

# Advanced Tracking Mechanism for Humans Using Mapping Technology

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**ABSTRACT:** A device similar to Harry Potter's Marauder's Map which pin points the exact location of every person or a person of interest at all times. To create a device similar to this, a system with Raspberry pi and its related software's are used for monitoring multiple targets concentrating indoor environments. In high tech hospitals, the doctors are generally busy and they don't use mobile phones inside the hospital so it is very difficult to locate the doctor when an emergency like accident cases are occur and if these cases are not confronted by doctors immediately might causes even death of the patients. So we can use this technology in order to avoid such problems. This technology can also use to monitor and track criminals in a prison center where highly notorious criminals are imprisoned. This technology can also use for security system in banks, IT companies, research centers or laboratories, etc.

**KEYWORDS:** Raspberry pi, Marauder's map, IT

## I. INTRODUCTION

The Marauder's Map is a magical document which reveals all the secrets of Hogwarts School in the movie "Harry Potter" which is shown in the figure 1. It pinpoints the exact location of every person in the school by a dot in the map and also reveals the location of secret areas and even ghosts. The name Marauder's map comes from the four famous mages from the movie series "Harry potter". So in order to implement a similar device in our modern technology, a real time monitoring system for tracking every person in an institute or a company is required. To perform reliable localization and tracking, the required features are color, face detection, face recognition and non-background detection should all be utilized. This system is designed in a different platform and the usage of camera for surveillance is neglected. The camera is only used in front end of an institute in order for face recognition purpose only. For surveillance camera setups with near parallel viewing angles of cameras can cause the Probabilistic Occupancy Map (POM) to be inaccurate. Therefore, when there is heavy occlusion on the corridor, there can be ambiguity in how to generate a set of person location hypotheses. Also, for locations which are only viewed by one camera, the POM is also not as effective. These are the main difficulties faced during camera surveillance for tracking and monitoring multiple targets. The other major drawbacks of camera surveillance are that cameras are not color calibrated, which makes cross-camera tracking difficult because the same person may have slightly different color appearance when viewed from different cameras. The second problem is that the CPF (Circular polarizer Filtering) does not have the mutual exclusion constraint, and multiple particle filters may start tracking the same object.

The Marauder's map is already implemented using different technologies using surveillance cameras for multiple tracking. This kind of technology is implemented about 9 or 10 years ago. Andriyenko et.al [1] formulate a multi-target tracking as a discrete continuous optimization problem that handles each aspect in its natural domain and allows leveraging powerful methods for multi-model fitting. Data association is performed using discrete optimization with label costs, yielding near optimality. Trajectory estimation is posed as a continuous fitting problem with a simple closed-form solution, which is used in turn to update the label costs. Earlier

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technology includes colour based particle detector for tracking multiple targets. Different types of filters are used to identify the persons through camera. C. Beleznai et.al [2] present a GPU-accelerated, real-time and practical, pedestrian detection system, which efficiently computes pedestrian-specific shape and motion cues and combines them in a probabilistic manner to infer the location and occlusion status of pedestrians viewed by a stationary camera. The articulated pedestrian shape is approximated by a mean contour template, where template matching against an incoming image is carried out using line integral based, Fast Directional Chamfer Matching, employing variable scale templates (hybrid CPU-GPU). The motion cue is obtained by employing a compressed non-parametric background model (GPU). Given the probabilistic output from the two cues, the spatial configuration of hypothesized human body locations is obtained by an iterative optimization scheme taking into account the depth ordering and occlusion status of individual hypotheses. The method achieves fast computation times (32 fps) even in complex scenarios with a high pedestrian density. Employed computational schemes are described in detail and the validity of the approach is demonstrated on three PETS2009 datasets depicting increasing pedestrian density. While using cameras for this technology there are a lot of algorithms required for digital image processing. Some of the important algorithms used are k-shortest paths [3]. Multi-object tracking can be achieved by detecting objects in individual frames and then linking detections across frames. Such an approach can be made very robust to the occasional detection failure: If an object is not detected in a frame but is in previous and following ones, a correct trajectory will nevertheless be produced. By contrast, a false-positive detection in a few frames will be ignored. However, when dealing with a multiple target problem, the linking step results in a difficult optimization problem in the space of all possible families of trajectories.

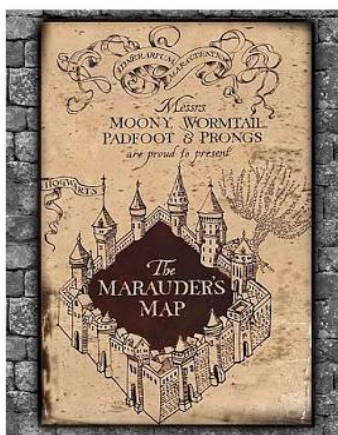


Fig.1. Marauder's Map

## II. RELATED WORK

1.CONCEPT OF DESIGNING: The concept of designing this technology is based on using Raspberry Pi or Arduino. These devices are very cost effective and the usage of Arduino is limited due to limited facilities. Arduino doesn't support camera and only run through C++ programming so it has so many limitations compared to Raspberry Pi which is an open hardware device. In order to make a device similar to Marauder's Map concept, Raspberry Pi and its related softwares are used.

A copy of the block diagram as shown in fig 2 without display is implemented in other rooms or in the main rooms only where the tracking is more important. Arduino is also used instead of raspberry pi for cost effective and all these are connected to a server and send to the control room where the tracking is monitored using a display unit. While swiping the card the camera will record a video of the process for 30 seconds for security measures in order to avoid

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malpractices. A speaker unit is also included in places where warning should be given to persons while entering a restricted area. The swiping module is only needed only on main entry area in order to identify the respective person and then he/she is monitored or tracked using Wi-Fi information in the server while swiping the card for security access. The door motor is only used in the main entries and in restricted areas where the need of security is more and only opened after identifying the person with the allotted authorized ID card.

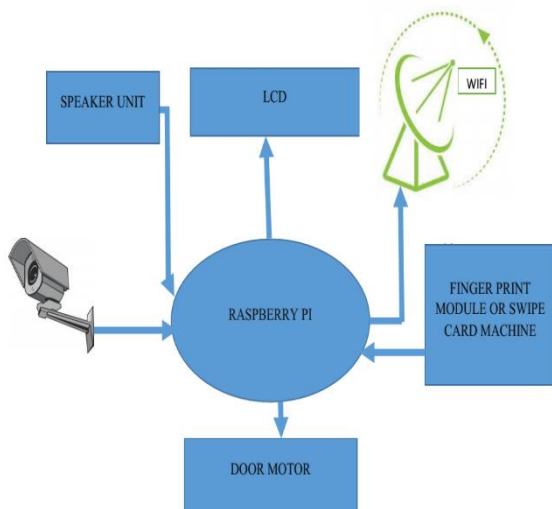


Fig.2. Concept of Block Diagram

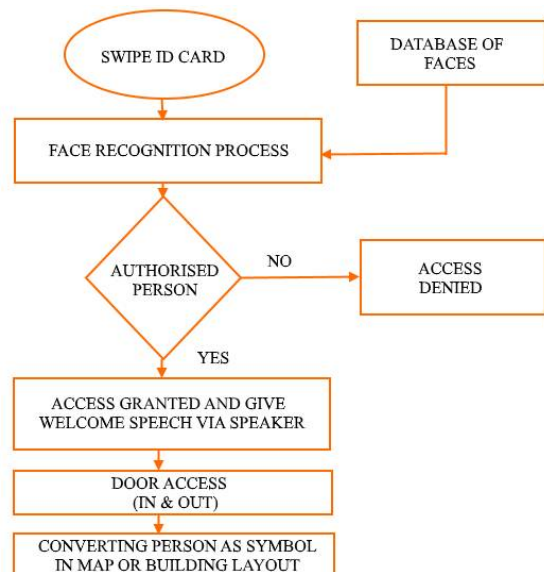


Fig.3. Flow chart of whole operation

The door motor is only used in the main entries and in restricted areas where the need of security is more and only opened after identifying the person with the allotted authorized ID card. Arduino is used in places where face recognition process is not required since it doesn't support camera and places where security is minimum. The whole operation of the proposed system was shown in a flow chart as shown in fig 3 above. A user interface software is designed to show the movements of the targets with names or colours on the screen in a laptop or a display unit. This also give messages or warning through a speaker unit to persons while entering in a restricted area or unauthorized area or area for authorized persons only. The person's position is spotted with the help of a Wi-Fi device by sending the information to the server while swiping the card during security protocols and that will help to save money for using a lot of cameras in each and every rooms.

**RASPBERRY PI:** Raspberry Pi is a small PC without display with the same length and width as a credit card which is shown in figure 4. The latest version of Raspberry pi is costs up to \$35. It has been designed as an educational computer for school children to learn to program, but is also hugely popular due to its small size and amazing low cost. The latest model is raspberry pi 3 model B and it is shown in fig 4 below. It consists of 40 pin extended GPIO , on board wifi ,micro SD card slot etc as shown

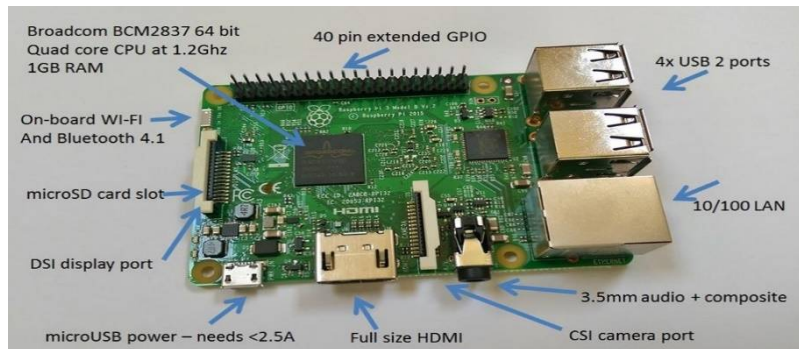


Fig.4. Raspberry Pi 3 model B

### III. FACE RECOGNITION PROCESS

A facial recognition system is a computer application capable of identifying or verifying a person from a digital image or a video frame from a video source. One of the ways to do this is by comparing selected facial features from the image and a facial database. It is typically used in security systems and can be compared to other biometrics such as fingerprint or eye iris recognition systems. Viola-Jones algorithm is the best algorithm for face detection and recognition process among other algorithms due to high detection rate (detection process is faster compared to others) and in practical applications at least two frames per second must be processed.

**VIOLA-JONES ALGORITHM FOR FACE RECOGNITION:** Viola-Jones algorithm's Haar feature based cascade classifiers is the simplest method for face recognition process. Here a cascade function is trained from a lot of positive and negative images and then used to detect faces in others images. This algorithm requires a lot of negative images (images of faces) and a lot of positive images (images without faces) in order to train the classifier and then extract features from it. For extracting features this algorithm uses haar features like edge features, line features, four-rectangle features, etc.

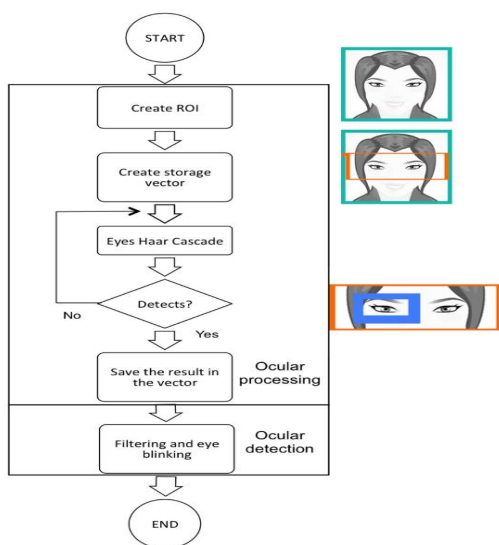


Fig.5. Flow chart of Viola-jones for eye detection

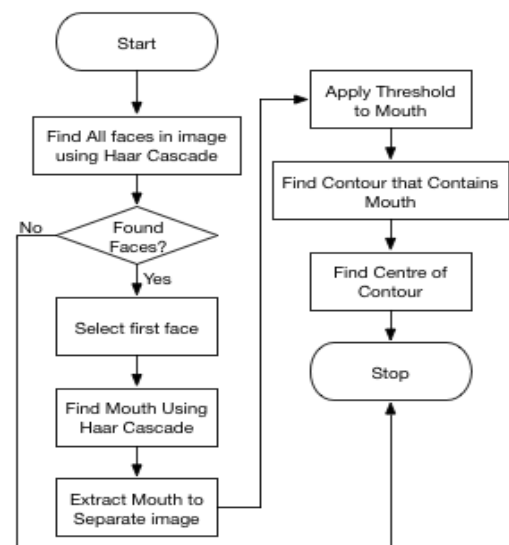


Fig.6. Flow chart of Viola-Jones for mouth detection

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These features are like convolutional kernel. Each feature is a single value obtained by subtracting sum of pixels under white rectangle from sum of pixels under black rectangle. Now all possible sizes and locations for each kernel is used to calculate plenty of features. Sum of pixels under white and black rectangles is needed for each feature calculation. Integral images are also used for this calculation which helps to simplify calculation of sum of pixels, how large may be the number of pixels, to an operation involving four pixels. So this algorithm is faster compared to other algorithms. For minimum error rate select features that best classifies the face and the non-face images. Here the Viola-Jones algorithm is used to detect a target. It was shown in fig 5 and fig 6. Fig 5 shows the flow chart for eye detection. It clearly explains about the detection of eye of a person. For face recognition, eye and nose detection has to be done. So Viola-Jones algorithm was used for that. Mouth detection was used to detect a target. Flow chart for mouth detection was shown in fig 6 above. Haar cascade was used to find the mouth of the target. Then mouth was extracted to separate the image. Then threshold was applied and finds a contour that contains the image.

## IV. RESULTS

1. **SOFTWARE OUTPUT:** Face recognition is performed using Viola-Jones algorithm and the program is executed using PYTHON language in Linux terminal. This algorithm is implemented in open CV as `cvHaarDetectObjects()`. Face recognition process can be divided into major 3 steps.

Step 1: The first step is to find a good database of faces with multiple images for each individual.

Step 2: The next step is to detect faces in the database images and then to train the face recognizer.

Step 3: The last step is to test the face recognizer to recognize faces it was trained for.

For implementing the face recognition program in open CV the required library files are

- Cv2: This is the openCV module & contains the functions for face detection & recognition.
- Os: This module will be used to maneuver with image and directory names.
- Image: openCV does not support gif format so use Image module to read the image in grayscale format.
- Numpy: The images will be stored in numpy arrays in the database.

```
Gtk-Message: Failed to load module "overlay-scrollbar"
2 is Correctly Recognized with confidence 29.15139655
3 is Correctly Recognized with confidence 32.3938790423
5 is Correctly Recognized with confidence 34.3565508048
7 is Correctly Recognized with confidence 44.3297146637
1 is Correctly Recognized with confidence 37.6819645242
11 is Correctly Recognized with confidence 39.8980390296
10 is Correctly Recognized with confidence 19.4849737279
15 is Correctly Recognized with confidence 25.2105434172
6 is Correctly Recognized with confidence 25.8154211953
13 is Correctly Recognized with confidence 32.6527994538
4 is Correctly Recognized with confidence 0.0
14 is Correctly Recognized with confidence 25.5569113665
12 is Correctly Recognized with confidence 30.7063923459
8 is Correctly Recognized with confidence 99.8276423452
9 is Correctly Recognized with confidence 46.2072675938
```

Fig.7. Output of face recognition program

2. **HARDWARE OUTPUT:** The hardware implementation of the proposed system is shown in the fig 8 below. The hardware output is obtained with the help of raspberry pi and Arduino. The Arduino is implemented in places where security is minimum and face recognition process is not required.

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Fig.8. Hardware implementation of block diagram

## V. FUTURE SCOPE

The efficiency and speed can be further increased in future with new upgraded versions of Raspberry Pi. The latest version released now is Raspberry Pi 3 with inbuilt Wi-Fi and Bluetooth with an increment in the processor speed. In future there may be devices similar to Raspberry Pi which has more speed and efficiency with less complexity, so this project can be further upgraded using those devices for faster real time monitoring and video processing.

## VI. CONCLUSION

Here by recognizing the required person or target, the face recognition using the openCV library with PYTHON language can be implemented in the hardware i.e. Raspberry Pi. So all the programs for this project can be done in open source with PYTHON as the language. By using PYTHON language, it reduces the complexity of the program and can be executed with minimum errors. The door access only granted after identifying the authorized person from the database. So from this, it can be concluded that this concept is a grant success in applications for security measures in all industries. This mechanism allows maximum security with very cost effective.

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