

Mobile to Server Face Recognition: A System Overview

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Abstract—This paper presents a system overview of Mobile to Server Face Recognition, which is a face recognition application developed specifically for mobile phones. Images taken from mobile phone cameras lack of quality due to the low resolution of the cameras. Thus, a prototype is developed to experiment the chosen method. However, this paper shows a result of system backbone without the face recognition functionality. The result demonstrated in this paper indicates that the interaction between mobile phones and server is successfully working. The result shown before the database is completely ready. The system testing is currently going on using real images and a mock-up database to test the functionality of the face recognition algorithm used in this system. An overview of the whole system including screenshots and system flow-chart are presented in this paper. This paper also presents the inspiration or motivation and the justification in developing this system.

Keywords—Mobile to server, face Recognition, system overview

I. INTRODUCTION

FACE detection and recognition is one of the most difficult problems in computer vision area. This is the reason why this field receives a huge attention in medical field and research communities including biometric, pattern recognition and computer vision communities [1][2][3][4]. The first step for face recognition is face detection or can generally be regarded as face localization. It is to identify and localize the face. Face detection technology is imperative in order to support applications such as automatic lip reading, facial expression recognition and face recognition [5][6].

Human face is the primary identification method. Therefore, by recognizing face, we are able to gather information about the person. The nature of this method is embedded into Mobile to Server Face Recognition application to provide a convenient way to recognize a person and retrieve information of that person. Mobile to Server Face Recognition is an application involving face detection and recognition. In general, this application utilizes mobile phones as the platform or the client and a server. Inputs (images) are provided by the client (mobile phone) and will be sent over the server to be processed. The process of detecting and recognizing faces are done in the server side with the integration with the Matlab programs.

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The idea of Mobile to Server Face Recognition has the similarity with the system that has been shown in James Bond latest movie, *The Quantum of Solace*. There was a scene in an opera theatre where James Bond (Daniel Craig) captured images of the suspected enemies using his mobile phones and sent them to the headquarters in London. Within a few seconds, he received the information of each of the images he sent. Even though it was just a movie but the logic justification behind the system is already existed. With the advanced technologies that we have today, it is not something that is impossible to be developed.

However, detecting and recognizing faces are challenging as faces have a wide variability in poses, shapes, sizes and texture. The problems or challenges in face detection and recognition are listed as follow [7]:

- Pose - A face can vary depends on the position of the camera during the image is captured.
- Presence of structural components - There may be another additional components on the face such as spectacles, moustache or beard with different type, shapes, colours and textures.
- Facial expression - The facial expression resembles directly on the person's face.
- Occlusion - A face may be partially obstructed by someone else or something when the image is captured among crowds.
- Image orientation - It involves with the variation in rotation of the camera's optical axis.
- Imaging condition - The condition of an image depends on the lighting and camera characteristics.

II. THE FUNDAMENTAL INSPIRATIONS

Researchers worldwide continue in implementing innovative and novel works concerning face detection and recognition techniques to achieve a better performance based on the traditional methods such as eigenface, wavelets and neural networks. These algorithms or methods have been integrated into mobile platform using mobile devices such as mobile phones, PDAs and smart phones.

Mobile technology is getting diffused and mobile phone is a must-have appliance for most of us today. This application is making use of the booming mobile technology into something beneficial to the society. Many telecommunication companies have attempted to developed applications which involving biometric technology in their mobile phones. The motivation to develop Mobile to Server Face Recognition is driven from the existing systems such as OKAO Face Recognition Sensor and Face LogOn as well as the new breakthrough in face recognition by the researchers of University of Illinois.

A. OMRON, OKAO Vision Face Recognition Sensor

OKAO Vision Face Recognition Sensor is the world first developed face recognition technology that has been implemented in mobile phones or any other mobile devices with a camera function in 2005 [8]. The main aim of this system is to protect the mobile phones and the data they hold by authenticating and verifying the users of the mobile devices via face recognition instead of passwords. Figure 1 shows the OKAO Vision Face Recognition Sensor being tested using a mobile phone.



Fig. 1. A user is testing the system using a mobile phone

B. Face LogOn Xpress and XS Pro-1000

In 2008, XID Technologies Pte. Ltd., a company from Singapore has successfully utilized face recognition technology into their award winning products, Face LogOn Xpress and XS Pro-1000. These products are already in the market for commercialization. Face LogOn employs face recognition in authentication for personal computer access instead of using passwords. XS Pro-1000 is a plug and play system developed for outdoor control access, which applies face recognition for authentication.

XID Technologies is the first company in the world that has developed 3D facial synthesis and recognition solution with the ability to function in outdoor in real world environment [9]. Fig. 2 shows the XS Pro-1000 hardware.



Fig. 2. XS Pro-1000

C. University of Illinois, Face Recognition using Sparse Representation

A research has been conducted by a group of researchers of Illinois University, USA [10]. They have successfully demonstrated a novel algorithm using sparse representation and compressed sensing to address the problem of occlusion for frontal view images.

The fundamental principle of this method is the robustness from redundancy whereby the redundancy in the measurement is important in detecting and correcting the gross errors. This principle is not applied in the conventional method whereby the redundancy information is not being taken into measurement [11]. The result was significantly increased in

accuracy over the conventional methods for linear feature model.

This new method employs the sparsest linear combination of images in database in representing the faces, which is not using the specific or particular feature as applied in traditional methods. Fig. 3 illustrates the recognition process using sparse representation [11].

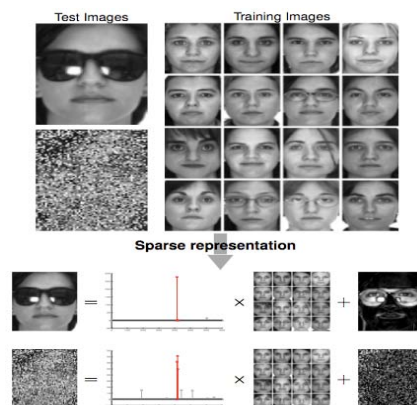


Fig. 3. Example of face recognition method using sparse linear combination due to occlusion

The different approach offers a more accurate performance for occlusion images, faces that are partially covered or obscured rather than the traditional methods.

By looking at the performance demonstrated by the researchers, it is positive that this approach can be applied on real time systems, which involve a small number of images in the database such as access control system for a building or laboratory.

Yi Ma, one of the researchers of as well as a professor envisions a system that utilizes face recognition for mobile phone whereby users are able to capture a person's image using mobile phone camera, submit a query and receive information regarding the person [10]. This fundamental idea is adapted in Mobile to Server Face Recognition.

III. JUSTIFICATIONS ON SOCIAL SITUATIONS IN MALAYSIA

The justification for this proposed system is based on three major situations in Malaysia, which are rape and murder, children abductions (some of them were raped and murdered) and the issues of illegal immigrants pouring in to Malaysia. The number of rape cases is increasing each year as depicts in Table I [12]. The most tragic rape and murder cases are such as Suzailly Mokhtar, which happened in 2000 and Canny Ong, which happened in 2003 [13].

TABLE I. STATISTICS OF RAPE CASES REPORTED IN MALAYSIA (2000-2007)

States	'01	'02	'03	'04	'05	'06	'07
Perlis	10	13	11	21	26	28	27
Kedah	123	132	119	127	163	221	313
Penang	75	73	70	89	71	115	161
Perak	79	100	118	121	148	183	226
Selangor	269	253	280	289	368	421	562
K.L.*	97	120	77	116	111	142	221

N.S**	82	62	69	89	97	103	153
Melaka	43	57	67	100	77	125	139
Johor	234	235	312	323	324	343	473
Pahang	79	79	70	102	84	143	194
Terengganu	48	45	38	58	99	127	130
Kelantan	74	70	66	83	90	152	167
Sabah	94	115	111	149	156	199	196
Sarawak	79	77	71	94	117	129	136
Total	1386	1431	1479	1760	1931	2431	3098

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The second crime is abduction or kidnapping. Table II depicts a statistics for missing persons for 2006 until 2008 [11]. One unsolvable case was involving Nur Sharlinie Mohd Nasyar, went missing since 2008 [14].

TABLE II. STATISTICS OF MISSING PERSONS IN MALAYSIA (2006-2008)

YEAR	TOTAL MISSING		FOUND		STILL MISSING	
	M	F	M	F	M	F
2006	265	985	174	659	91	326
2007	187	791	105	494	82	297
2008	150	661	69	327	81	334
TOTAL	602	2437	348	1480	254	957
GRAND TOTAL	3039		1828		1211	

The last motivation is the high number of illegal immigrants in Malaysia. One terrifying impact on the excessive numbers of illegal immigrants is the safety issue. The numbers of reported cases regarding violence is steadily increasing. According to Royal Malaysia Police (RMP) statistics for 2008, 1849 violent cases and 3034 properties cases were reported involving immigrants [15].

IV. OBJECTIVE OF THIS PAPER

The main objective of this paper is to present the fundamental idea of the system as well as the general overview of the system prototype, which includes system functionalities, flow chart, technical aspects and result obtained from preliminary testing.

V. THE PROPOSED SYSTEM: MOBILE TO SERVER FACE RECOGNITION

A. Brief explanation how this application works

Mobile to Server Face Recognition is a mobile application that deploys face recognition method. This application will be embedded directly into any mobile phone is enabled with Java and 3G technology and also equipped with a camera. This application is simple and easy to use by anyone even children. Our target users are the public citizens including children and authorities such as Royal Malaysia Police Department.

The main idea of this system is to offer a simple application for public used in order to help reduce the number of crimes. The complexity of using mobile phone is very low which means it is very easy to use to perform tasks such as send and receive SMS or MMS, make calls and connect to the Internet. Due to the highly usage of mobile phones in Malaysia, mobile phone platform is preferred as the device for

this system. As depicted in Table III, it shows that the number of mobile phones subscribers is getting higher for each year [16].

TABLE III. STATISTICS OF NUMBER OF MOBILE PHONE USERD IN MALAYSIA

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008
Mobile phone users (000)	0.0	10.0	100.0	1500.0	5130.0	3120.0	4020.0	2100.0	
Mobile phone users (1000)	28.1	10.3	12.3	85.3	84.7	88.1	88.4	80.0	
Mobile phone users (10000)	1411.0	10242.0	10445.0	51300.0	55422.0	53400.0	53800.0	54300.0	
	5004	5002	5000	5001	5008	5008	5010	5011	

Basically, our mobile phone will work as a device that captures images and sends them directly to the server (via Internet) and directly receives the information (from the server) about the images (persons) in a form of text messages. The basic mechanism works like this; when we see someone looks suspicious, we can just capture his/her picture using our mobile phones and send it to the server.

The server will then return the information about the image to our mobile phone in a form of text message. The information includes the person's name, age, nationality and status. For example: freeman, in custody, wanted or any criminal records. Once we receive the information and (let say) it turns out to be that the image of the person is actually a wanted criminal. Thus, we can lodge a police report at the nearest police station regarding the information.

B. Technical Aspects

Basically, this system will consist of two different parts, the server part and the face recognition part. Further explanation is provided as follows:

- *Mobile Platform* - This system will be embedded into any model of mobile phones that support Java technology and will be integrated with Java applications.
- *Mobile Technology* - Java 2 Platform, Micro Edition (J2ME) technology will be used to provide an environment for this application running on mobile phones.
- *Hosting (Web Server)* - A server is required to host the application. This application will transmit and receive data over the Internet. Apache HTTP Server can be used as the web server using a normal pc.
- *Database / Dataset* - A small database or dataset will be developed for testing and evaluation. The database will consist of images and information of each of the images (e.g. name, age, gender, nationality and status).
- *Face Recognition method* - Face recognition part will be developed using Matlab software. It will be integrated with the server.

C. Flowchart

Basically, there are two different flowcharts respectively. Figure IV is the flowchart for the client side, which is the process running on the mobile phone. When the application is started, a main menu will be displayed. A user will need to choose an action either to capture a picture or to quit the

application. If the user chose to capture a picture, the process will continue to capture and save the picture in the mobile phone memory. At this stage, the image taken by the mobile phone camera is not yet submitted to the server but still kept in the phone memory. The process will continue to the next step whereby the image will be submitted to the server. The process flow ends at the client side when the image has been submitted to the server.

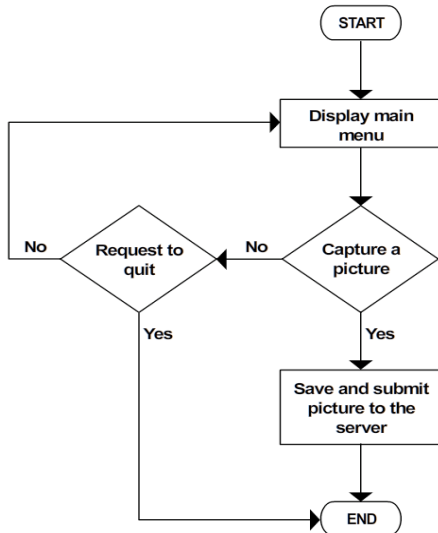


Fig. 4. Process flow on the client side

A flowchart on the server side is illustrated in Fig. 5. The server will receive the image that has been submitted by the client side. Matlab functions, which consist of a set of coding for face detection and recognition will be called. When the face of the image has been successfully recognized, the data will be used to find the information related to the person in the database. If the person does exist in the database, a text message consists of relevant information will be sent to the client. Otherwise, a “No Record” message will be sent. The process flow ends at the server side when the result or information has been sent back to the client.

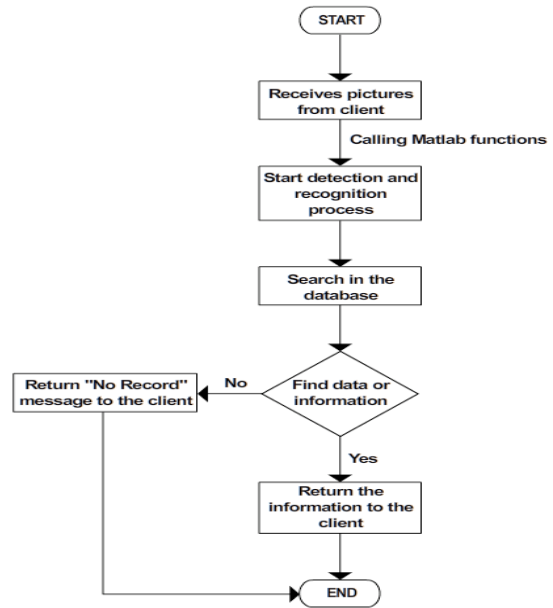


Fig. 5. Process flow on the server side

VII. TESTING RESULT

A preliminary testing has been done where the application has been embedded into a real Sony Ericsson mobile phone enabled with Java and a camera. The first results are shown in the following screenshots, Fig. 7.

VI. SYSTEM ARCHITECTURE

The system architecture is illustrated in Fig. 6. The process is explained as a whole.

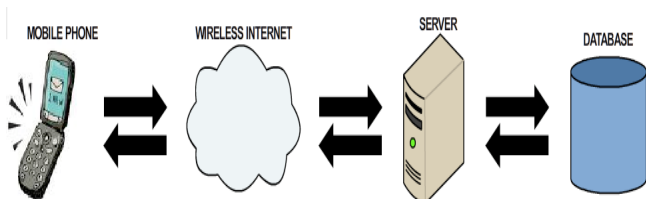


Fig. 6. System Architecture

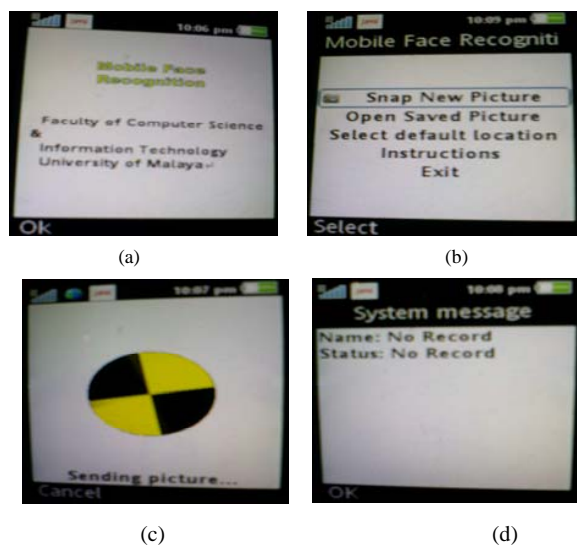


Fig. 7. (a) Interface, (b) Main Menu, (c) Sending image, and (d) Result in the form of text message – no record was found due to a new image has been used, where the new image was still not included into the database at that time

VIII. CONCLUSION

Mobile to Server Face Recognition is a prototype developed to test the system backbone using Matlab and server to perform face recognition process. There have been numerous face detection and recognition systems in the

market. However this system offers extra feature which involving server and real time face recognition process. The result demonstrated in this paper indicates that the interaction between mobile phones (client side) and server (server side) involving Matlab functions is successfully working. The result shown before the database is completely ready. The system testing is currently still going on using real images and a mock-up database to test the functionality of the face recognition algorithm used in this system.

It is hoped that this paper may be able to contribute ideas for the particular area and could be a kick-start for more solid development. If this system can be fully developed with a highly effective rate, there will be possibilities of collaboration with Royal Malaysia Police Department and the Immigration Department. It is not impossible that this system may be a new alternative to help the government to deter crimes in future. Undoubtedly, there are so much of tasks to be accomplished to take this system into action. However, by providing such information like this regarding the proposed system, it may be able to contribute to some extent and profound studies.

ACKNOWLEDGMENT

First and foremost, I would like to convey the sincerest gratitude to my supervisor, who has given her knowledge, encouragement and effort. The research is funded under the University of Malaya Short Term Research Grant.

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