SOLENT UNIVERSITY

Face Recognition Door lock

Beng (Hons) Electronic Engineering

ABSTRACT

The development of the Biometric identification has increased and fulfilling the gaps of the traditional identification techniques in the worldwide market.

Currently, there are still traditional identification techniques, such as PIN and swiping a pattern, whereas it is less required. Most of the recent electronic devices requires different biometrics identification such as fingerprint or face recognition.

This project is focused on the development of a system able to recognize the individual face and unlock a door, if the detection matches with the recognizer data enrolled, the door will open, otherwise will not open.

However, to accomplish this project will be used two algorithms, one to face detect and other to recognize the face.

CONTACT

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INTRODUCTION

Throughout years face recognition has gain a wide range of applications such as Security Systems, Biometrics, Human Computer Interaction (HCI) and Social Networking. The words Face Recognition refers to identification and verification of a face.

The Face Recognition System (FRS) is an expectation of a computer recognize faces supported by an algorithm and comparing the input data (video frame) with the database created by the operator.

There are three stages for recognize a face:

✓ Face Detection – supported through peripherals, 2 or 3D image, video frame.
✓ Face Extraction – supported through haar cascade algorithm analyses image.
✓ Face Recognition – supported through Local Binary Pattern algorithm , comparing and matching database faces.

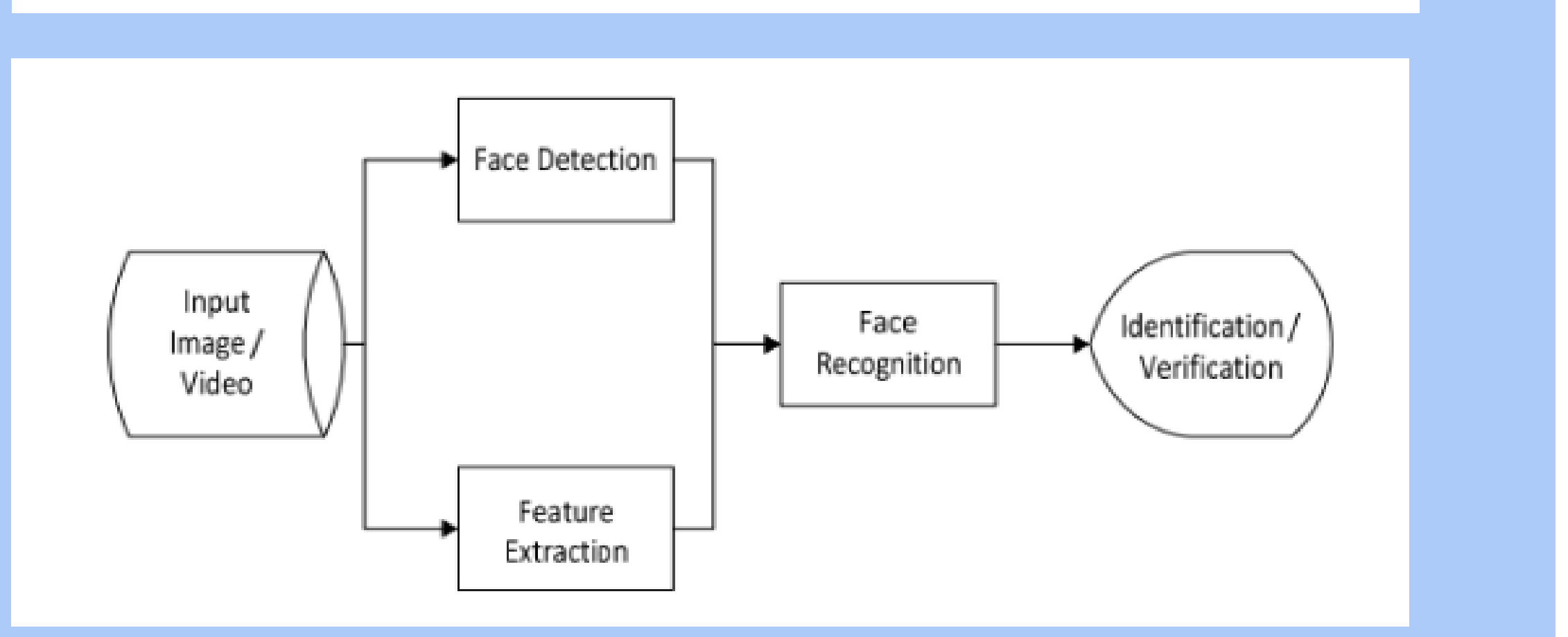

Figure 1. Face Recognition System Diagram

ALGORITHMS

Haar Cascade – Face Detection

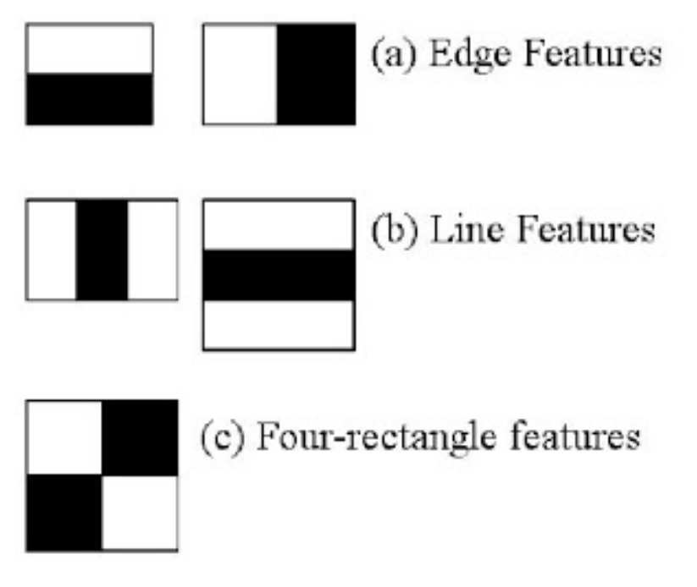

Figure 2. Haar Features

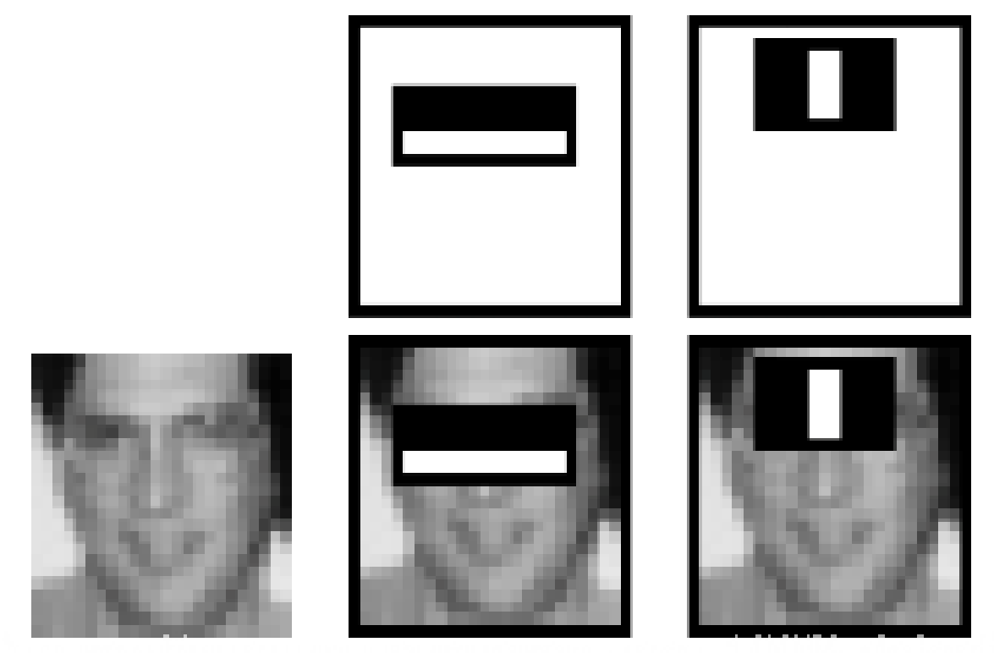

Figure 3. Adaboost Representation

Local Binary Pattern Histogram – Face Recognizer

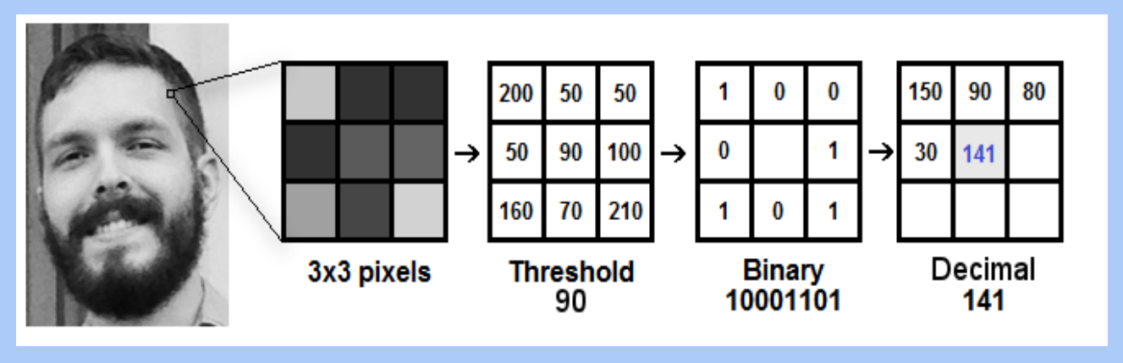

Figure 3. Local Binary Pattern

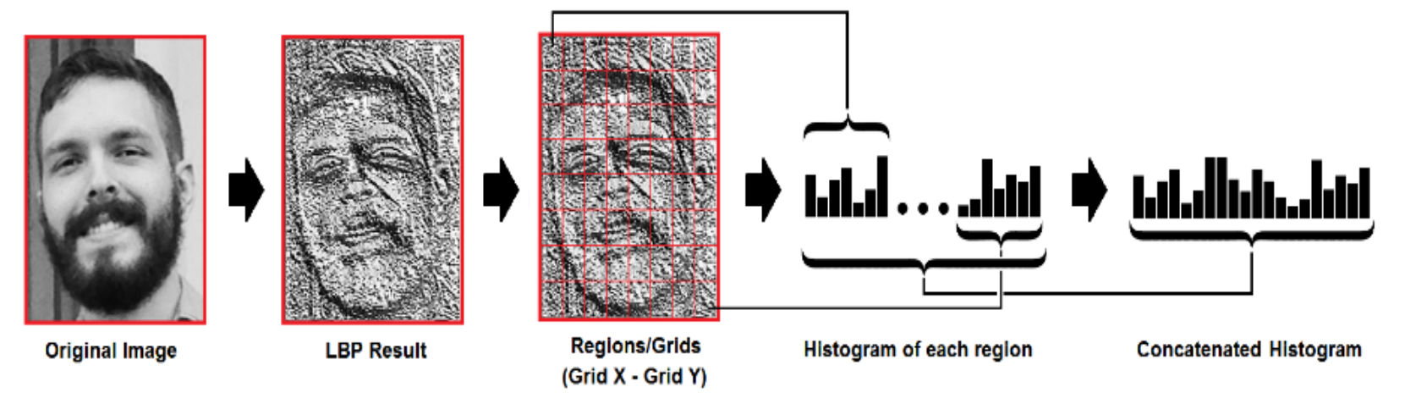

Figure 4. Extract Histogram

METHODOLOGY

Software

Microsoft Visual Basic allows to simulate the code in python language. In order to achieve a face recognition sucessefully was needed the OpenCV library, which contains the two algorithms (Haar cascade and LBPH). Althought was need to develop 3 differents code programs.

I. Face Detection and Gathering – Detects the face and gather 30 face pictures in a file.
II. Training the Recognizer – Train the information gathered (30 face pictures) using LBPH algorithm.
III. Face Recognizer – Recognize the face using LBPH algorithm and matching real time video frame with the information gathered.

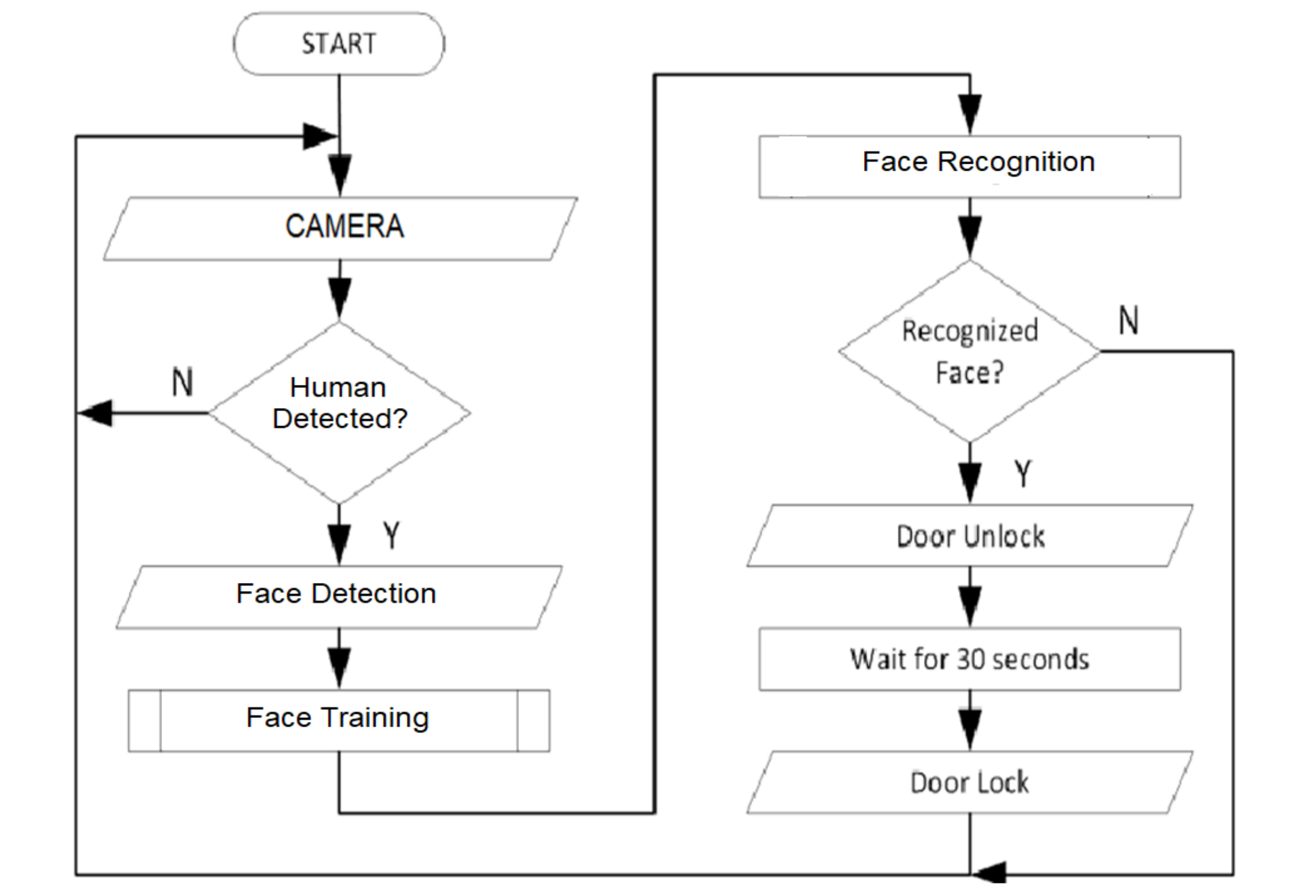

Figure 5. Flowchart Face Recognition System

Hardware

Pi Camera – High definition camera used as input, which will send the information to the microcontroller to process the video frame.

Raspberry Pi - The microcontroller used to accomplish this task. The reason of choose was due to it`s ability to support image processing (OpenCV library) and python language to perform all the 3 codes.

Modulo Relay – allows the low voltage circuit that comes from the microcontroller connect the higher voltage that will turn on the door lock.

Door lock - will perform depending on the relay signal.

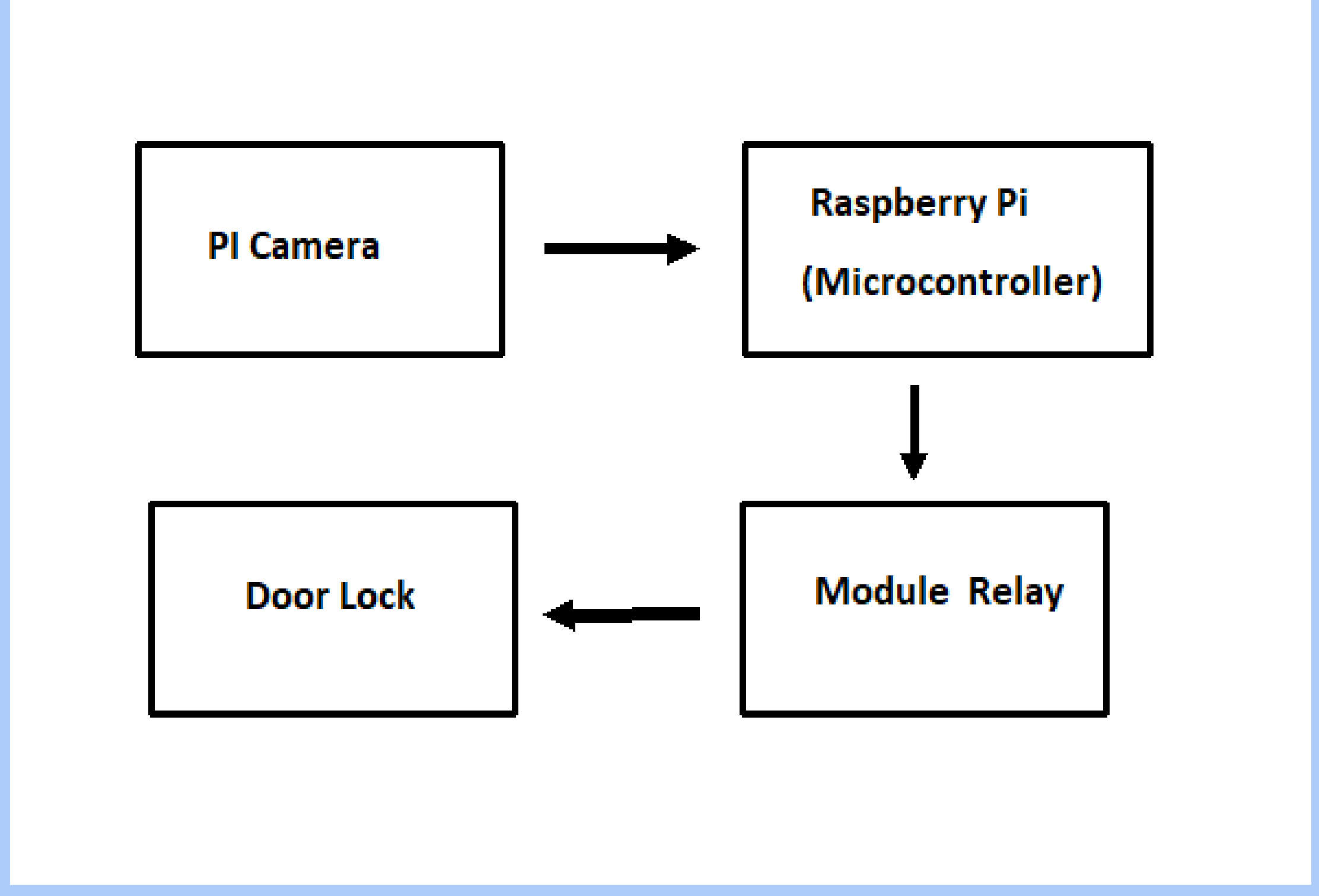

Figure 6. Hardware Diagram

RESULTS AND TESTING

The table 1 below, demonstrate the parameters used to test the face recognition system. Figure

Components	Description	Results / Comment
Processor	Quad core 64bit ARM-Cortex A72 1.5Ghz	-
RAM	4 GB	-
Programming Language	Python 3.7.3	-
Camera Resolution	640x480 pixels	-
Sampling Rate (display)	30fps	-
Face Detection	Haar Cascade Algorithm	Average 0.5 to 1 seconds
Face Recognition	LBPH Algorithm	Average 0.5 seconds
Face Tracking	Closest distance of detected face position in current frame	0.01 – 0.05 seconds (depends on the distance)

Table 1. Testing specification and results

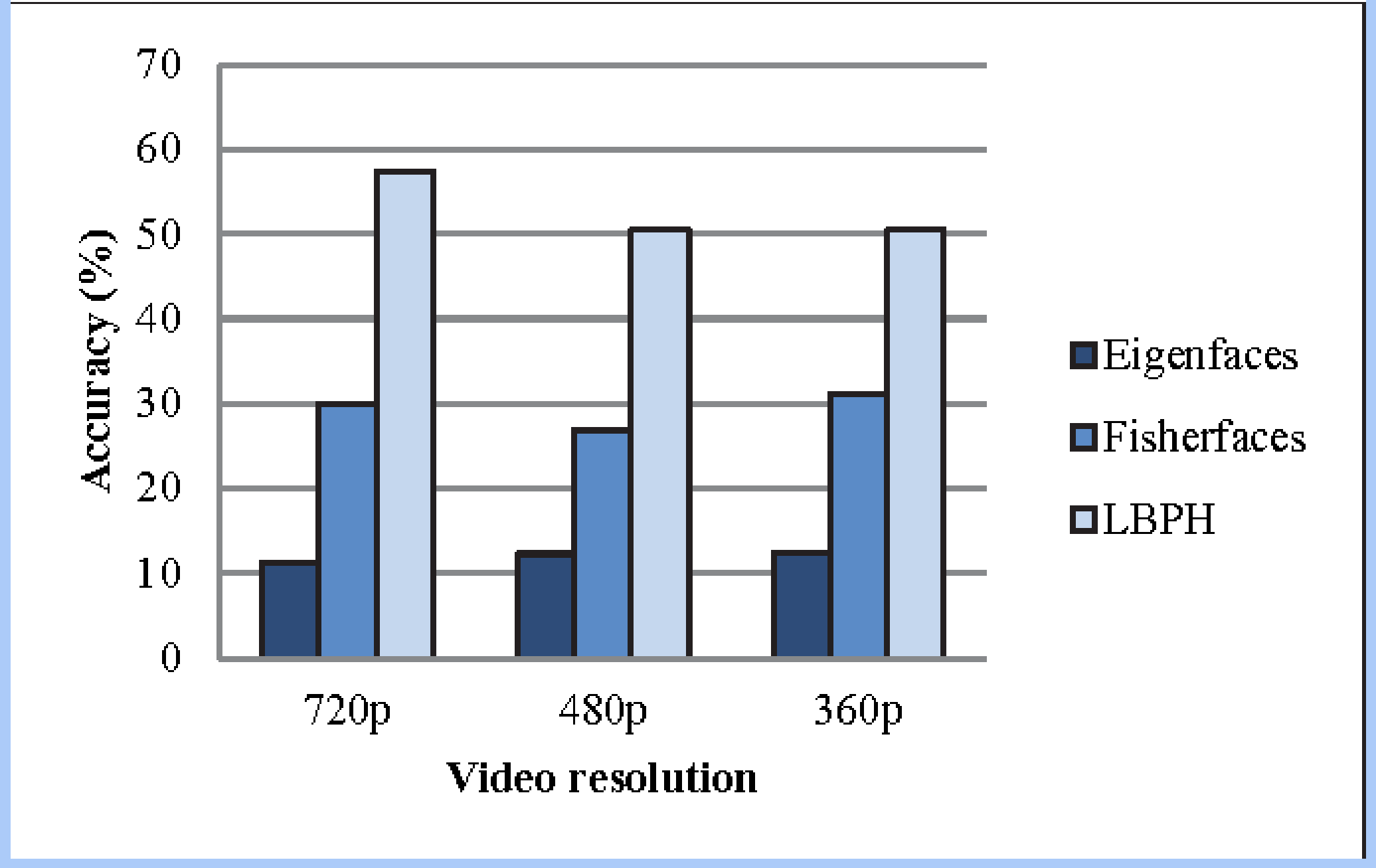

Figure 7. Accuracy testing using different resolutions.

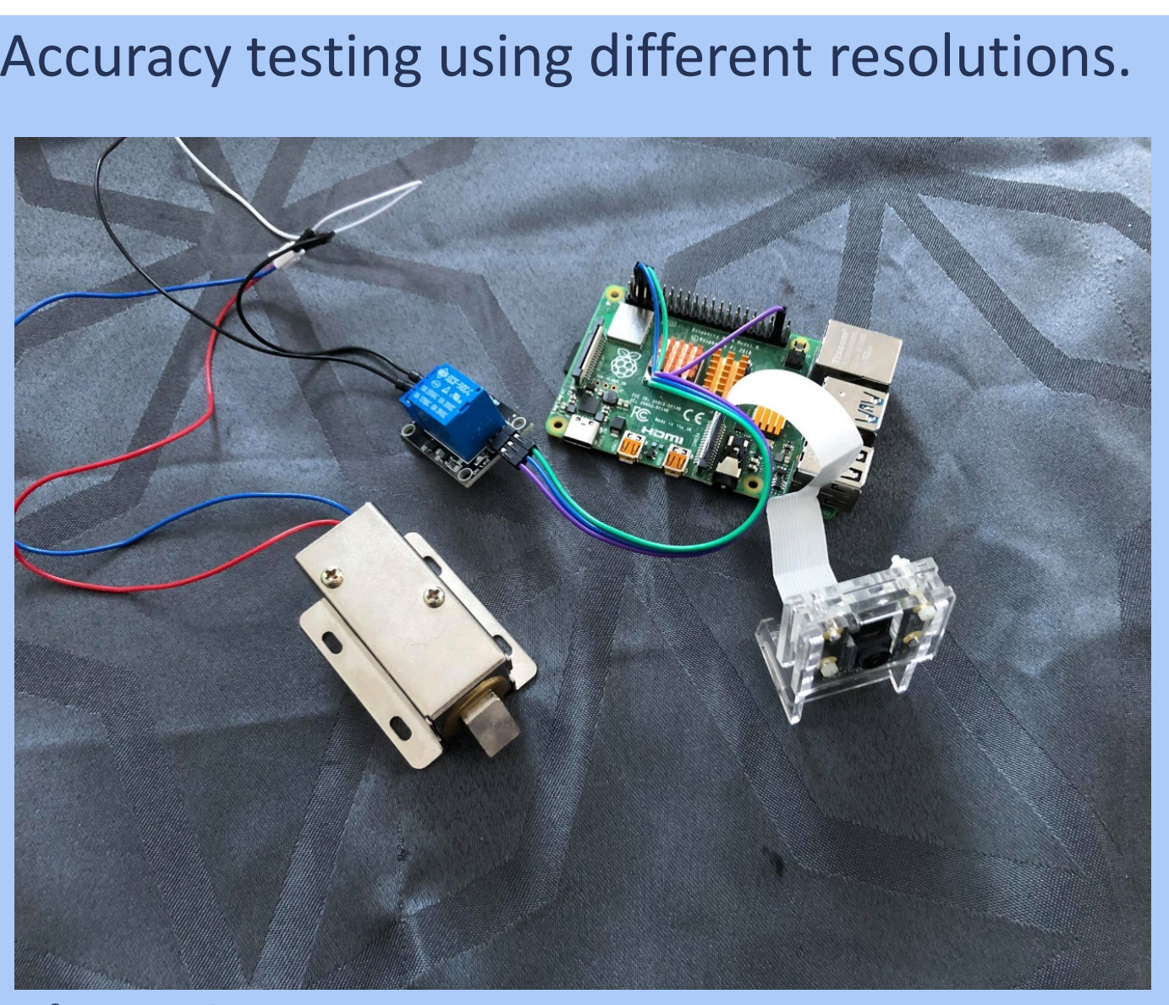

Figure 8. Prototype.

CONCLUSIONS

The two algorithms used to face detect and recognize human faces was sucessfully developed and tested. Its was shown that the speed and accuracy of the system was greatly achieved comparing with other algorithms (figure 7). Future work can include the usage of SHIFT and SURF algoritms, which are improved algorithms with greater accuracy in terms of robust recognition.

REFERENCES

1 *Documentation*. [online] Available at: <https://opencv-python-tutroals.readthedocs.io/en/latest/py_tutorials/py_objdetect/py_face_detection/py_face_detection.html> [Accessed 1 January 2020].

2 Docs.opencv.org. 2011. *Face Recognition With OpenCV — OpenCV 2.4.13.7 Documentation*. [online] Available at: <https://docs.opencv.org/2.4/modules/contrib/doc/facerec/facerec_tutorial.html#local-binary-patterns-histograms-in-opencv> [Accessed 1 January 2020].