# PEDESTRIAN DETECTION USING MOVING CAMERA

MAJOR PROJECT-II / DISSERTATION
SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE AWARD OF THE DEGREE
OF

## MASTER OF TECHNOLOGY
**IN**
## SIGNAL PROCESSING AND DIGITAL DESIGN

SUBMITTED BY


## ASHUTOSH GOSWAMI

## 2K14/SPD/03


UNDER THE SUPERVISION OF


## Mr. RAJESH BIROK
## ASSOCIATE PROFESSOR




**DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING**
DELHI TECHNOLOGICAL UNIVERSITY
(Formerly Delhi College of Engineering)
Bawana Road, Delhi-110042

2014-2016

# CERTIFICATE

This is to certify that the Major Project-II / dissertation title **"Pedestrian Detection Using Moving Camera"** submitted by **Mr Ashutosh Goswami**, Roll. No. 2K14/SPD/03, in partial fulfilment for the award of degree of Master of Technology in Signal Processing & Digital Design at **Delhi Technological University, Delhi**, is a bonafide record of student's own work carried out by him under my supervision and guidance in the academic session 2015-16. To the best of my belief and knowledge the matter embodied in dissertation has not been submitted for the award of any other degree or certificate in this or any other university or institute.

**Mr Rajesh Birok**
**Supervisor**
**Associate Professor**
**Dep. ECE**
**Delhi Technological University**

# DECLARATION

I hereby declare that all the information in this document has been obtained and presented in accordance with academic rules and ethical conduct. This report is my own work to the best of my belief and knowledge. I have fully cited all material by others which I have used in my work. It is being submitted for the degree of Master of Technology in Signal Processing & Digital Design at the Delhi Technological University. To the best of my belief and knowledge it has not been submitted before for any degree or examination in any other university.

Ashutosh Goswami
M. Tech. (SPDD)
2K14/SPD/03

Date: JUNE, 2016
Place: Delhi Technological University, Delhi

# ACKNOWLEDGEMENT

I am indebted to my thesis supervisor Mr. Rajesh Birok, Associate Professor Department of Electronics and Communication, for his gracious encouragement and very valued constructive criticism that has driven me to carry out the project successfully.

I am greatly thankful to Prof. Prem R. Chadda, Head of Department (Electronics & Communication Engineering), entire faculty and staff of Electronics & Communication Engineering and friends for their continuous support, encouragement and inspiration in the execution of this "Thesis" work.

Finally I express my deep sense of gratitude to my parents who bestowed upon me their grace and were source of my inspiration and encouragement.

**Ashutosh Goswami**

**M.Tech (SPDD)**

**2K14/SPD/03**

**Dedicated to my**
**Parents, Mentor, Friends**
**and**
**the Almighty…**

# ABSTRACT

A perfect on-board Pedestrian Detection System, referred to as PDS, must detect the presence of people, stationary or moving, on the way of the vehicle and react according to the risk of running over the pedestrian. The action performed by PDS in case a pedestrian appears right before the moving vehicle and is likely to get harmed includes: warning the driver in advance, or apply braking action, or deploy external airbags, perform an evasive manoeuvre or else. It is also necessary that the entire system works well without disturbing the driver needlessly in normal situations, if there is no risk at all. In addition to that, such a system should work satisfactorily well independent of the time, road, and weather conditions. Additionally, the cost of the pedestrian detection module should be relatively small compared to the total cost of the vehicle.

Following are the various modules and techniques based on computer vision used that together constitute a Pedestrian Detection System, added to that various methods used to make it suitable for our application involving pedestrian detection using moving camera.

For Pedestrian Segmentation, sliding window based approach will be used. As the camera is moving, then in such moving systems case the prevalent methods for segmentation like background subtraction will get failed. Therefore, with the help of sliding window technique which scans through the frame through different scales, segmentation of the object of interest is done.

For feature extraction, HOG (Histogram of Oriented Gradients) based features descriptor is favourable because it is independent of intensity and based on change in intensity levels i.e. gradients or edges. Moreover, it works pretty well when it comes to dealing with human detection related applications in particular.

After feature extraction, a suitable Neural network classifier modelled on training and subsequent testing, decides whether the region cropped by sliding window is in actual containing a pedestrian or not. So here basically the classifier is trained for four classes. These four classes correspond to four different view of pedestrian like: front view, side view (left or right) and rear view. For training, features of positive and negative images are extracted. Positive images are pedestrian images and negative images are images of possible background objects.

In addition to that, Neural network is preferred over SVM classifier because single neural classifier can be used for training and classification of multiple classes and for large set of database convergence is better in neural network based classifier.

# TABLE OF CONTENTS