Automated Visitor Record System

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Highlights: The traditional way of recording visitor information takes large amount of time and is prone to fraud. Hence, in this project we propose an automated system using Radio-Frequency Identification (RFID), smart card information retrieval as well as computer vision and image processing to record and manage visitors' data. To evaluate the similarity between face images from camera and National Registration Identification Card (NRIC), we propose a novel method to find dissimilarity index between the faces where we found that this method yields a promising result. Additionally, the system is able to minimize the need for human interventions, improves the time required for recording visitors' information as well as efficiently manages and analyses visitors' records.

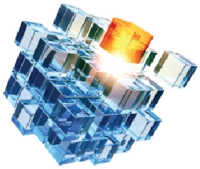
Key words: *Automated systems, computer vision, face similarity, RFID technology*

Introduction

Automated Visitor Record System (AVRS) is an efficient visitor management system that is easy to use. The prototype has attracted Polis Bantuan UITM's and Polis DiRaja Malaysia (PDRM)'s attention and they have submitted their intention to use the system. Ablelogic

Technologies Sdn Bhd has also presented their interest to be the sales agent for this product. With AVRS, the visitor are not required to enter their details manually, but they have to use their NRIC card and face for visitor record. AVRS comes with an RFID reader, camera and NRIC Scanner which are connected to a computer/laptop. The visitor will scan their NRIC card for first time visit. With the addition of the face recognition system, this would introduce dual-verification (smart card + face), where the visitor can only register using their own NRIC card, thus reducing the possibility of visitor cheating on their personal information. Subsequent visit will only require the visitor to handover their NRIC and the system will automatically retrieve the personal information based on their face. This method would save a lot of time since subsequent visits do not require the system to re-read the NRIC for personal information.

AVRS is much reliable than traditional way of manual recording of visitor info as well as introducing a higher standard of solution in term of security for enterprise or business. Improved database entry and online access would serve as value-added such that the commercialization of AVRS will be successful. As far as the NKRA is concerned, this solution can ensure the higher standard of security especially in universities, government agencies, and corporate buildings. Additionally, this product has the potential to bring profit to UiTM once it is ready for market. It would promote the practice of green technology, by reducing the use of paper, minimizing any paper work with its attendance reporting and analysis, as well as promoting new research in this direction.



Special features of the Prototype

There are several special features of the prototype, including:

- Ease of use and deployment
- Highly cost-effective for mass-production
- Reliable dual-verification process and quick visitor management
- Efficient management of visitor records, with reporting features and statistical analysis
- Dual-record system involving check-in and check-out process
- Online database accessibility

Successful implementation of the proposed system would bring several significant contributions, including:

1. Fast, efficient, accurate and smooth visitor management and monitoring
2. Provide an alternative and better way than the traditional way of managing the visitor records
3. Readily accessible data for reporting, forecasting, analysis and program improvements
4. Reduce the running cost of the institutions
5. Online storage/retrieval for visitor access and for reporting as well

Methodology

Using the proposed system, visitor registration process would be faster than the previous recording system as the system will scan the National Registration Identity Card (NRIC) which contain all information including photo and fingerprint of the visitor. This would reduce the workload and time required to record all of the information. The recorded data can be saved as a single file which can be transferred to another computer or load by the system. The proposed system also will produce full and detailed analysis of the visitor record.

The system will list out automatically who had visited and provide the statistical analysis such as the number of visitor for specific period of time. The flow when a visitor checks in is shown in Figure 1.

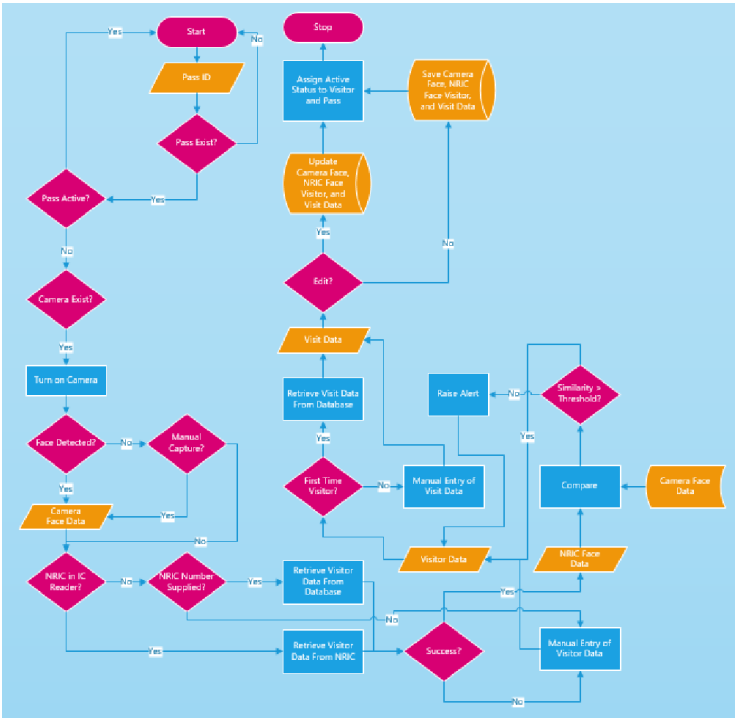


Figure 1: AVRS Check in flow

Moreover, we propose to add face recognition into the system in order to ensure the validity and credibility of visitor's information. The photo taken at the guard post during visitor registration will be compared against the photo inside the NRIC. In face recognition, one of the most successful appearance-based face descriptor is Gabor Wavelets (GW) (Bianconi & Fernández, 2007;

Daugman, 1985; Jones & Palmer, 1987), where the biological relevance of GW's kernel significantly contributed to the effectiveness of its facial features representations (Bianconi & Fernández, 2007; Daugman, 1985; Jones & Palmer, 1987; Claudio. A. Perez, Leonardo. A. Cament, & Luis E. Castillo, 2011; Xie, Shan, Chen, & Chen, 2010). Inspired by and using similar kernel as to the receptive field on human cortical cells, GW is orientation selective while being able to preserve the inherent spatial locality.

These properties made GW to be optimally localized in space and frequency domains, which are generally the sought-after features of a good face descriptor that would help to maintain optimal intra-class and inter-class separation. Among numerous well-known implementations of face recognition based on GW are Gabor Fisher Classifier (GFC) (Liu & Wechsler, 2002), Local Gabor Binary Pattern Histogram Sequence (LGBPHS) (W. Zhang, Shan, Gao, Chen, & Zhang, 2005), Elastic Bunch Graph Matching (EBGM) (Wiskott, Fellous, Kuiger, & von der Malsburg, 1997), and Histogram of Gabor Phase Patterns (HGPP) (B. Zhang, S., Chen, & Gao, 2007). Additionally, using weighted fusion of Local Gabor Feature Vector (LGFV) and global Fourier transform, Su et al. proposed a method called Hierarchical Ensemble Classifier (HEC) (Su, Shan, Chen, & Gao, 2009). On the other hand, Jie et al. proposed Local Matching Gabor (LMG) where they classified the Gabor features independently using ensembles of Borda count (Jie, Qiang, & Nagy, 2007).

Besides, over the years, several improvements to LMG have been proposed including works by Perez et al (C. A. Perez, L. A. Cament, & L. E. Castillo, 2011; Claudio. A. Perez et al., 2011; Perez, Castillo, & Cament, 2010).

Recent improvements to LMG called LMGEW//LN has been reported where LMG is improved using entropy-like weighting (EW) strategy and Local Normalization (LN) approach (Cament, Castillo, Perez, Galdames, & Perez, 2014). Additionally, various further improvements to LMGEW//LN have also been made (Cament et al., 2014; Xie et al., 2010). These combined Gabor-based methods managed to produce state-of-the-art face classification results on several publicly available face datasets, surpassing most previously published methods.

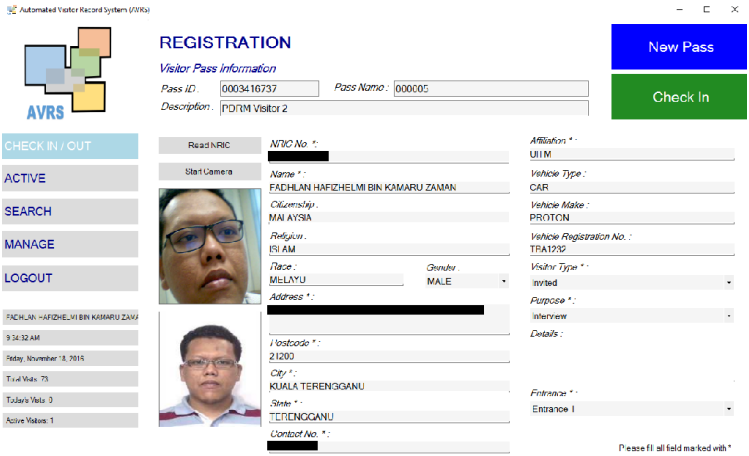
Software and Hardware

AVRS is developed using Microsoft Visual Studio in C# language. The database is built using Microsoft SQL Server. Hardware requirement for AVRS are:

1. PC/Laptop with Windows OS
2. A Web camera
3. NRIC Reader
4. 125KHz RFID Reader
5. RFID Smart Cards

The hardware and software for AVRS is shown in Figure 2.

(a)



(b)

Figure 2: (a) AVRS hardware and (b) AVRS software

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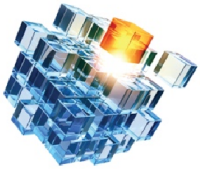

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