A Driver Assaulting Event Detection Using Intel Real-Sense Camera

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Abstract

Biometrics refers to a technology that applies biological or behavioral characteristics such as fingerprint, face, iris, retina, vein, and voice, signature to security system. Since the 9/11 terror attack that occurred in the 9/11 , all the countries in the world had been much interested in security using biometrics and the importance of protection and security of information has risen. Accordingly, the need for verifying identity and personal authentication has increased.

Advantage of face detection and recognition, one of above mentioned biometrics is that it is inexpensive in building new physical infrastructure. Unlike other biometrics such as fingerprint recognition and iris recognition, face detection is non touch mode. For this reason, face detection is applicable to such diverse fields such as finance, robot, and access control and surveillance camera. The disadvantage of image data is that it takes more time and costs more than data processing using sensor. Advance in relevant technology such as image recognition technology, communication infrastructure, bulk data processing environment led to high efficiency at low cost.

This study aims to verify identity of passengers of limited indoor area such as taxi and bus and track behavioral trajectory of relevant person by making good use of face detection, face recognition and object tracking technology. This study is to accumulate data that are applicable to recognition of crime pattern and the understanding of movement by detecting attack events or recording movement log.

Keywords: Detecting Driver Assaulting, Real-Sense Camera, Event Detection, Public Transportation Driver

1. Introduction

Biometrics refers to a technology that applies biological or behavioral characteristics such as fingerprint, face, iris, retina, vein, voice, and signature to security system. Since the 9/11 terror attack that occurred in the USAall the countries in the world had been much interested in security using biometrics and the importance of protection and security of information has risen. Accordingly, the need for verifying identity and personal authentication has increased.

The advantage of face detection and recognition, one of above mentioned biometrics is that it is inexpensive in building new physical infrastructure. Unlike other biometrics such as fingerprint recognition and iris recognition, face detection is non touch mode. For this reason, face detection is applicable to such diverse fields such as finance, robot, and

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access control and surveillance camera. The disadvantage of image data is that it takes more time and cost more than data processing using sensor. Advance in relevant technology such as image recognition technology, communication infrastructure, bulk data processing environment led to high efficiency at low cost.

Detecting face accurately from image acquired is required to apply face detection and recognition technology. Face detection means judging whether there is human face in given image and designating location and scope of face in image. Face detection includes Knowledge Based Method that uses prior knowledge on components of face, Feature Invariant Approach that extracts using structural characteristics of shape, Template Matching Method that extracts using correlation between structural pattern and image and Appearance-Based Method that extracts based on learning data. Face recognition checks whether there is face image in database. Face recognition includes one using statistics, one using neural network and one based on characteristics.

CCTV based security has studied object tracking and movement trajectory analysis actively. Police and public institutions recognize the importance of CCTV based security. Also, studies of of building intelligent image surveillance solution by predicting risks such as analysis of abnormal behavior pattern of object based on specific space has been conducted.

This study aims to verify the identity of passengers of limited indoor area such as taxi and bus and track behavioral trajectory of relevant person by making good use of face detection, face recognition and object tracking technology. This study aims to accumulate data that are applicable to recognition of crime pattern and the understanding of movement by detecting attack events or recording movement log [1].

2. Related Works

This study uses Face Detection and Recognition and Object Tracking using image processing as one of biometrics. Unlike biometrics including fingerprint recognition, face detection and recognition is more inexpensive in equipment than other methods. Face detection and recognition is non touch mode. Biometrics using visual data is required to process a large amount of visual data which takes much time to process data. Pretreatment is needed to reduce processing time. Filtering, binarization and edge detection are applicable to pretreatment [2].

2.1. Face Detection

As shown in Table 1, face detection is composed of various methods for example Knowledge Based Method that uses prior knowledge of components of human face, Feature Invariant Approach that detects by extracting structural characteristics of human shape which is irrelevant to a change in pose, observation time or light source, Template Matching Method that detects by entering face composition standard pattern and extracting correlation with input image and Appearance Based Method that detects by extracting face expression method from learning data[2][5]. Figure 1 shows a picture of relations between patterns of face template sections.

Table 1. Classification Table of Face Detection Methods

Approach	Representative works
Knowledge Based Method	Multi-Resolution Rule Based Method
Feature Invariant Approaches - Facial Features - Texture - Skin - Multiple Features	Grouping of Edges Space Gray-Level Dependence Matrix of Face Pattern Mixture of Gaussian Integration of Skin Color, Size and Shape

Template Matching Method - Predefined Face Templates - Deformable Templates	Shape Template Active Shape Model
Appearance Based Method - Eigen Face - Distribution Based - Neural Network - Support Vector Machine - Naïve Bayed Classifier - Hidden Markov Model - Information Theoretical Approach - Boosting Approach	Eigen Vector Decomposition and Clustering Gaussian Distribution and Multilayer Perception Ensemble of Neural Networks and Arbitration Schemes SVM with Polynomial Kernel Joint Statistics of Local Appearance and Position Higher Order Statistics with HMM Kullback Relative Information Fast Approach with Adaboost
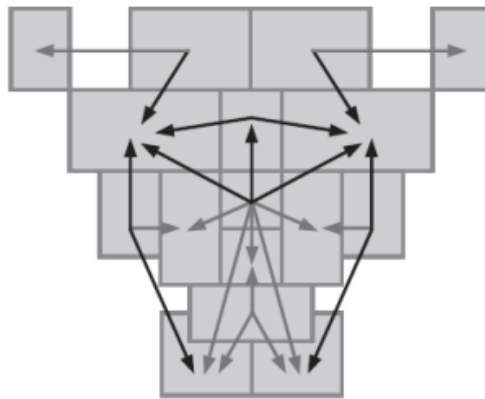
Figure 1. Example of Face Detection using Template Matching Method

2.2. Face Recognition

Face Recognition can be defined as a method that checks whether there are data that coincides in face database for a given image or image data. Further information such as skin color, age, gender can be used to limit the scope of database search. Such face recognition consists of separation of face from image, extraction of characteristics of face and figure classification process through search in database. Separation of face area which is required for face recognition was already mentioned in face detection.

Face is detected from input image and then extracted and aligned. Face alignment process is performed based on extracted face. This process is required to get data which is comparable to face database. Figure 2 below shows examples of above mentioned process.
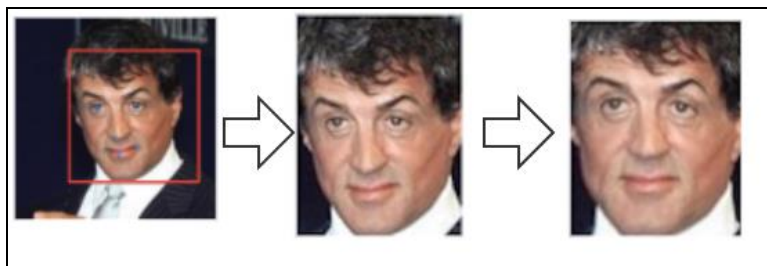

Figure 2. Preprocessing of Face Recognition

Faces extracted from input image do not have typical shape because there is a difference in illumination and rotation of face. Face alignment is required to compensate for low recognition. Histogram Equalization, Histogram Stretching and Gausian Convolution are used to reduce effect of illumination. There are methods which creates new model instance in space reduced to lower level using PCA (Principal Component Analysis) and AAM (Active Appearance Model) as a method that compensates for rotation and size of face. As seen in Figure 1 the process can be identified as the process which compares the face on the database based on face extracted from input image. The face located in the middle shows that head is lowered. The picture on the right shows that the rotation angle of the face has been compensated through face alignment process [8].

Extraction of characteristics that can express human face from aligned face image is required. Extracted characteristics are used in recognizing the by comparing similarity through database on characteristics of face and sorter [6][7].

2.3. Object Tracking

Image processing is performed by using image data obtained from fixed camera in image based surveillance system and a change in extracted data is detected and detecting and tracking of an object are conducted based on it [3][4]. This study aims at finding movement area of humans on screen by taking humans as an object. Tracking has the following difficulties because humans are not fixed object and there are various methods in detecting and tracking humans; first, human movement is difficult to predict and shape changes rapidly depending on movement. Second, objects are overlapped in part or whole by human movement. Part or whole of a human is hidden or overlapped. Third, humans vary in size and shape and appearance of humans can vary easily depending on clothes, cap or glasses. Fourth, if a human moves rapidly, the observer is likely to lose sight of an object being tracked by blurring of human object in each frame. Fifth, noise such as shade occurring in light source causes difficulty in tracking [9].

Object tracking has a flow. Characteristics of an object are extracted from input image and an object is detected and interest area is divided. Then, object tracking is performed by applying object tracking algorism.
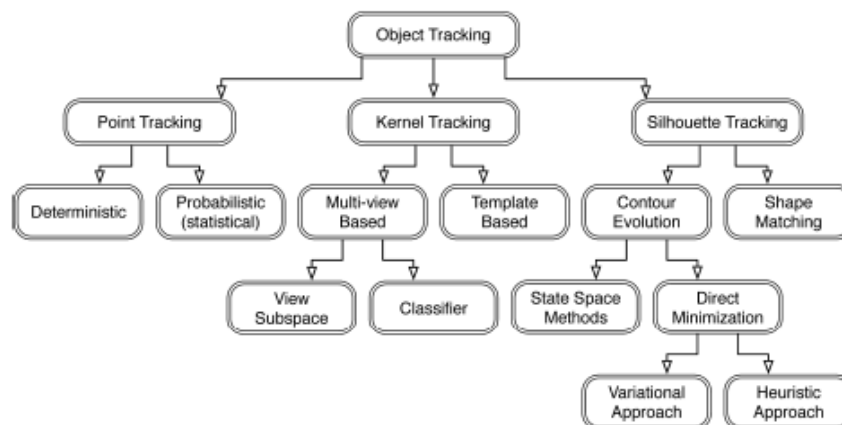

Figure 3. Diagram of Object Tracking Algorithm [3]

Figure 3 shows the diagram of object tracking algorithms. Object tracking can be divided into three categories with Point Tracking, Kernal Tracking and Silhouette Tracking. These also can be divided sub categories. Figure 4 shows characteristics of three categories[3][9].
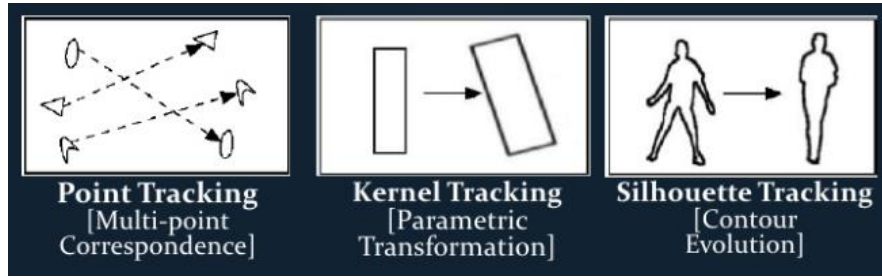
Figure 4. Characteristics of Point Tracking, Kernel Tracking and Silhouette Tracking

3. Driver Assaulting Event Detection System

For basic direction of this system, the scope of this study is limited to indoor area. This study is divided into detection-recognition and detection-tracking. Face is detected for a figure that enters a designated area in detection-recognition phase and whether there is a figure in specific figure database and the information is delivered to image processing system. If the figure exists in specific figure database, surveillance phase is raised. In detection-tracking phase, events such as attack are detected through analysis of movement trajectory of an object and it is notified to image processing system.

The system proposed by this study requires at least one camera and image processing equipment that stores and processes database and image data of specific face and tracks trajectory of movement of an object.

Figure 5. Intel REAL SENSE Developer Kit SR300

Intel Real Sense Development Kit is used as camera that collects inner image as seen in Figure 5. REALSENSE has the specifications as seen in Table 2

Table 2. The Specifications of REAL SENSE

OS Support	Microsoft Windows® 10
Connectivity	USB 3.0
Recommended CPU	Intel 6th generation processor or above
Video Streaming	720p at 60 frames per second video capture optimized for streaming 1080p at 30 frames per second video capture for video conferencing
Depth Range	Approximately 20cm to 150cm (Software optimized in this range)
Microphone	dual-array microphones

SDK Support	Dynamic background segmentation
	3D scanning
	Facial recognition and hand gesture recognition

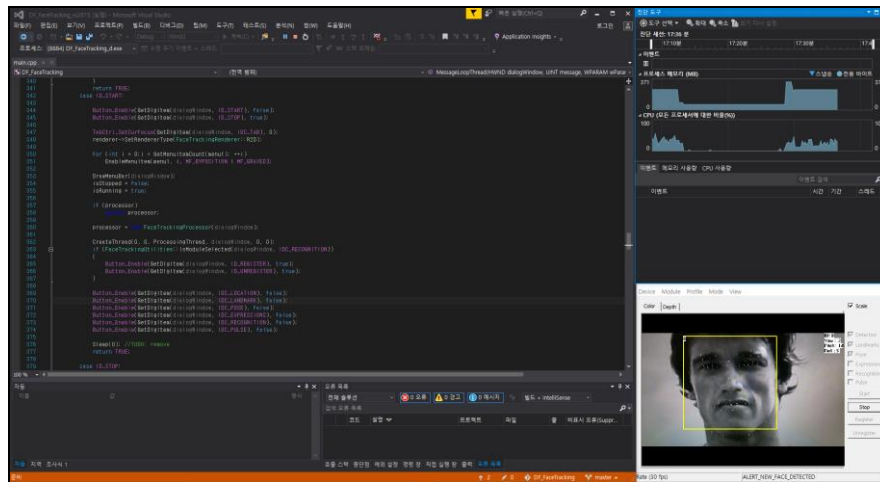**Figure 6. Hardware Specification of REAL SENSE**

Figure 7. Development Environment

Figure 6 shows a hardware specification of REAL SENSE. It has Infrared Camera, Infrared Laser Projector, RGB Color Camera, 2nd Gen ASIC, System Module and Software. Also, Figure 7 shows a development environment of this study. It is used that Visual Studio 2015 on Window 10. Also REAL SENSE needs the to operate over intel 4th generation CPU chips.
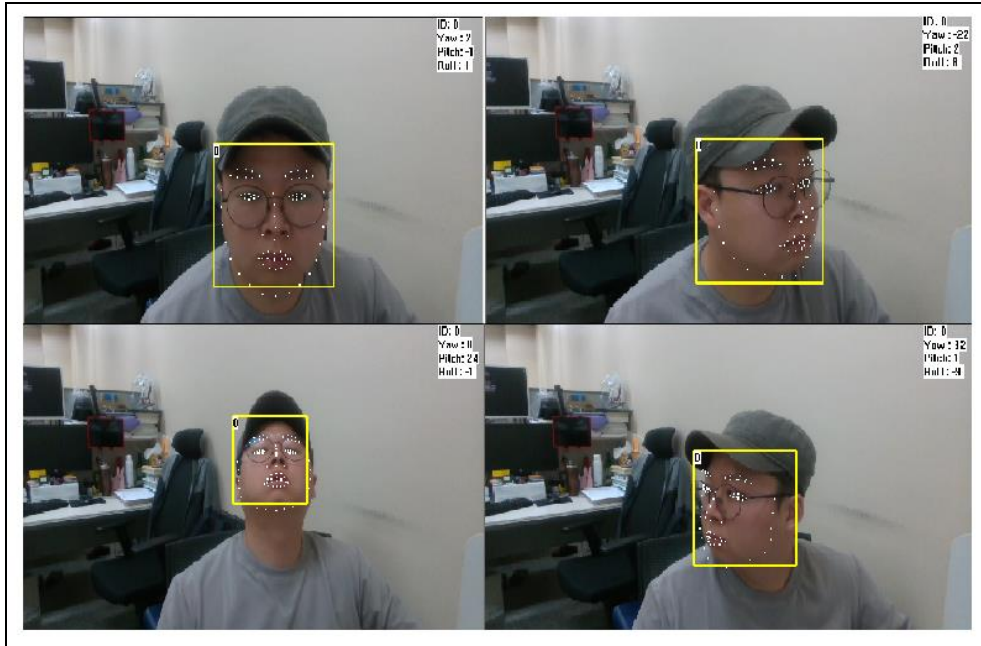
Figure 8. Face Detection

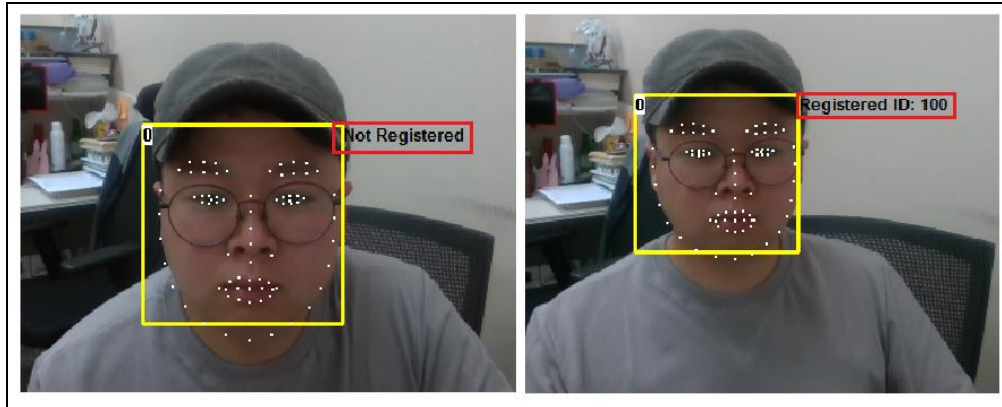**Figure 9. Object(Human) Detection**

Figure 10. Face Recognition

Figure 8 shows a screen that the face is detected in the proposed system. As you can see, the face is detected irrespective of angle of face reflected in a screen. Figure 10 shows a screen that is a result is a of face recognition that is output by comparing face database and input specific face. On the left is a case that there is no face in face database while on the right is a case that there is face in face database and registration number of specific face is output. Figure 9 shows a screen that human body is detected in proposed system.

4. Conclusions

The purpose of this study is to prevent secondary accident that may occur and cope with violence on driver by detecting specific events regarding the taxi driver or bus driver. In this paper, a limited type of experiment was conducted. In other words, the experiment was carried out in a laboratory and not in a taxi or bus. Face detection and recognition was conducted in a smooth manner but event detection through analysis of object movement trajectory varies depending on surrounding environment such as illumination or object overlapping. It is expected that in taxi or bus which has more diverse environment, event detection rate will be lowered. In the next study, the author of this paper will try to raise event detection rate in actual environment such as taxi or bus.

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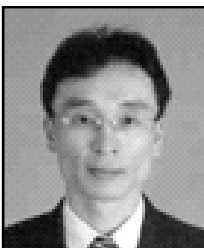
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