# Augmented Reality for Patient Information using Face Recognition and Cloud Computing

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***Abstract*— In any medical sector, retrieving information about a patient and their treatment tend to be difficult when a medical practitioner does not have information about a patient on hand in times of emergency. In order to improve the situation, this paper aims to develop an application that uses face recognition and cloud computing for simple knowledge transfer between medical practitioners and patients. This event will help practitioners to monitor the health information of patients remotely. By combining an Augmented Reality (AR) application on a tablet computer with the necessary information, details about patients and possible treatments are conveyed in a simple manner. Therefore, face recognition for patient information system using face recognition and cloud computing is designed to implement the proposed technique.**

Keywords— Watermark, Augmented Reality, Face Recognition, Cloud Computing, Medical, Patient-Information, Mobile.

## I. INTRODUCTION

Today, there are a number of methods that is used by medical providers to store medical record information securely and retrieve it efficiently. The methods can be paper-based, electronic-based or hybrid-based [1].

Paper-based medical record is usually stored alphabetically or numerically. It takes up a lot of space as it requires additional personnel to handle and support paper files and to organize countless of documents. As medical providers takes in more patients, more paperwork will be required for every patient visit and procedure. However, an electronic-based medical record requires less personnel, time and no physical storage space as it is a digital version of the paper chart that contains a patient's history within a single practice. The last method the providers use to store medical information is through hybrid-based – a combination of paper-based and electronic-based record. Providers print digital information, scan paper records and access information from either type of system, so that their electronic and paper systems are compatible.

To help ensure a patient receives the best available care when admitted to a hospital, administrative staff must be able to manage records and access information as quickly and efficiently as possible [2]. Other than that, by using a paper-based method, files can only be retrieved or tracked down and shared desk-to-desk [3]. There is no concept of sharing the same information at the same time.

Although the type of health information a medical provider uses often depends on the type of facility, its size, the number of patients it treats and the volume of records it keeps, a standardized method can be used by all medical providers so that it eases and fastens the process of documenting patients information. Augmented Reality is used in health care facilities across the world today.

Recent hardware and software advances have reduced the cost of Augmented Reality while significantly improving the experience for users and developers [4]. Augmented Reality can be implemented to the electronic-based method to increase efficiency of the Electronic Health Report system. A system with paperless concept of documenting patient's information by using the technology of Cloud Computing can be developed in order to retrieve needed information effectively and less time consuming. In addition to using a Cloud Computing technology, a portable concept can be added for the system to work anywhere within the hospital area. This concept is to increase the portability of the Augmented Reality application by making it run on hand held devices.

In order to make the process faster, Machine Learning is used to recognize the patients face efficiently. Machine Learning teaches a computer to do what comes naturally to humans – to gain a level of understanding of what an image contains [5].

## II. LITERATURE REVIEW

This section includes findings from the literature review that was done in product backlog phase. There are five related literatures that can be referenced to this paper. The first paper is [6] where there is an issue of data privacy and data protection, thus this paper solutes to the usage of cloud-based system. However in [7], there is challenges in resources such as low computing power, battery life, limited bandwidth and storage. Their solution is to move the processing and storage of data out from mobile devices to the cloud. Furthermore, in [8], this paper discusses on timely treatment for patients, hence strengthening emergency medical care systems in countries. In another paper, they debate on the emergence of the need of Electronic Health Record. Their solution is to introduce the Electronic Health Record to the general public [9]. Last but not least, in [10], this paper discusses on how a machine performs tasks that previously only humans could do. Then, a case study of Machine Learning was performed.

Based on a survey performed on related products, there are three that has the same relativity in terms of storing patient's information and retrieving them using a biometric support. The first product is Image-based Ear Biometric Smartphone App, followed by Simprints Biometric System and Mobile Facial Recognition System for Patient Identification.

From the first product, the author created the smart phone application on an iOS platform so that it can easily be used by a field health worker seeing many patients on a daily basis. In this application, potentially matching records are presented to the health worker, ranked in order of ear biometric similarity, given an image of an individual patient's ear. If a record of the individual is already enrolled in the database, then that individual's record will appear ranked in the first position or at least within the top 5 to 10 records. The features in this application includes adding a new patient, viewing the information of an existing patient, editing the information of an existing patient and matching a visiting patient to database record. Although the author targets the public health problem of managing medical records at on-site medical clinics in less developed countries where many individuals do not hold IDs, there is still a limitation – being that it cannot perform longitudinal study on infants under the age of three as their ears will be developing over time. It is essential as vaccination of infants is one of the major requirements in a hospital. Although ear biometric can somewhat be trusted, but it is not feasible to be used on patients of all ages.

According to the second product, this application uses fingerprint as a biometric reference to people. The system uses a fingerprint scanner which is connected to an android phone. The fingerprint is scanned, then the template of the fingerprint will be transmitted to the android phone. Then, if the ID of the fingerprint matches, the health information will be displayed. The limitations of this application is that, with fingerprint as a biometric reference, infants, elderly, and individuals with worn fingerprints can be hardly identified as their fingerprint patterns are either unidentifiable or worn.

Last but not least, in the third product, the author address the issue of patient identification during a medical emergency when a patient's medical information may become inaccessible as a result of the patient's inability to communicate effectively in order to provide the needed medical information. The author explores the feasibility and practicability of using mobile platform and facial recognition technology as a means to deploying a cost-efficient system for reliable patient identification and verification. The system comprises of features such as patient enrollment and patient identification. Google glass is integrated with this system for patient facial recognition. The limitation in this system is that, the health worker needs to enter the patient's age and gender before capturing the facial photograph. If the age entered is incorrect, then the process will repeat until it is entered correctly. Hence, it is time consuming to retrieve the health information of patient when the information is needed pronto and in emergencies.

## III. METHODOLOGY

Before this system could be developed, a literature survey was done to get a clear framework through making a review. The keywords used to search for papers from 2005 to 2018 were as follows: augmented reality, electronic health record, cloud, face recognition and security.

The development methodology used is Scrum Methodology (Figure 1) and the main reason why this methodology was used is so that the project will be done in stages according to phases and completed perfectly within the time-frame planned.

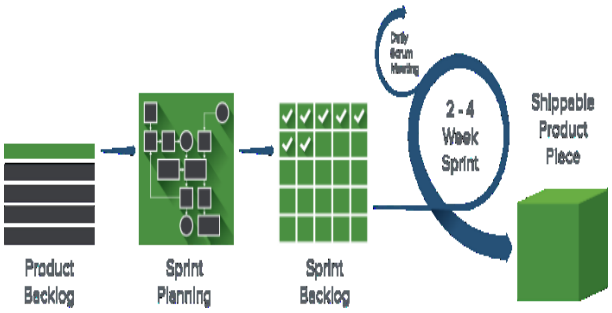


Fig. 1 The phases in Scrum Methodology

During product backlog phase, a list of work that needs to be done was given and placed in order according to priority. Basic elements of the project was identified, including the issues related to the current method of storing health records, i.e. the need of a secure biometric method to retrieve personal records and security risks; the objectives of the new system which has key features that is included in the product backlog is Electronic Health Record, Face Recognition, Augmented Reality, Cloud Computing and also Portability; and benefits of the new system. The scopes were also defined in this phase. The system was drafted based on the six Unified Modelling Language (UML) diagrams. Figure 2 below is the use case diagram designed for the system.


Fig. 2 Use Case Diagram

The second phase was where the burn down chart is plotted to plan the time required in order to finish the project in time. At the end of the day, the remaining hours for tasks to be completed is updated.

Then, in the third phase, the main feature that is needed for the system includes the extraction of Electronic Health Record by using Cloud Computing. After the feature is done, the feature of Face Recognition is sprinted followed by the feature of Augmented Reality. After the completion of these three main features, the feature of portability is added to the system to enable the system to run on hand held devices. The system was constructed using Jetbrains PyCharm and Android Studio 3 as it is both a desktop and mobile application, with Huawei Nova 3i as a test device. Figure 3 below shows the user interface for desktop application.

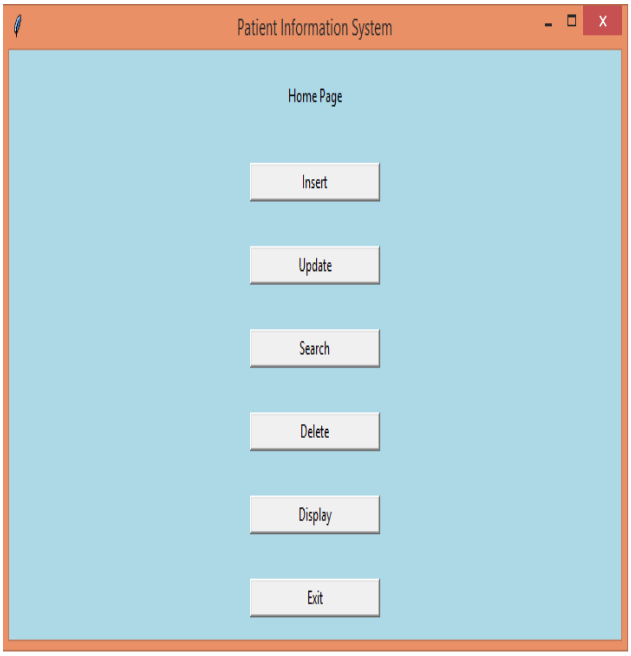


Fig. 3 Interface for Desktop Application

The last phase contains the shippable product piece which includes the working model of the application.

## IV. Result and Discussion

Regarding the testing which is part of the sprint backlog phase, system testing was done. The summary of test cases is in Table 1, whereby there were a total of 11 test cases for each of the functionalities in the application as well as the Android application. The functionalities are as follows: upload user details, edit user details, delete user details and request user details.

TABLE I Summary of Test Cases

| Test Case ID | Test Scenario | Expected Results | Pass/Fail |
|---|---|---|---|
| TC01 | Launch Application | Application launches | Pass |
| TC02 | View Patient Information | Patient Information successfully displayed | Pass |
| TC03 | Edit Patient Information | Edit Patient Information page shows up | Pass |
| TC04 | Delete Patient Information | Information successfully deleted | Pass |
| TC05 | Add Patient Information | Information successfully registered | Pass |
| TC06 | Enter incorrect Patient ID | Error pops up | Pass |
| TC07 | Enter correct Patient ID | Data is successfully searched | Pass |
| TC08 | Enter incorrect Syntax | Error pops up | Pass |
| TC09 | Enter correct Syntax | Data is successfully accepted | Pass |
| TC10 | Save changes | Changes saved | Pass |
| TC11 | Close Application | Application closes | Pass |

## IV. CONCLUSION

In conclusion, this paper discussed about how Electronic Health System can be secured and brought portable through Face Recognition and Cloud Computing. This Augmented Reality application is specifically designed for the medical sector as it uses the combination of Facial Recognition, Augmented Reality and Cloud Computing to store and display medical information of patients which will be augmented on a hand-held device when an action is triggered.

The action must include the authorized people pointing the device camera towards the face of the patient. This application includes three scopes which are Users, System and the Cloud. Each of these scope have different functionalities.

For future enhancements of this project, there are a number which can be implemented. Firstly, the project can be done using working Face Recognition module as the current application does not have a complete working face recognition system. Secondly, the user interface of the application can be tremendously improved by upgrading it to have a more professional-like finish and can be customized by the user according to their needs of criteria. Lastly, an end-shift report of list of patient's information for medical professional can be added to ease their reporting works.

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