

# AUTOMATED TAILGATING DETECTION SYSTEM

**PROJECT FOR VMWARE CAMPUS AMBASSADOR PROGRAM:  
VIRTUAL HACKATHON**

Done by:  
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4<sup>th</sup> Semester  
Computer Science

# Today's Presentation

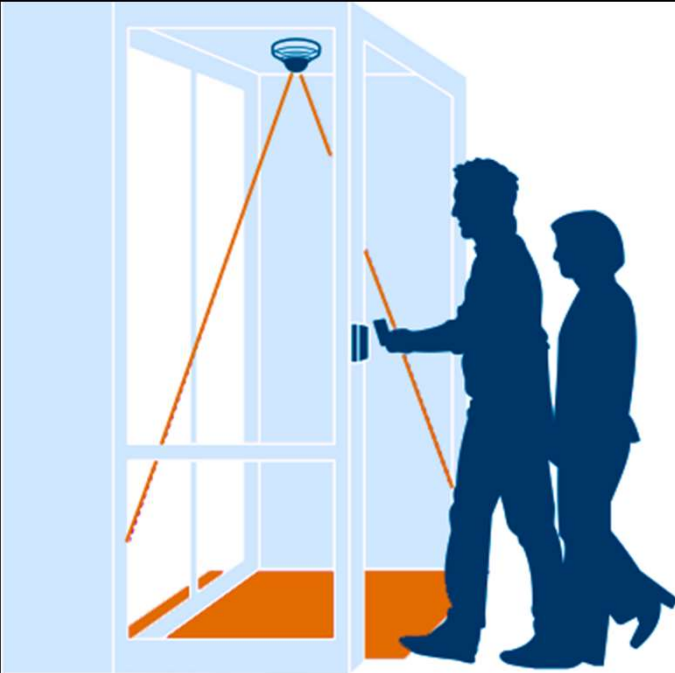
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# 1. Problem Statement

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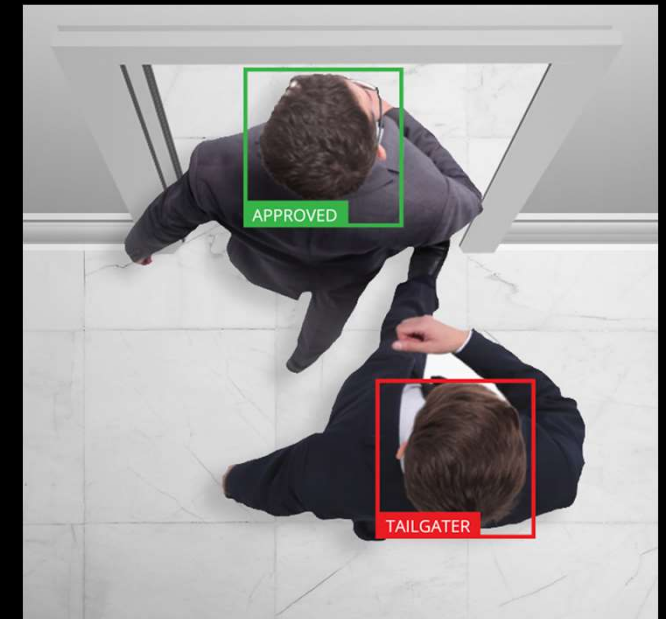


Given a CCTV camera footage of a secured door entry

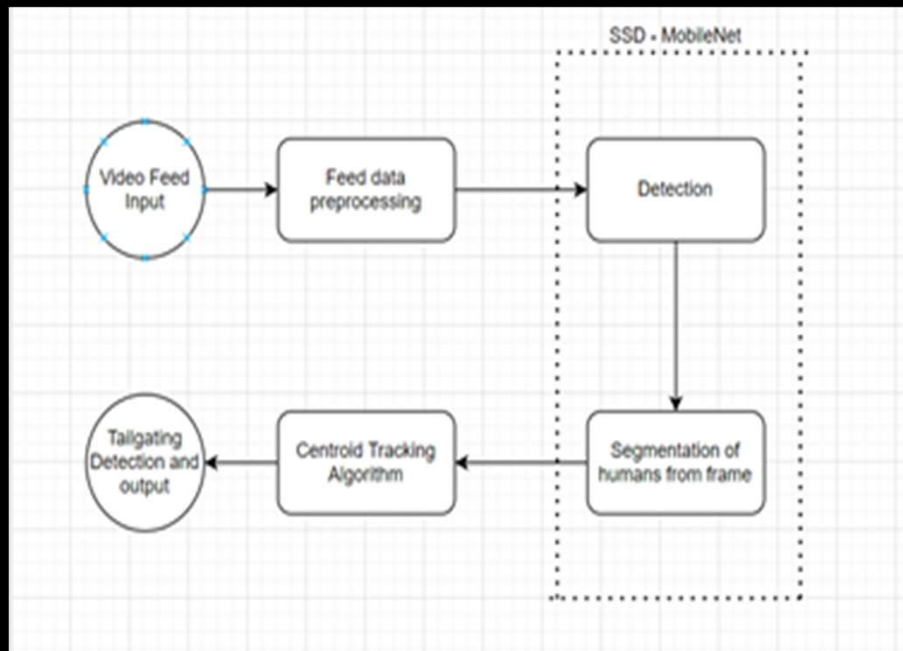
- detect anyone tailgating using an automated system.
- The system should segment individuals from the video and detect whether they are tailgating or not

## 2. Introduction

- Proposed solution is implemented in full and presented in further slides
- Security breaches known as tailgating
  - also referred to as piggybacking.
  - unauthorized person follows an authorized individual to enter a secured area.
- Results in
  - huge revenue loss
  - threats to privacy and safety.
- Cause:
  - common courtesy
  - simply following a person through doors
- Present Solutions:
  - Simple Motion Detection Video Approach
  - Cameras and mirror method
- Proposed Solution
  - Computer Vision based Approach
    - Object Detection: Single Shot Detector
    - Object Tracking: Centroid Tracking Algorithm
    - Tailgating Detection

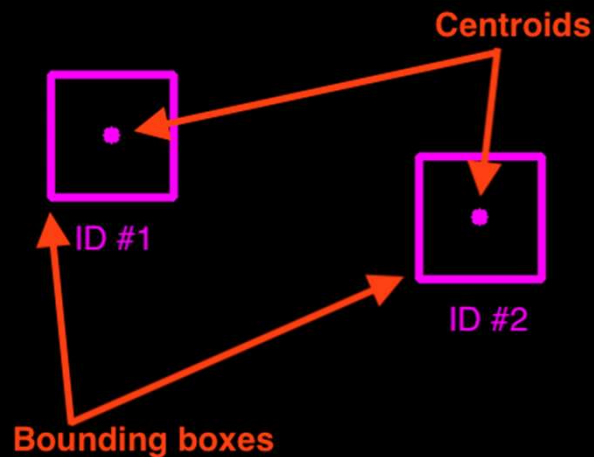


### 3. Implemented Solution



- **Computer Vision Based Solution**
- 3 phases implementation:
  - Object Detection
  - Object Tracking
  - Tailgating Detection

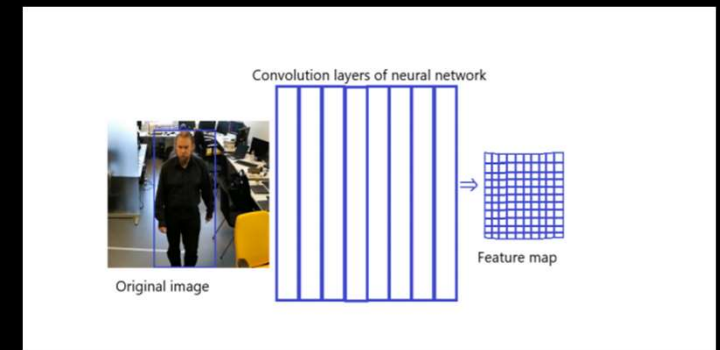
## 3a. Object Detection



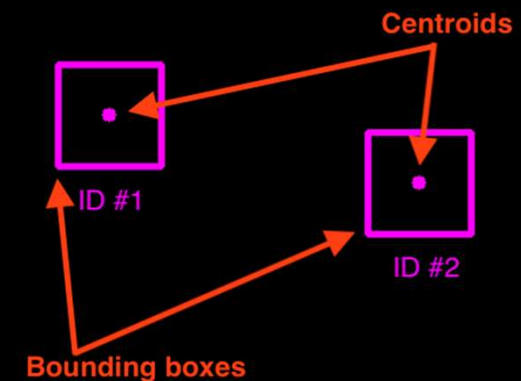
- Multiple objects detected using single shot
- For each object detected
  - create an object tracker with the bounding box coordinates
  - then find the centroid of each object detected
- Above steps are done using Single Shot Detector (SSD)

## 3ai. Single Shot Detector

- Object Detection: Single Shot Detector (SSD)
- What is SSD
  - used in object detection and classification on images.
  - running the convolutional network once on the input image
  - This forms a feature map.
  - Formation of bounding boxes for the recognized objects
  - These bounding boxes have different sizes and aspect ratios.
  - Each bounding box represents a detected human.

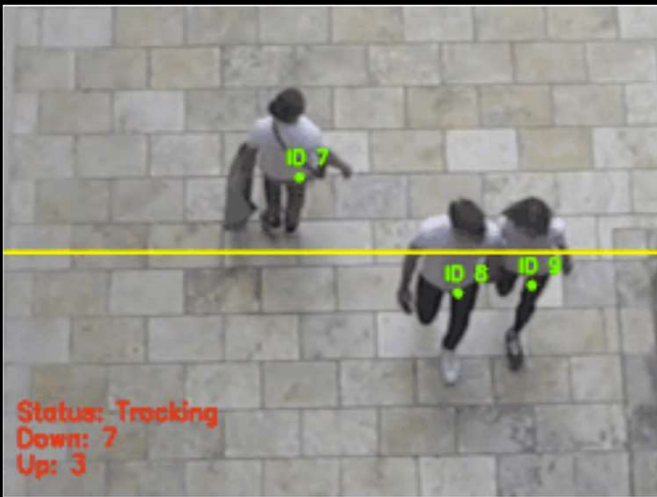


SSD Working Principle



## 3b. Object Tracking

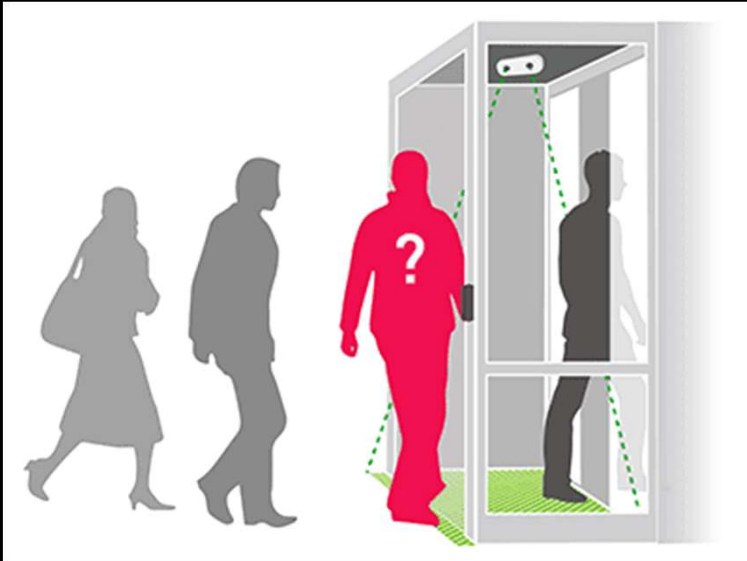
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- Object tracking is done using the centroid associated with each objects.
- Tracking algorithm relies on the Euclidean distance
- Euclidean distance between centroids in subsequent frames is calculated
- The primary assumption of the centroid tracking algorithm is that centroids must lie close together between subsequent frames.



## 3c. Tailgating Tracking



- An imaginary line would be used to mark the gate region
- The line coordinates will be sent to the backend of the app where the live feed is being processed
- The line will be used as a line of reference across which tailgating can be detected.
- The number of people passing through the gate in the frame is compared with the number of authorized entries
- Mismatch in number raises an alert
- The number of authorized entries is equal to the number of card entries at any particular time

# Architecture and Results

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- Setup description:
  - Over the head camera
  - Virtual gate
  - Card reader
- Inputs:
  - Video stream for object detection
  - Card Swipe inputs
- Tailgating Detection process
  - Object Detection
  - Object Tracking
  - Alert on Tailgating
- Outputs:
  - Video warning
  - Audio based warning
  - Log file

# Setup Description

1. Card reader outputs:

0 => No card read

1 => Card read



2. Overhead Camera



3. Virtual gate



# Inputs

- Video stream for object detection
  - Made use of own set of videos to test and validate the detection
  - Used 5 sets of video ; 4 generated by own camera

- Card Swipe inputs
  - Represented using CSV file
  - 0 – No card swipe
  - 1 – Card Swipe



	Time (in sec),Card Entry
1	0,0
2	1,1
3	2,1
4	3,0
5	4,0
6	5,0
7	6,1
8	7,0
9	8,1
10	9,0
11	10,1
12	11,0
13	12,0
14	13,0
15	14,1
16	15,0
17	

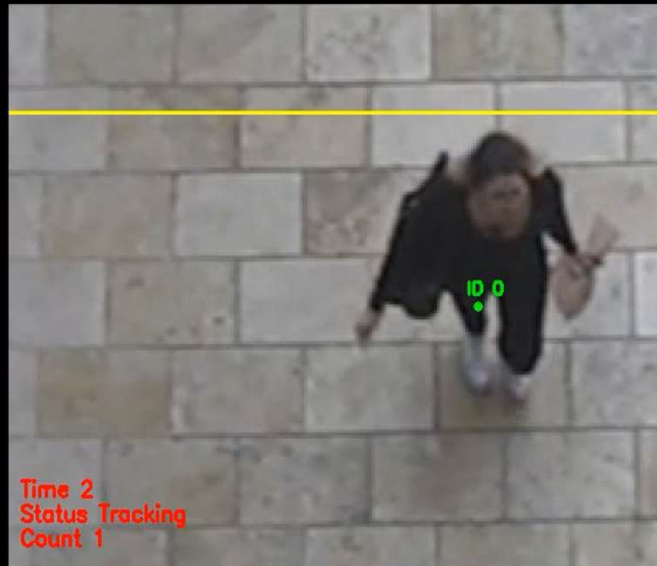


# Tailgating Detection Process

Object Detection  
(Detected Object  
shown with green  
point)



Object Tracking  
(Tracked using direction  
of movement and  
indicated below (Count))



- Alert on Tailgating
- (Number of tailgates alerted on video too )



# Outputs

Video warning  
Displayed on top  
of video



Audio based warning

Beep Sound  
generated for  
tailgating detection



Log files showing

- total count of entries
- card entries per sec

Time,Count,Card Values

```
0,0,0
1,0,1
2,1,1
3,1,0
4,1,0
5,1,0
6,1,1
7,1,0
8,1,1
9,1,0
10,1,1
11,1,0
12,2,0
13,2,0
14,4,1
15,4,0
```

## 4. Advantages and Challenges

- Advantages:

- Our software would be easily configurable by anybody
- Can be used for any video feed in general
- User friendly
- Can detect with high accuracy and speed

- Challenges:

- Identifying humans even if they have some accessory(such as a person wearing a helmet or a cap)
- This approach cannot detect cases where a person carrying another person on their shoulders or in some other way.

## 5. Additional Features and Future Works

- Facial Recognition: We can also add facial recognition as a feature if the employee database consists of pictures of each employee and these pictures can be provided to us in order to not only detect the person who is tailgating but also release the picture of the intruder detected to the necessary authorities and also to verify (if possible) whether the intruder is someone in the database or not.



**Thank you**  
**Any**  
**Queries?**