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COMMERCIALLY VIABLE ELECTRONIC HEALTH RECORDS SYSTEM WITH VERSATILE IMAGE CAPTURING APPLICATION FOR ENT CLINICS

Brian Keith Alegre [1], Homer Co [1], Arianne Mae Landicho[1], Jose Florencio Lapena M.D. [2], April Angeli Mulingtapang [1], Nico Antonio Ng [1]
[1] De La Salle University, Manila, Philippines
[2] University of the Philippines, Manila, Philippines

Abstract: The use of electronics health records (EHRs) has been encouraged due to their long-term benefits which include higher quality of healthcare and more effective operational performance. However, because of high implementation and maintenance costs and other issues regarding privacy and security, electronic health records (EHRs) are not adopted (Menachemi & Collum, 2011). The group has developed an EHR that addresses these issues for medical application, particularly for Ear Nose and Throat (ENT) Surgeons. The data structure of the software follows the standard diagnostic procedures of ENT clinics in the Philippines; thus it can be adopted by an ENT clinic at a lower cost than specially-designed electronic health records. The software database includes security parameters to address the privacy and security issues of electronic health records. User authentication is required to prevent unauthorized personnel from viewing and modifying stored patient records. Users are given specific levels of access which restrict them to functions only required by their jobs. An audit trail keeps records all activities done in the software. These security parameters maintain the confidentiality and integrity of the patient records ensuring the accountability of all actions done by each user (Alegre, Landicho, Mulingtapang, Ng, 2012). The software interface is designed following several usability design principles for an efficient software design which minimizes the learning curve for new users and shortens the temporary loss of productivity (Armijo, McDonnell & Werner, 2009). Incorporating medical photo documentation which has been proven to be a powerful tool for diagnosis and treatment, the software is capable of capturing images and recording videos with any imaging device connected to a personal computer or laptop via USB (Alegre et al., 2012). The benefits of this developed software may improve the quality of healthcare, lower the implementation cost of electronic health records, and address the issues of privacy and security of patient records.

Key Words: Electronic Health Records; Health information technology; Commercially viable technology; ENT doctors; Medical photo-documentation

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1. INTRODUCTION

All physicians and clinic managers aim to have continuous improvement on the quality of healthcare that they provide. Some ways of achieving this is through the implementation of electronic health records and documentation of images and videos during diagnosis. However, issues concerning with high cost, confidentiality, and privacy prevent clinics from implementing EHRs (Menachemi & Collum, 2011).

The primary objective of this study is to design and develop a commercially-viable electronic health records system that can be installed to any ENT clinics here in the Philippines. The software is designed compatible with any image capturing device that has been installed in the computer to capture images and videos (that does not require an expensive image capturing device to do so). It also incorporates security parameters to address the issues regarding privacy of patient records. The software also follows specific design principles which make it more efficient and unlikely to cause human and software errors (Alegre et al., 2012).

2. METHODOLOGY

The software was developed using visual C# 2010 Express following these 5 steps: survey ENT clinic forms, design the database structure, design the software map, design the user interface, and conduct experiments. The first step is to survey the standard patient record forms and the diagnosis report forms of ENT clinics here in the Philippines which allowed the group to design the data structure and information exchange of the software. After analyzing and compiling the data from the survey, the group has determined all the necessary information to be stored in the database. The group then designed the structure of the database and set relationships to link the correct data together. The next step is to design the software map where the right number of windows necessary and the proper linking of information are determined. In the same stage, the flow of the program was also organized. Next, the group designed the user interface following user experience design principles to design a functional and usable software. Lastly, the group debugged the program for unwanted errors and tested the image capturing and video recording (Alegre et al., 2012).

3. FEATURES

The features of the software can be can be categorized into four sections: imaging capability, data storage, security features, and user interface design. (Not all clinics can afford expensive image - capturing devices such as fibre-optic endoscopes.) Without photo documentations, future diagnosis will not be as accurate as when references of diagnosis history are available. The software solves this problem by having a versatile image capturing feature where a doctor can use a more affordable high resolution webcam that has been installed in the computer to record significant details in a diagnosis report. The software allows the user to select which image capturing device installed in a computer to use for a particular diagnosis. The user will no longer need to open a separate application for the image capturing device which solves not only the problem but also reduces the time spent in organizing diagnosis documentations (Alegre et al., 2012).

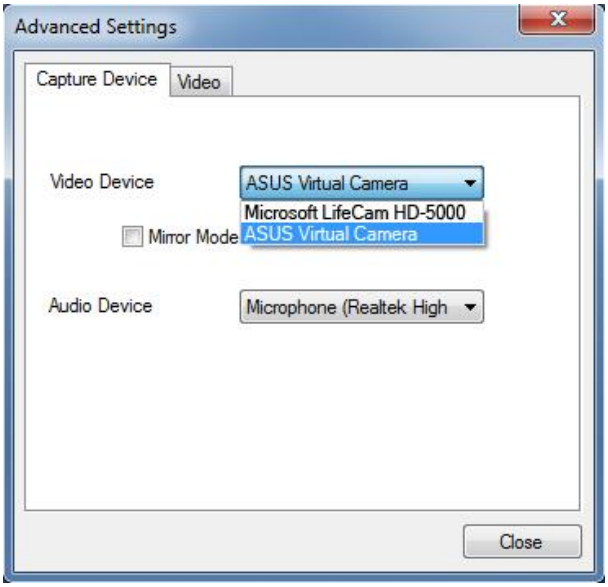

Figure 1.Dialog box showing available camera devices to select from

The software stores four types of data such as text, image, video, and portable document format (PDF). Only text data are stored in a secure Microsoft access file to minimize the file size (and so that accessing the database won't take too long). All image and video files are stored in a hidden folder to be set up by the administrator to prevent unwanted tampering of data while all

portable document formats are stored in a folder assigned by the user. This software also generates smart ID codes where different types of ID have their own unique code to prevent mix-ups of ID numbers of users, patients, and diagnosis that might cause errors in the future. Important information are also present in the IDs such as date of images captured, date of diagnosis, year the patient started visiting the clinic, and other details. The software is also designed with a search query for quick results of information needed (Alegre et al., 2012).

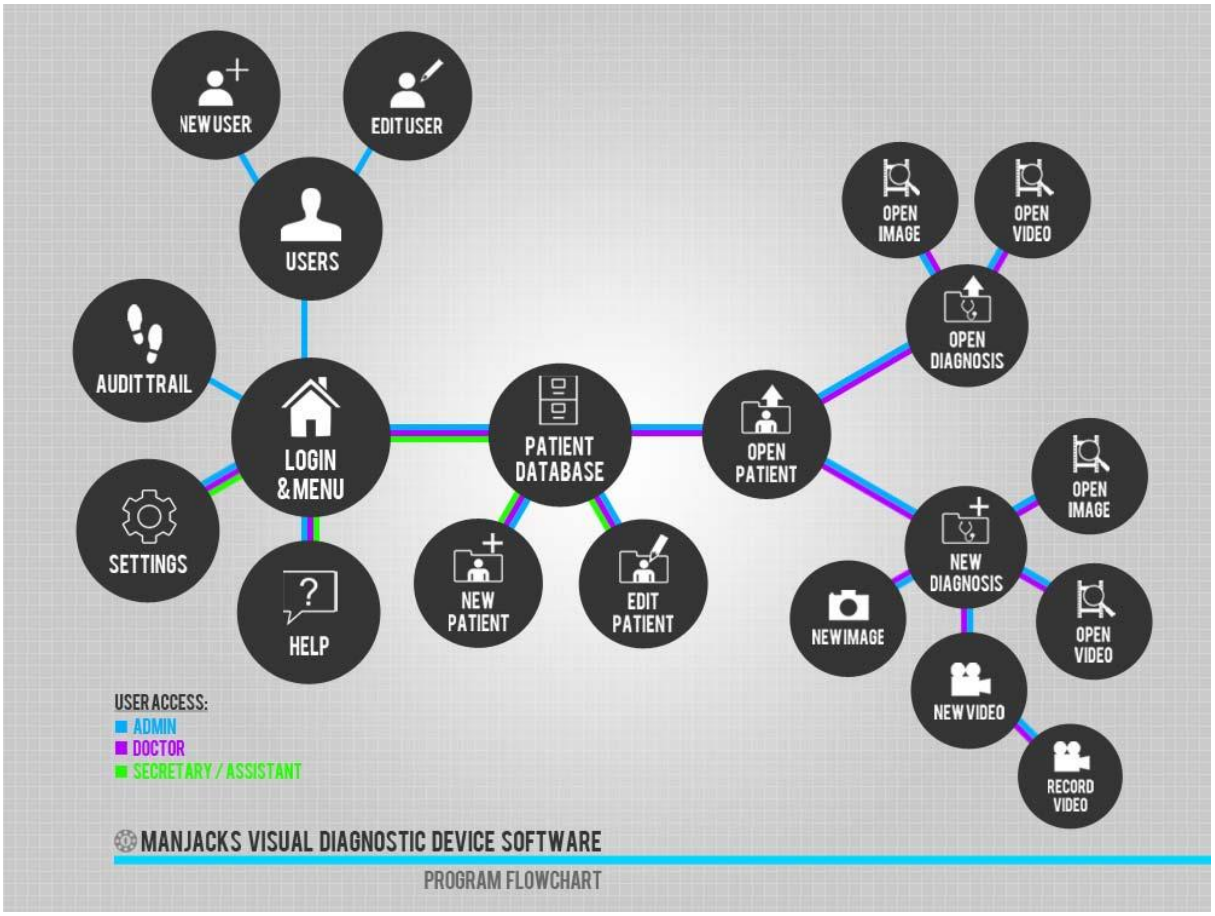

Figure 2.Map of access given to the different user types

One of the priorities of designing this database is to ensure the patients' privacy and security. The software has three security features namely, the user authentication, user levels of access, and the audit trail. The first security parameter ensures that only authorized clinic personnel and doctors are given access to the patient records. The second security parameter limits each type of user only to their functions. The access given to a secretary or assistant user level is restricted to only adding and editing patient information; they are not given access to opening and editing of diagnosis reports. The access given to a doctor user-level is restricted to viewing, creating and modifying patient information and diagnosis reports, but is also restricted to the administrator functions. Only administrators are allowed given access to administrator functions such as adding or deleting users and viewing the audit trail. The third security parameter keeps all users accountable to all actions done with the software by keeping a log of all activities done in the software. The audit trail keeps track of the time when users log in and out, which user added, modified, or deleted a patient record, which doctor conducted the diagnosis, who printed patient diagnosis reports, etc. for future reference. This security parameter allows the source of inconsistencies in data to be traced (Alegre et al., 2012).

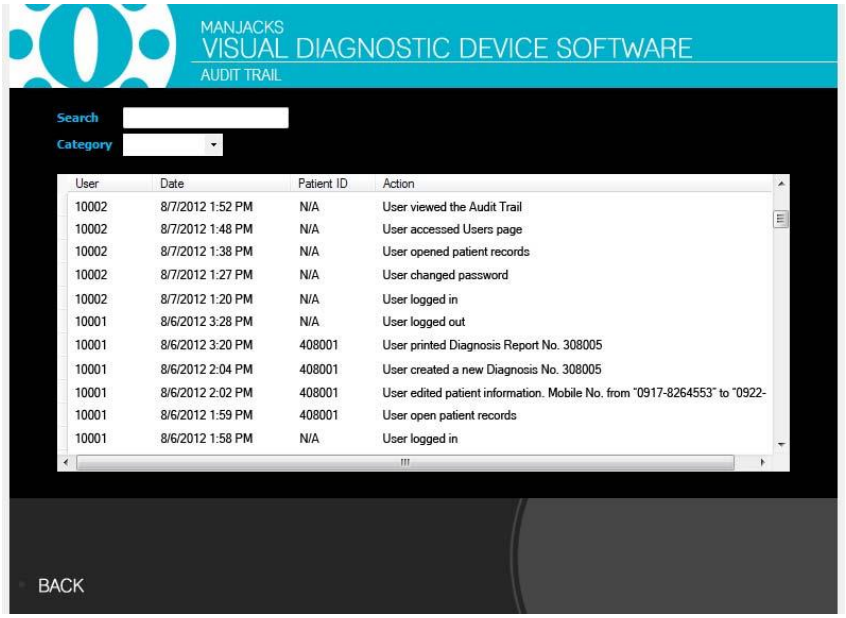

Figure 3.Dialog box showing the activities recorded in the Audit Trail

The fourth type of feature of the software is its user interface design. A good software design requires both functionality and usability. The importance of this feature includes effective information display, clear software instructions, faster learning/adaptation of the software, human error prevention, and a visually appealing design. The user interface follows certain usability design principles and heuristic evaluation. The first usability principle for the user interface design is consistency. The layout and position of functions are all the same throughout the program which allows users to easily locate the needed commands. A consistent layout means that the controls and functions designed in a program are where users expect them to be. The second design principle followed is the visibility of system status. The buttons of the program are designed to give user feedback and information such as when a button is pointed and becomes highlighted, the user is informed that the button is clickable. Also, a quick help guide also appears, briefly explaining to the user what function of the pointed button is. Another design principle followed is the user freedom and control. The software allows users to freely explore the software by putting 'back' buttons everywhere. 'Undo' buttons are also designed to allow users to quickly correct changes made. The software also considers minimalistic and aesthetic design which only shows important data and information, properly placed to ensure that everything is visible and readable. The software also uses icons for a quicker visual understanding of certain functions. The software also follows the design principle of using real-world metaphors to prevent misunderstanding and miscommunication between the user and its software. The last design principle is the error prevention where all functions are designed to have an exit clause so that when unexpected bugs occur, the whole software will not crash and will only display an error sign, clearly explaining the error to the user (Alegre et al., 2012).

4. CONCLUSION

The software was tested by 20 people and no errors occurred during the test. The software was also tested with different webcams and was able to capture images and record videos. The software can be implemented to any ENT clinics here in the Philippines since it is based on the standard examination procedures of ENT doctors. Further research on centralized web-based data storage is recommended which will allow a secure sharing of diagnosis reports between doctors.

5. REFERENCES

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