Hardware-based Facial Recognition Study with Siamese Network and One-Shot Learning

Abstract

This project presents a possible hardware-based solution regarding facial-recognition. The SiPeed Maix Bit is a microcontroller with an integrated camera, suitable for deep-learning tasks. The work starts with the premise of using a lite and performant CNN able to functionate in a small board. With a much lower computational cost than a standard CNN, MobileNet is the perfect solution for the Maix Bit. After a succesful test using an already trained MobileNet for the classification of dog and cats, the study moves on extending the concept. The idea is to use a Siamese Network combined with the One-Shot Learning. In this concept (Figure 1) two CNNs (in this case two MobileNets with an added GlobalAveragePooling2D-layer to reduce the size of the feature map) have exactly the same compositions of layers. Both of them are returning a feature map that supports the One-Shot-Learning phase: here, by computing the euclidean distance between the two feature-maps, the network returns a similarity score. This then delivers a comparison between two faces: the live-detected one with the most similar one found in the database. Figure 2 describes the actionflow within the board: after switching mode by holding the button, the camera is ready to take a new picture and store it in the DB; going back to normal mode the board is able to compare the live-detected faces with the one stored in the SD-card. The experiment shows a working MobileNet CNN on the SiPeed Maix Bit with a partly acceptable preciseness. Indeed, it also reveals that image alignment, brightness, and other camera related parameters play an important role in the accuracy of this method. Another drawback is the small RAM size of the board: it is only possible to load one feature map vector at the time from a saved-image. Finally, the pretrained MobileNet also didn't help providing a satisfiyng accuracy. A further improvement could be training it with a large face-dataset.

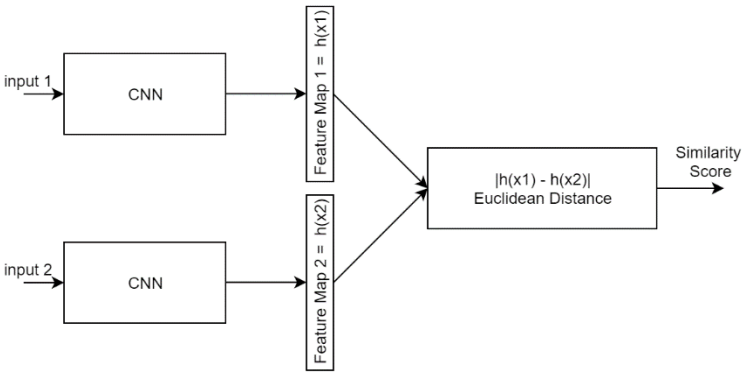

Figure 1 Siamese Network with One-Shot-Learning

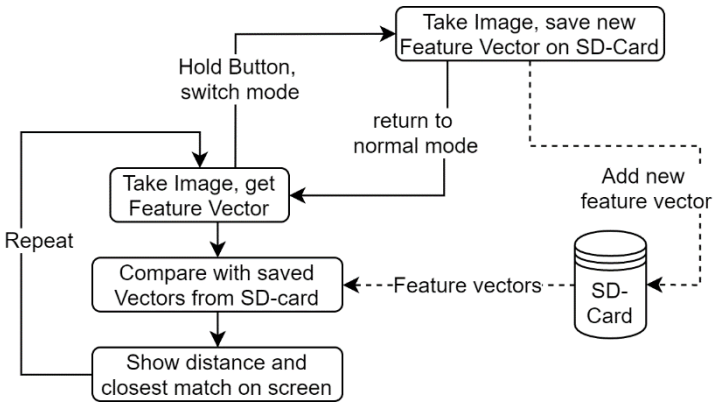

Figure 2 Simplified overview of the application

Figure 1 Example of comparison within the board

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