers-side computing was selected based on the speed consideration.
- Hardware considered were Arduino, Raspberry-Pi and FPGA. Raspberry-Pi was selected based on the cost.
- DNN considered were AlexNet, MobileNet and GoogleNet. MobileNet was selected based on Accuray to MAC operations ratio.

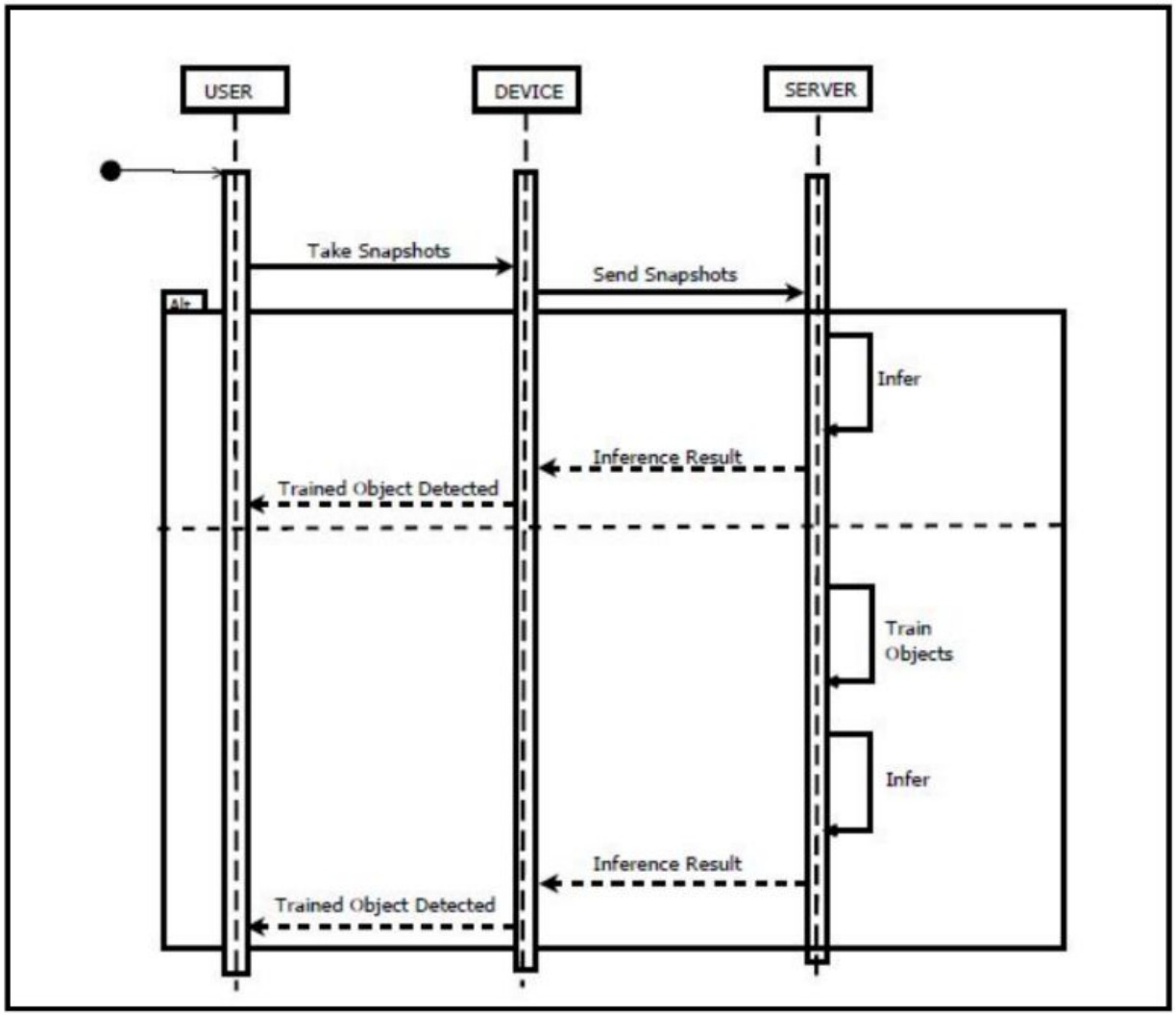
Features

- Cloud training
- Portable
- Transfer Learning
- Training Custom Defect

Architecture



Implementation



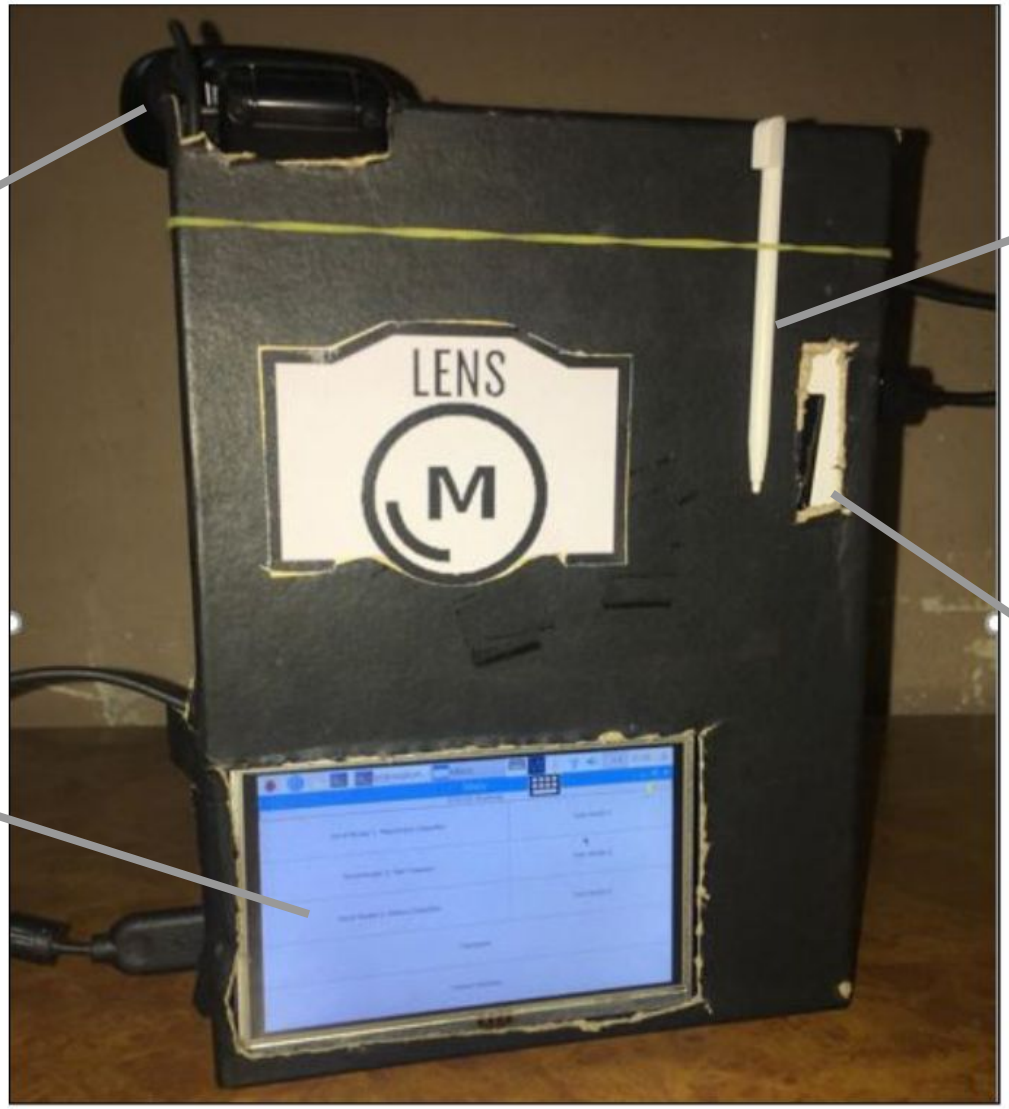
Working

- Input
  - Image resolution and processing time are directly proportional.
- Training
  - Transfer Learning
    - MobileNet for Transfer Learning
  - Training custom data
    - User Input Data
  - Classifiers
    - Industry requirement specific

Working

- Inference
  - Real-time defect detection
- Communication
  - AWS Cloud computing
- GUI
  - Datasets
  - Custom dataset
  - Retrieve Model
  - Test Model

M-LENS



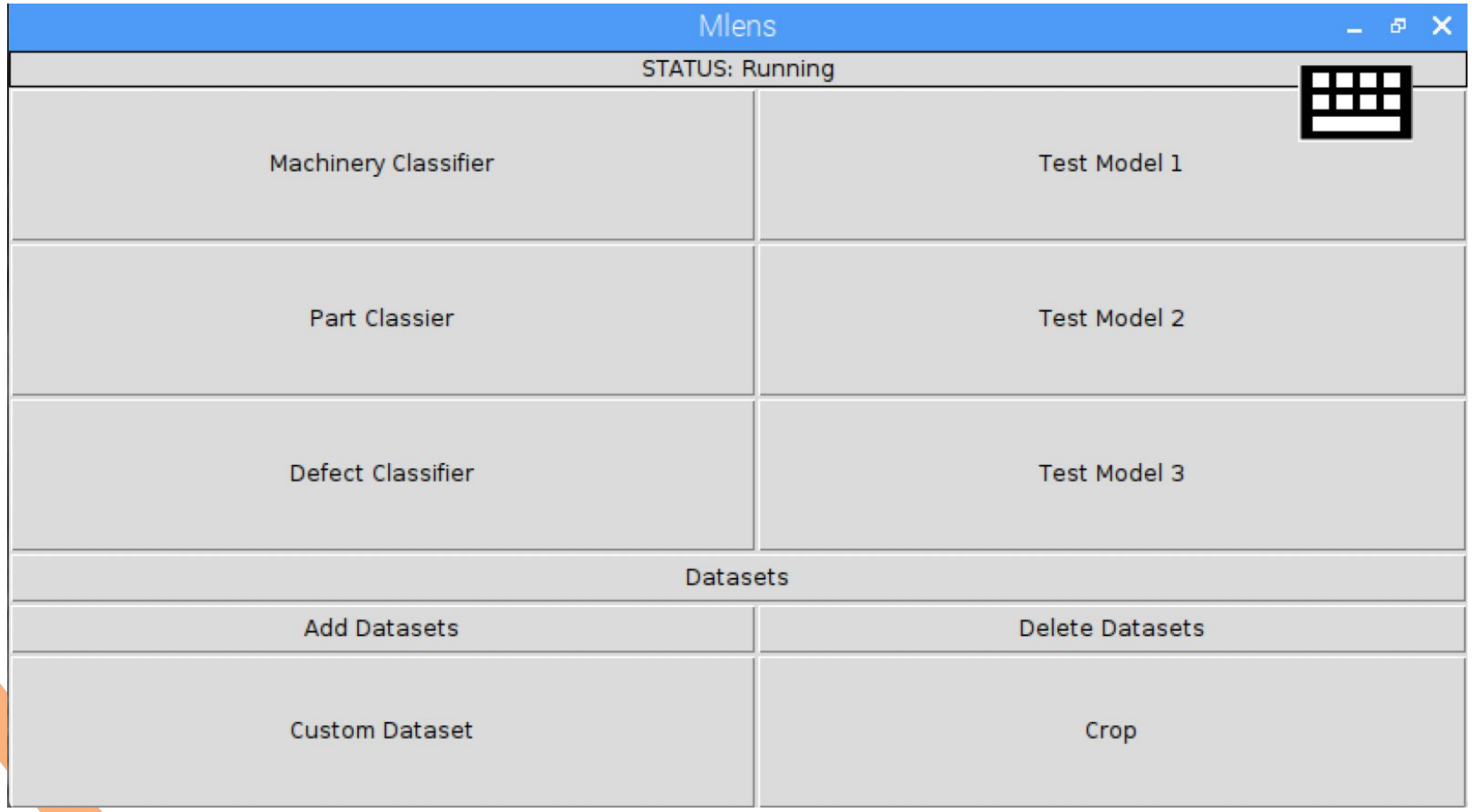
WEB CAM

STYLUS

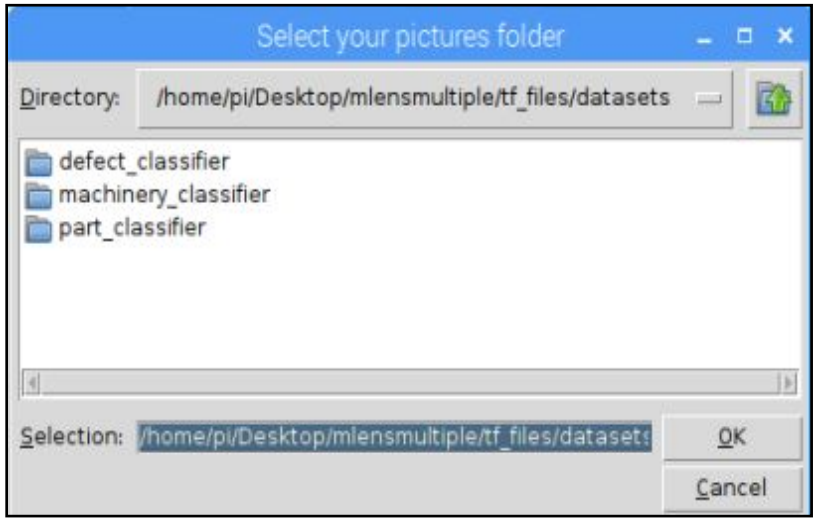
SCREEN

POWER BANK
(INSIDE)

GUI


Mlens
STATUS: Running
Machinery Classifier
Test Model 1
Part Classier
Test Model 2
Defect Classifier
Test Model 3
Datasets
Add Datasets
Delete Datasets
Custom Dataset
Crop

GUI

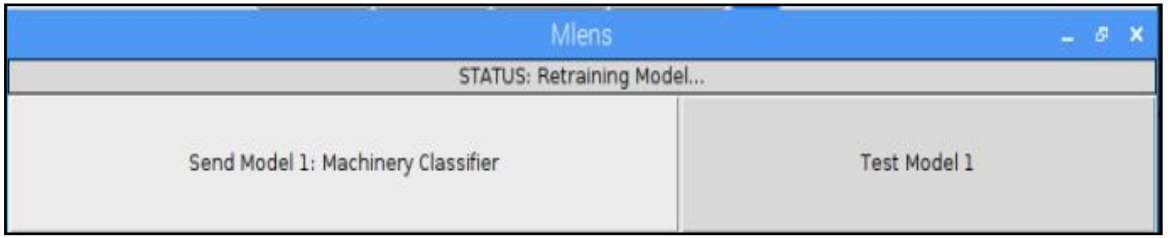


Datasets: Shown are all the datasets present on the device along with image storage directory information.

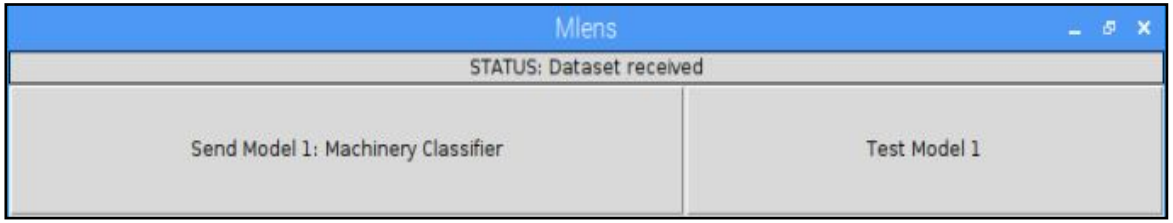
Custom Dataset: The snapshot button clicks 30 images (from multiple angles).

GUI

Running: The process of sending dataset to the server is going on.



Retraining Model: The server is retraining the model and sends the updated model to the device.



Datasets Received: The server has received the datasets.

GUI

Test Model: After receiving the updated model, inference takes place. The result shows whether the image is faulty or not. It also displays the type of fault detected.

Applications

- Crops - Plant fungus, bacteria and other blight detection
- Pipes damage inspection
- Scrap processing plants' maintenance.
- Part manufacturing industry
- Aircraft and Shipbuilding industry

Conclusion

- Broad scope of application makes it viable to tackle variety of issues from industrial manufacturing to ship and aircraft building.
- M-Lens uses supervised learning where the user specifies the class name. This results in fast and efficient way of detecting and classifying defects while minimizing human intervention.
- Using transfer learning the device develops its knowledge about the defects in the cloud.

Video Link - https://www.youtube.com/watch?v=2ZT-dtsKMFM

Q&A