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End Of Study Thesis

In view of obtaining the **Engineer diploma**
Field: **Computer science**
Speciality: **Computer Systems Engineering**

Theme

REAL-TIME ON-BOARD COUNTING SYSTEM IN CROWDED SCENES

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- Dr. Nassima DIF MCB President
- Dr. Oussama SERHANE MAB Examiner
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In public spaces, **crowd counting** is a useful tool for situational awareness. Interest in computer vision has grown significantly as a result of the fascinating yet challenging problem of automated crowd counting using images and videos. During the past few decades, many approaches were proposed to count people in crowded scenes and which have made a remarkable progress. However, there is not a crowd counting model that works for all applications (e.g., non real-time, real-time), and which can be deployed in different hardware platforms with different computational capabilities (e.g., cameras, drones, servers, edge devices, mobile phones etc.).

This thesis aims to give the background of crowd counting, and explains our real-time crowd counting and face detector model called **YOLO-CROWD**, which solves the problem of occlusion in YOLO models and which can be deployed on edge devices. Additionally, this thesis describes our platform **CrowdCounting.AI**, which implements dense and very computationally-demanding models that run on powerful devices for the best accuracy, and which also implements our model **YOLO-CROWD** for real-time applications.

Key words: Crowd counting, CNNs, YOLO, real-time, edge-devices, density estimation, evaluation metrics, loss functions, transformers, YOLO-CROWD, Crowd-counting.AI,

THANKS

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DEDICATION

*We sincerely dedicate this work to our great teacher **Mustapha Mechab** who died during the COVID-19 pandemic, may God bless him with heaven, he was a big influence for us and for countless people.*

CNN Convolution Neural Network.

YOLO You Only Look Once.

CSRNet Congested Scene Recognition Network.

P2PNet Purely Point-Based Framework.

FIDTM Focal Inverse Distance Transform Map.

SSD Single Shot Detector.

MAE Mean absolute error.

RMSE Root Mean Squared Error.

GAME Grid Average Mean Absolute Error.

MPAE Mean Pixel-Level Absolute Error.

PSNR Peak Signal to Noise Ratio.

SSIM Structural Similarity Index Measure.

RFE Receptive Field Enhancement module.

SEAM Separated and Enhancement Attention Module.

SGD Stochastic gradient descent.

IOU Intersection over union.

HOG Histogram of oriented gradients.