Topic 2 - Thermal sensor based human detection model

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I. Introduction

In this paper, we will describe the development of a model using CNN (Convolutional Neural Network) written in C and compiled using **gcc**. This model will be used in embedded systems as it will fit into 1-core ARM MCU (in our case a STM32F4 card for development purposes) which add several constraints :

- the language used (for memory usage optimization)
- the size of the model (for accounting the storage limitations on the board)
- the band-with of the model (because of the CPU power which is relatively limited)

The goal of this project is to detect a human being in front of a thermal sensor according to several factors such as the temperature and the shape of the image. The model will be trained using previous recorded data from a thermal sensor, under the form of 32x32 pictures such as the following one :

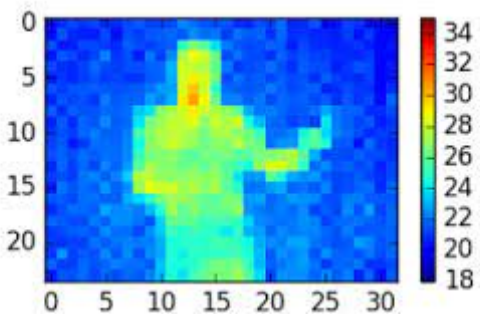

Fig. 1. Sample of data collected from the thermal sensor, 32x32 RGB

II. State of the art

For years, researchers have been investigating and innovating different applications related to people detection and recognition.
The introduction of machine learning to computer vision problem was a great step forward in the last decade. Furthermore, the recent implementation of optimized neural network for mapping human body pose gives really good results.
Those neural networks were improved by using convolutional neural network in order to extract and detect body parts through max/avg pool and Conv2D filters. To make the final recognition, the convolutional neural network learnt the hierarchies of the features and made prediction based on that.

III. Description of the methodology

We want to use the **MobileNetv3** model in this project, as it was studied in class and we are already familiar with it. It is a model adapted to embedded systems, and it results in a good accuracy for this specific context.

Here is a first version of our methodology :

1) **Data pre-processing** with **feature selection** to get better insights of the data frames : *do we focus on object size, average temperature, temperature variation or do we perform a static analysis ?*.
   As we're using **MobileNetV3**, we might **need to shape the input** in order to fit the requirements of such a special architecture such as up-scaling the picture.
2) **Model tuning** with grid search or cross-validation to assure that the hyper-parameters will correctly go along our interests !
3) **Model training optimization** with **the correct selection of the main backpropagation's components** : the optimizer and the adequate loss function

IV. Implementation

Describe how did you implement the method, which hardware or software as used.

V. Analysis and results

Description of the analsysis and results.

VI. Conclusions and Future Research

In this paper we have proposed ...