Software Model Design for Biometric Examiner Personal Verification

Sethapong Wong-In, Rangsit University, Thailand
Paniti Netinant, Rangsit University, Thailand

The Asian Conference on Society, Education & Technology 2016
Official Conference Proceedings

Abstract
Nowadays the Examiner Personal Verification in most universities uses comparison methodology to match a physical appearance of examiner to a student ID card. This methodology is simple by it is easily lead to an examination cheating. For instances, some students' faces have been changed during study but their student ID cards are not up to date. Some students might hire another person to impersonate them for the examination. While some students may lost their student ID cards or student ID cards get damaged. By these, it is inevitable for the proctors to face the above problems. This paper proposes the applied Biometric Technology to the Examiner Personal Verification by using fingerprint to verify an identity. This paper tends to create a software model to solve the problem not specific to any university for general. Therefore, the software model is supposed to design to be the framework for a developer to develop software to suit each university standard in the future. To develop good and acceptable software, the software model should be designed based on a software design standard to ensure that our model shall follow and meet a quality standard. This paper is designed a software model based on IEEE standard for Information Technology-System Design-Software Design Descriptions (IEEE Std 1016TM-2009).

Keywords: Examiner Personal Verification System, Software Design, Biometric Technology.

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1. Introduction

Software model design for personal verification examiner of an examination using a biometric is a very important and essential process to every school, university, even institute or organization where there is a process to personal assessment. The only objective of examination is to assess competency of examiners or students. There are many processes in examination, for instances a preparing basic information, room, examiner list, proctors, data and time, etc. Besides, the one important process is an examiner personal verification that emphasizes on accuracy, clarity, convenience and speed.

Some academic institutes give a priority to an examiner personal verification, of which there are some problems and challenges. Raising up two problems are intentional cheating i.e. hiring another person to impersonate for the examination or forgery and unintentional cheating i.e. lost and damaged a student ID card, un-matching of a personal to a photo on card due to no update. The challenge in examiner personal verification is in case that there are such many examiners. Thus, it is a time consuming in a verification and may cause to some errors.

An examiner personal verification system (EPVS) is to cope with these problems and challenges, there is an idea to use IT to verify examiner personal identifications. The issue of problem can be divided into four levels: The infrastructure, managing, identifying, and reliability and by two points of view: non-IT, without information technology and IT views, with information technology as illustrates in figure 1.

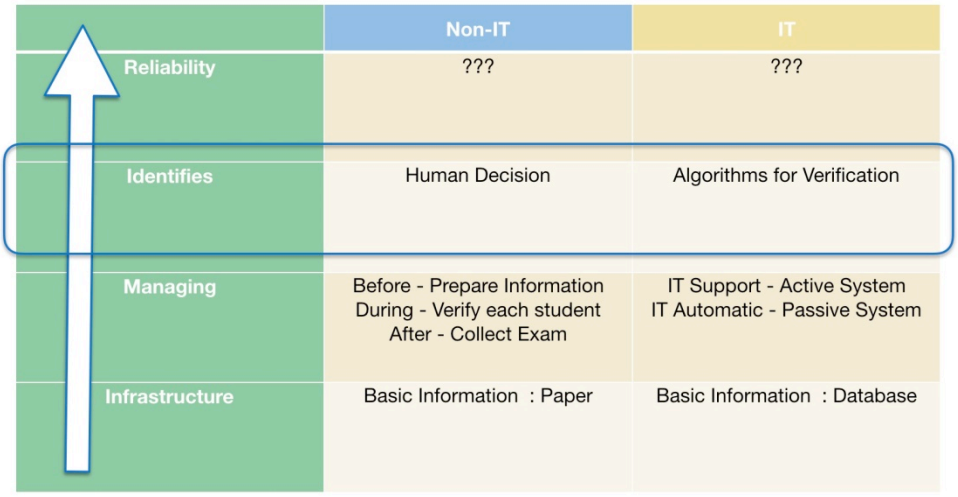


Figure 1: EPVS Problem issues

In an infrastructure level, this level concern about the infrastructure of Examiner Personal Verification System and basic information to verify examiners, the data preparation format are cared for. By the non-IT view, information is prepared in a paper base for an instance, a signed paper for examination participation while the IT view, a database is applicable. To transform non-IT view to IT view for this issue, have to prepare Information from every paper into computer base.

In a managing level, it is concern about how to control and manage the process in an examiner personal verification. By the non-IT view, proctors would verify a student ID card and a signed paper while the IT view can be verified in two ways: an active or a passive. Regarding of an active verification, an examiner has to react some activities to the system i.e. a finger scanning, a pressing, or any other activities depending on a specific IT system while a passive one, an examiner has no interaction with the system but the system itself will automatically verify, for instances, taking CCTVs to scan examiners' faces while queuing to enter the room. To transform non-IT view to IT view for this issue, have to analysis the non-IT process and reengineering it on term of computer process. This issue is very important because if the software designer understands every process of non-IT clearly they can design new system without mistake.

In an identifying level, it is concern about a methodology to verify examiners. By the non- IT view, proctors make decision by comparing a person with a photo affixed on a student ID card while in the IT view, various algorithms are applied for a decision making to verify the real examiner, and however it depends on a methodology in managing level. For non-IT identify examiner by human decision might have human error. Sometime the real examiner have the old student card, make the proctor confuse. To transform non-IT view to IT view for this issue will reduce the human error by using machine to make decision instead. Using machine for examiner verification have many methodologies such as: apply user and password, Smart card and biometric technology. Biometric technology is the good solutions to use what people have, the most biometric that used in many applications include: retina, fingerprint, palm, face, speech, iris, motion and others to the identified the real examiner (Uddin, N., et al., 2011).

In a reliability level, the accuracy and reliability of system are focused, as both non-IT and IT have to specify what index to be used and how reliable the index is. For biometric technology uses biometric error to measure the efficiency.
Figure 1 show the issues that we could concern about in EPVS. Nowadays many University and school try to apply IT Solution into their work.IT Solution in the university have many system such as registration system, human resource system, account system, asset management system, class management system and the others. EPVS is sub-system of the University System but it more complicate than the other system.

2. **Biometric Technology**

An idea to bring Biometric Technology in verification and specifying identity is widespread used in many patterns and various organizations, for instances, security system, and people searching. BT is to use personal identity i.e. a fingerprint, a face, a hand geometry, an iris and a voice of which using BT in an examiner verifying can solve the problems such as a student ID card lost, a forgery, having an impersonate and verifying simultaneous of examiners.

Biometric technology can divide into 3 issues (Choudhary, J., 2012) include: physical biometric, behavior biometric and chemical biometric. Physical biometric is concern about physical measurement and include modalities such as face, fingerprints, iris-scans, hand geometry. Behavior biometric is concern about the way in which a user

performs such as speech, signature, gait, keystroke dynamics and other. Chemical biometric is concern about chemical cue measurement such as perspiration and smell.

An important question of a biometric technology is how the best we can use the biometric technology, regarding of a research (Prabhakar, S., Pankanti, S., & Anil J, 2003), there are a biometric technology in a comparison by five identities: a fingerprint, a face, a hand geometry, an iris and a voice as well as by seven indexes: barriers to an universality, a distinctiveness, a permanence, a collectability, a performance, an acceptability and a potential for a circumvention.

In figure 2, each biometric technology has different advantages and disadvantages. It is also stated that there is no a perfect biometric technology. The most efficiency to use a biometric technology depends on the methodology and the system characteristics, for instances, it is indicated that using a fingerprint and an iris can more identify a personal than using a voice. However, in tele-banking, the biometric technology by a voice is considered to use because a communication methodology is using a voice, for instance.

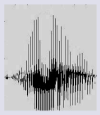
BIOMETRIC	FINGERPRINT	FACE	HAND GEOMETRY	IRIS	VOICE
					
Barriers to universality	Worn ridges; hand or finger impairment	None	Hand impairment	Visual impairment	Speech impairment
Distinctiveness	High	Low	Medium	High	Low
Permanence	High	Medium	Medium	High	Low
Collectibility	Medium	High	High	Medium	Medium
Performance	High	Low	Medium	High	Low
Acceptability	Medium	High	Medium	Low	High
Potential for circumvention	Low	High	Medium	Low	High

Figure 2: Biometric Technology Comparison

The methodology to measure the biometric efficiency is biometric system error indicators that have 2 types of errors: False Match Rate (FMR), mistaking biometric measurements from two different persons to be from the same and False Non Match Rate (FMNR), mistaking two biometric measurements from the same person to be from two different persons. Both FMR and FMNR is less is more. Using FMR or FMNR to be the indicator is depending on what kind of application. For example the criminal Identified System use FMNR to identify the criminal, the security system might use FMR to identified person who have right to access.

To develop EPVS, with high quality, we have to develop software base on the standard. Software Development has life cycle call Software Development Life Cycle (SDLC) include: requirement collect, analysis, design, coding, testing, implement and evaluate. Each step has own standard and some standard is propose on different issue. The software development has many standards such as: European Space Agency (ESA), Institute of Electrical and Electronic Engineers (IEEE), and International Organization for Standardization (ISO), Capability Maturity Model Integration

(CMMI) by Software Engineering Institute Carnegie Mellon University USA, is focus on the document in software development process. ISO/IEC JTC 1/SC 7 Software and systems engineering have many standards and projects under the direct responsibility of ISO/IEC JTC 1/SC 7 such as: ISO 3535:1977 forms design sheet and layout chart, ISO 5806:1984 Information processing. ISO Standard has focus on the standard of international operator (Al-Qutaish, R., & Al-Sarayreh ,K., 2008). Institute of Electrical and Electronics Engineers (IEEE) set the software development stand into many issue such as Standard of Software Requirement, Standard of Software Design, Standard of Software Testing, Standard of Software Quality Assurance and others. IEEE Software Standard is focus on the definition and concept of methodologies in software development. This paper is focus on software design methodology so we use Software & Systems Engineering Standards Committee to be standard.

Software design is very important, software designer have to create design model form user requirements. If the software design model have good quality it's easy to build software for the other rules in software development team. To develop the process view, the designer partitions the software into separate tasks (Kruchtenr, B., 1995).

Software design technique can divide into 3 techniques: process-oriented design technique, data-oriented design technique and object-oriented design technique (Yau, S., & JEFFERY, P.,1986).

The software design standard is to get an effective EPVS. It is necessary to develop a quality software. Nowadays the biggest problem in software development is what not developed to meet user‘s requirement. The cause of this problem is that there are various processes in software development which are information gathering, problem analysis, designing, coding, testing, installing, training including document making. It means to develop software, there need various personnel and roles whom possess different point of views in software development which sometime it is misinterpreted in communication and might cause the final results not meet users' requirement. Moreover, different roles may have their own views and might not be aware of the effect of other views which can cause to an error in software development.
Software Design by IEEE standard (Software & Systems Engineering Standards Committee, 2009) has specified view of software development as shown in figure 3 and indicated in different views in software development, a message conveying and giving an example of different charts.

Design viewpoint	Design concerns	Example design languages
Context (5.2)	Systems services and users	IDEF0, UML use case diagram, Structured Analysis context diagram
Composition (5.3) Can be refined into new viewpoints, such as: functional (logical) decomposition, and run-time (physical) decomposition.	Composition and modular assembly of systems in terms of subsystems and (pluggable) components, buy vs. build, reuse of components	Logical: UML package diagram, UML component diagram, Architecture Description Languages, IDEF0, Structure chart, HIPO Physical: UML deployment diagram
Logical (5.4)	Static structure (classes, interfaces, and their relationships) Reuse of types and implementations (classes, data types)	UML class diagram, UML object diagram
Dependency (5.5)	Interconnection, sharing, and parameterization	UML package diagram and component diagram
Information (5.6) with data distribution overlay and physical volumetric overlay	Persistent information	IDEF1X, entity-relation diagram, UML class diagram
Patterns (5.7)	Reuse of patterns and available Framework template	UML composite structure diagram
Interface (5.8)	Service definition, service access	Interface definition languages (IDL), UML component diagram
Structure (5.9)	Internal constituents and organization of design subjects, components and classes	UML structure diagram, class diagram
Interaction (5.10)	Object communication, messaging	UML sequence diagram, UML communication diagram
State dynamics (5.11)	Dynamic state transformation	UML state machine diagram, statechart (Harel's), state transition table (matrix), automata, Petri net
Algorithm (5.12)	Procedural logic	Decision table, Warnier diagram, JSP, PDL
Resources (5.13) May be refined into resource based viewpoints with possible overlays	Resource utilization	UML Real-time Profile, UML class diagram, UML Object Constraint Language (OCL)

Figure 3 : Software Design Viewpoint Standard by IEEE

From figure 3, there are many views in software development and current charts are unable to cover all views causing to the problems mentioned earlier. The research presents an idea to compile different views in software development to be closest to one chart by presenting with Information Flow Diagram (IFD). By IFD, it can present in view of Context Logical Dependency Information Interface State Dynamic Resource in one chart of which the advantages are: all roles can see an overview of software development, operation between modules or processes, and effect in changing some point in one chart. Example of IFD is indicated in figure 4.

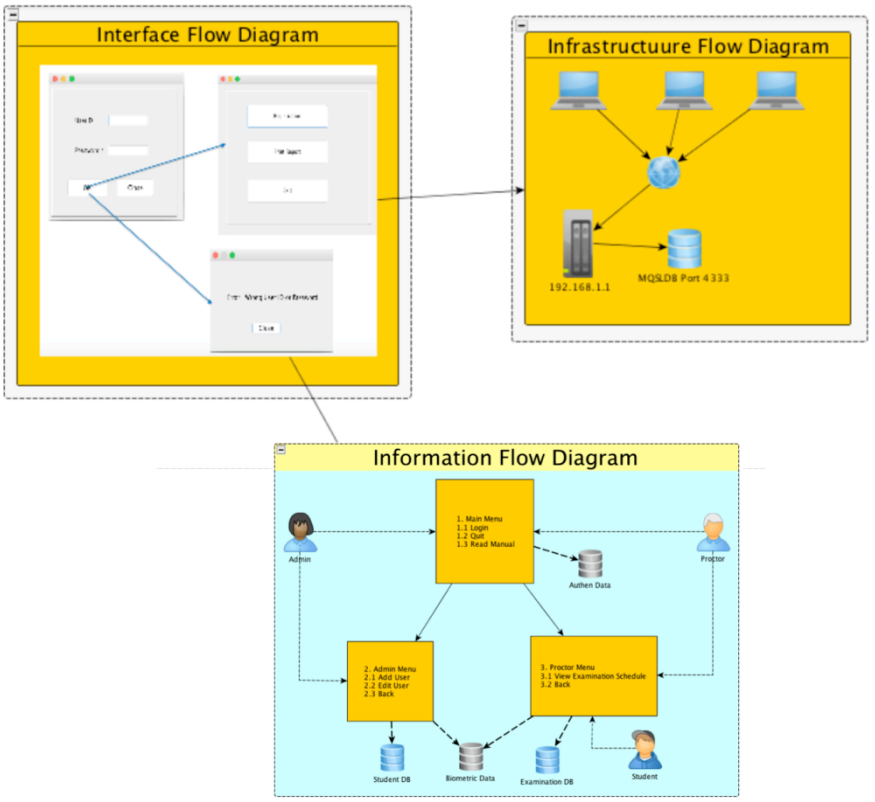


Figure 4: Example of IFD Figure

From figure 4, three diagrams include information flow diagram, interface flow diagram and infrastructure flow diagram show in one picture. The Information flow diagram show the information that use in each interface and show its flow to the next interface. It's also show the interactive between user and process. Interface flow diagram show the graphic user interface flow that can make user more understand how to use software than user manual in term of document. Interface flow diagram can reduce the gap of understand between user and software developer because user can see the final result of software development. The old school traditional software development uses the software prototype to show to the user. Software Prototype can make user see the final design of software but if user want to change something it's difficult to change in Prototype. Figure 4 also show the infrastructure flow diagram to make the implementer understand how to install the software into server and configuration the system and network. Three diagrams are the sample of multi-viewpoint in software design that can reduce the complex ability and gap of understand.

3.EPVS Framework

In order to develop the EPVS with the quality we not only focus on the software design but also concern on the whole picture of the examination system.
Framework in developing EPVS software system is comprised of 6 main issues and shown in figure 5 as horizontal axel stands for Physical Device while vertical axel stands for Methodology.

Issue 1: Examiner Information – considers information of examiner, method and process in data collection and storage. This issue is concern about what the examiner information is and how to gather them in to the system. Sometime the huge number of the examiner spent process time too much if we have not prepared the good methodology for gathering the data.

Issue 2: Examination Information System (EIS) – considers on an examination management system of which EPVS is part of this huge system. This system has to prepare exam room, exam schedule management and management in other issues. EIS also manage the examination both the examination room assignments and the examination proctor assignments in each room (Vasupongayya, S., Noodam, W., Kongyong, P., 2013),. This issue concern about how to connect the EPVS with the legacy system in each university. Sometime the legacy system in the university is very old and closes system; sometime have non-IT system.

Issue 3: The Result/ Output – consider an outcome from EPVS system i.e. outcome format, quality and reliability. This issue concern about the output that sent out from the EPVS, Some university concentrates on the accuracy to be the first priority and processing time is the second. Some university focuses on the ease of use.

Issue 4: Biometric Technology – considers about format and algorithm. This issues concern about which algorithm applied in EVPS. It's depends on what type of biometric that EPVS use. In the same biometric technology also have many algorithm such as: Face recognition use neural network, Eigenfaces, Independent Component Analysis and the others, fingerprint use the correlation-based techniques and minutiae for alignment (Mir, A. ,H. , Rubab, S. , Jhat, Z. 2011).

Issue 5: EPVS – consider how to connect BT with EIS and how it works together in each process. This issue concern about how to connect the biometric device with the examination information system. Each type of biometric has many devices and many vendors.

Issue 6: Intelligence System – considers applying intelligence system using high technology equipment. This issue concerns about how to make the EPVS to be the intelligence system or expert system by make it more automatic and passive system. For example, apply new model of CCTV with facial recognition function while the examiner walk into the examination room CCTV will verify each examiner automatically, apply mobile with fingerprint scan function to be the device instead signing name on paper. The Intelligence System issue can applied into remote access for online testing (Rodchua, S., Yiadom-Boakye, G., Woolsey, R. ,2011) for online learning student.

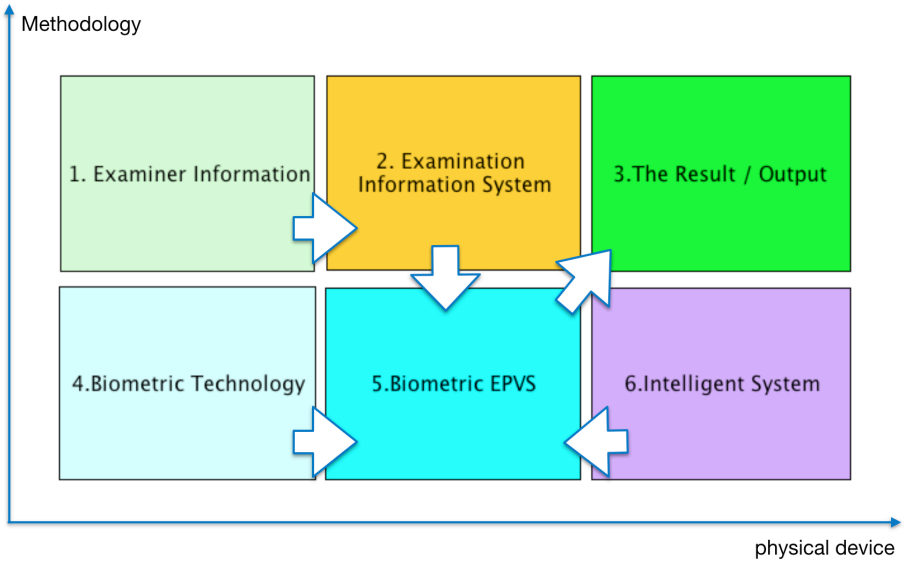


Figure 5: Framework in developing EPVS software system

Conclusion

In conclusion, solution to solve the problem in identifying the examiner by using Biometric, need a model framework in development. To develop good software to meet users' requirement, it is necessary to meet the standard, in which here is referred to IEEE Software Design Standard that be specified many points of view in design. Efficient Software Design may lead to an efficient System Development. Therefore, to make the Design more efficient, this research presents a way in software design by using Information Flow Diagram which presenting many points of view to make the relevant personnel to see the same view in order to reduce any misunderstanding in software design.

IFD in this paper is just the example of using multi-viewpoint for software model design. It still has to complete the notations and rules in the future. The IFD has the concept of using diagrams based on the interoperate information between modules, user and anything in term of information.

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Contact email: sethapongw@tmail.com, netinant1@gmail.com