A Multimodal Approach to Enhancing Automobile Security

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ABSTRACT

The continuous increase in use of the automobiles has resulted in increase in vehicular traffic and social vices such as theft, thus necessitating efforts for improving automobile security. As a result of this, various solutions such as satellite monitoring and General Packet Radio Services have been adopted to track vehicle locations over time. This article combines the uniqueness of an automobile plate number and the face(s) of an authorized vehicle driver to enhance the automobile security system, hence eliminating the inefficiency of the existing tag system while reducing the cases of unauthorized automobile use and outright theft. A weighted score approach was used in evaluating the efficiency of the character recognition subsystem with an accuracy of 89.3% recorded. The face recognition subsystem also achieved reliable genuine and an imposter attempt at 0.0 confidence level. The designed system ensured security of an automobile through the combination of a plate number and image recognition, thereby preventing an unauthorized driver from taking a vehicle out of a controlled area.

KEYWORDS
Automobile Face Recognition, Image Processing, Number Plate Recognition, OpenCv, Segmentation Vehicular Security

1. INTRODUCTION

Automobile security involves techniques and methods garnered towards ensuring the protection of automobiles from theft and unwanted users. Its fundamental is to enhance vehicle security with hostility towards burglary gadget. Today, automobile theft cases are increasing at an alarming rate all over the world, making research focuses toward the need for automobile security being increased continuously (Singh et al., 2015). Research shows that, various categories of anti-theft technologies exist. These range from Global Positioning System (GPS) monitoring, sensor-based tracking, biometric recognition, fingerprint recognition, voice processing, to image processing (Baksh et al., 2014) amongst others. If properly employed, there is no doubt that such technological advancements will greatly reduce occurrences of vehicular theft and unauthorized use while also contributing to research efforts in digital crime and forensics.

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The ability to uniquely identify vehicles has improved certain aspects of security. This unique vehicle identification has been achieved through the use of human resources or special intelligent equipment with the ability to recognize vehicles by their number plates in a real environment. As a result, various recognition techniques have been developed and number plate recognition systems are today used in various traffic and security applications, such as parking, access and border control, or tracking of stolen cars (Martinsky, 2007). Object recognition is an important task in image processing (Gonzalez et al., 2010; Khurana and Awasthi, 2013; Rani and Grewal, 2013) and computer vision and perhaps one of the basic requirements of any system that will be useful in identifying theft cases and forensic computation. It is concerned with determining the identity of an object being observed in an image from a set of known tags. This is important since humans can recognize any object in real world with little or no efforts while on contrary machines by themselves cannot recognize objects (Jain and Healey, 2010).

Plate numbers (otherwise called number plates, licence plates, or registration plates) have been widely adopted in automobile identification. This number plate most of the time serves as one of the unique identifiers of a vehicle in any part of the world and can be processed through Automatic Number Plate Recognition (ANPR) systems. An ANPR system often applied as a surveillance method uses optical character recognition to read license plates on vehicles (Amr et al., 2011; Kavneet and Vijay, 2013). Over the last few years, ANPR has become a useful approach for vehicle surveillance. An ANPR system consists of three main stages; Number Plate Localization (NPL), Character Segmentation (CS) and Optical Character Recognition (OCR). While number plate detection occurs in the NPL stage, the character segmentation stage is also an important pre-processing step necessary before applying OCR, and it is during this stage that each character from the detected number plate is segmented before recognition. In the last stage, characters are normally segmented from the number plate so that only useful information is retained for recognition (Kaur and Banga, 2010; Kranthi et al., 2011; Sharma et al., 2013). ANPR systems are based on common techniques such as Artificial Neural Network (ANN), Probabilistic Neural Network (PNN), OCR, etc. (Aniruddh et al., 2013). This paper combines the use of ANPR and facial recognition system to enhance automobile security.

Facial recognition systems are known to involve computer applications capable of identifying or verifying a person from a digital image or a video source. Images of objects from a particular class are highly variable which needs a serious attention if the accuracy of the system is important. One source of variation is the actual imaging process which can include changes in illumination, changes in camera position as well as digitization artefacts, all which are capable of producing significant variations in image appearance, even in a static scene. The second source of variation is normally due to the intrinsic appearance variability of objects within a class, even if no variation in the imaging process is assumed. The main challenge is actually in developing detection algorithms that are invariant with respect to these variations and are computationally efficient (Amit and Felzenszwalb, 2012; Chanda et al., 2013; Phillips et al., 2005).

Some existing facial recognition algorithms identify facial features by extracting landmarks, or features, from an image of the subject’s face. It involves algorithms that analyses the relative position, size, and sometimes shape of the eyes, nose, cheekbones, and jaw. If these features are properly identified, the result can be used to curb automobile theft occurrences.

Automobile theft occurrences in public places and car parks have increased over the years with the increasing use of automobiles. The use of tally or tag systems majorly found in developing countries and some developed countries has been effective only in automobile counting and documentation. The method however is ineffective when it comes to security and forensic analysis leading to theft of automobiles. This work will combine face recognition with automatic plate recognition technique to perform security checks upon entry and exit, thereby guaranteeing the security of automobiles in any controlled environment. The work will also provide an activity log that can be used to observe the movement of any vehicle in case of theft which will be useful in forensic computation.
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