

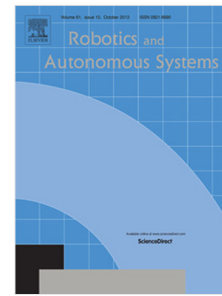
## Accepted Manuscript

Real-time head pose estimation using multi-task deep neural network

Byungtae Ahn, Dong-Geol Choi, Jaesik Park, In So Kweon

PII: S0921-8890(17)30352-4  
DOI: <https://doi.org/10.1016/j.robot.2018.01.005>  
Reference: ROBOT 2974

To appear in: *Robotics and Autonomous Systems*



Please cite this article as: B. Ahn, D.-G. Choi, J. Park, I.S. Kweon, Real-time head pose estimation using multi-task deep neural network, *Robotics and Autonomous Systems* (2018), <https://doi.org/10.1016/j.robot.2018.01.005>

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

# Real-time Head Pose Estimation Using Multi-task Deep Neural Network

Byungtae Ahn

Dong-Geol Choi\*

Jaesik Park<sup>1</sup>

In So Kweon

*Robotics and Computer Vision Lab, KAIST, Daejeon, Republic of Korea*

---

## Abstract

Driver inattention is one of the main causes of traffic accidents. To avoid such accidents, advanced driver assistance system that passively monitors the driver's activities is needed. In this paper, we present a novel method to estimate a head pose from a monocular camera. The proposed algorithm is based on multi-task learning deep neural network that uses a small grayscale image. The network jointly detects multi-view faces and estimates head pose even under poor environment conditions such as illumination change, vibration, large pose change, and occlusion. We also propose a multi-task learning method that does not bias on a specific task with different datasets. Moreover, in order to fertilize training dataset, we establish and release the RCVFace dataset that has accurate head poses. The proposed framework outperforms state-of-the-art approaches quantitatively and qualitatively with an average head pose mean error of less than 4° in real-time. The algorithm applies to driver monitoring system that is crucial for driver safety.

*Key words:* Head pose, Advanced Driver Assistance System, Deep learning, Convolutional Neural Network

---

## 1. Introduction

Driver inattention is a major cause of traffic accidents. According to the National Highway Traffic Safety Administration (NHTSA), many of the traffic accident fatalities and casualties in the United States during the past two years have been caused by driver inattention. In addition, about 3,400 of the 35,092 US traffic deaths in 2015 were caused by driver distraction, which is 8.8% more than the 3,197 deaths from the same cause in 2014. This is because the probability of a traffic accident is high due to a mistake of a driver rather than a defect in

a car or a road. Therefore, if the driver inattention is automatically detected, a traffic accident can be avoided by giving a warning to the driver in advance. Driver inattention occurs mainly when the driver's distracted or tired. If this happens, the driver adopts a different head pose than usual, so driver inattention can be detected before an accident. Therefore, head pose estimation plays an important role in active safety and advanced driver assistance systems (ADAS) in intelligent vehicles.

From the viewpoint of computer vision, head pose estimation is a process of inferring the position  $(x, y)$  and direction (*roll*, *pitch*, and *yaw*) from input face images. The existing approaches can be roughly classified into two types: generative methods and discriminative methods. Generative methods use geometric clues or a variable face model. These methods output continuous head pose values rather than individual categories, and they have the advantage of obtaining facial landmarks for various applications. However, since these methods

---

\*Corresponding author

*Email addresses:* joyel@kaist.ac.kr (Byungtae Ahn),  
dgchoi@rcv.kaist.ac.kr (Dong-Geol Choi),  
jaesik.park@intel.com (Jaesik Park),  
iskweon@ee.kaist.ac.kr (In So Kweon)

<sup>1</sup>This work is done while J. Park was with Robotics and Computer Vision Lab. He is currently with Intel Labs, 2200 Mission College Blvd., Santa Clara, CA 95054-1549, USA.

Download English Version:

<https://daneshyari.com/en/article/6867161>

Download Persian Version:

<https://daneshyari.com/article/6867161>

[Daneshyari.com](https://daneshyari.com)