

**ENG5220**

**Real-Time Embedded Programming**

**Project Report**

**Team 16: Fun Door Security System**

**Computer Vision Part**

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The computer vision (CV) part mainly concentrates on the face detection and face recognition, which is the core module of the whole system. The former determines whether a face is present and returns its pixel position, while the latter validates the input face against known information to determine whether there is a matched face in the database. Detection is an a priori condition for recognition. Therefore, OpenCV built-in function are used to detect the face first, and then performing face recognition. The face detection code is shown below.

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| CascadeClassifier classifier;  classifier.load("/home/pi/raspi\_project\_16/cascades/haarcascade\_frontalface\_alt.xml");  classifier.detectMultiScale(frame, faces, 1.2, 5); |

There are three methods given by OpenCV regards face recognition, which are Eigen Faces, Fisher Faces and Local Binary Patterns Histogram (LBPH), respectively. The project needs of CV are:

1. Superior accuracy;
2. High robustness and versatility;
3. Low hardware performance requirements;
4. Easy to update models;
5. Low cost.

Thus, the LBPH is used here. The advantage of this algorithm is that it is not affected by lighting, scaling, rotation and panning, and can also run on the not very high-performance platforms smoothly, making it feasible on Raspberry Pi.

The LBPH algorithm is to compare the grey value of the pixelson a circle of radiuswith that of the current pixel, and if the surrounding pixel has a greater grey value, the position of the pixel is marked as 1, otherwise it is 0. By arranging the value of each point, the current pixel is given a binary LBP value. The relationship betweenandis:



whereis the number of sampling points. However, as the number of sampling points grows, the number of LBP patterns increases exponentially, toin total, which is not conducive to expressing graphic information. The LBP patterns, therefore, are integrated through a certain rule called Equivalent Model, reducing the dimensionality of LBP patterns, so that the information of the image can be best represented with a reduced amount of data. The content about means of reducing pattern is not represented here.

With the method mentioned above, each pixel is given an LBP value based on surround information. The next step is LBP feature matching and the process is as follows:

1. Dividing images into non-overlapping areas;
2. Construct a grey scale histogram within each area;
3. Stitching the grey-scale histogram features of the whole image in a certain order to construct the overall features;
4. The similarity between the face to be recognized and the features from the database is calculated, and the highest similarity which is greater than the threshold is considered as the same person.

To train the model, the folders are named after the registrants’ names and the photos corresponding to the registrants are put under the folders. During training, the folder name is used as the label and the vector obtained from the training is stored in .xml extension files, which is the model for face recognition. When validation, the confidence level returned by the function is compared to a set threshold to determine if it is a known individual.