Project Proposal:

Data: From Patient to Health Record

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1 Background and Motivation

The electronic health record (EHR) serves as a collection of patients' health record and health status throughout their whole life for clinical purposes. The Chinese government, as well as Ministry of Health (MoH) of China, had regarded EHR as an efficient tool to improve the safety and quality of Chinese health care service and set a goal to ensure the universal usage of EHR among the whole population in most of the hospitals and clinics by the end of 2020 [1]. Comparing to traditional paper records, EHRs offered advantages such as remote data access, unified data standard, searchable digital database and integrated patient records including medical history [2]. A research taken by Jennifer King demonstrated that over 75% of EHR adopters identified that EHR enhanced the health care service [3].

EHRs offered more efficient entry and retrieval of relevant patient information. However, a potential weakness of EHR is the discommodious input interaction using traditional keyboard and mouse. The maximum number of words per minutes (WPM) was 80, when concentrating on typing [3]. A 2016 study estimated that doctors spent between 37% and 49% of their working hours on clerical tasks [4]. Doctors were overwhelmed by this clerical work and had a great possibility to make serious mistakes by typing manually under this circumstance [5]. All that paperwork contributed to the high level of burnout and depression in the profession, according to a 2018 study [2]. The solution – voice assistant can serve as clinical stenographers that transcribe doctors' observations and instructions and insert them into a patient's EHR [2]. In theory, with the assist of the speech recognition system, it will liberate doctors from tedious clerical work and improve the accuracy and quality of EHRs.

As the practice of voice recognition in the past 10 years, the accuracy of the outputs is not ideal. A research in 2010 implemented a voice recognition method and compared result with the manually translated content. The average accuracy was less than 82%, with 6.1% of incorrect recognition and 11.2% of rejected voice [6]. Speech averages about 110-150 WPM. However, due to the poor performance of voice recognition system, 70% of extra time was required to correct errors [2]. At present, with the development of the machine learning, plenty of voice recognition API was provided with a higher accuracy, such as Google voice recognition API [7] and Baidu voice recognition API [8]. Combined with noise reduction algorithm to obtain a clear voice input, the accuracy would achieve near 99%.

Apart from the voice recognition, an approach was necessarily required to allow machine to derive meaning from human languages, as well as decompose a sentence into independent words. Many Natural Language Processing (NLP) studies had been conducted and developed to analyze the part of speech (POS) and the meaning of languages. Tested by Che et al. [9], a sufficient accuracy and speed have been attained in some of Chinese processing modules, including WordSeg (97.4% of accuracy, 185KB/s of speed), POSTag (97.80% of accuracy, 56.3KB/s of speed), NER (92.25% of accuracy, 7.2KB/s of speed) and so on. With a further training on an additional dictionary containing specific disease names and medical drug names, it can be perfectly adapted to medical segmentation analysis.

Several voice recognition and language processing systems had been developed which only supported English. Alexa voice assistant of Amazon [10], Saykara [11] and Suki [12] are

famous and mature applications of AI assistant for doctors on either mobile platform or computer platform. Unfortunately, there has been no similar research or application in Chinese hospitals and clinics except IFLYTEK CO.LTD. [13] started implementing a voice EHR system in 2017. This system synchronously records the voice into patients' medical record, when doctors communicate with the patient. This project will explore feasible approach and method to implement voice recognition technology as well as NLP on automatically filling keywords into EHR to improve the efficiency of doctor's diagnose based on Chinese.

2 Aim and Objective

The main objective of this project is to create a system capable of translating real time voice input or audio files into plain text and process and analysis the key points to fill in the electronic health record (EHR). In other words, implementing a voice assistant can serve as clinical stenographers that transcribe doctors' observations and instructions and insert them into a patient's EHR.

The key objectives of this project are:

1. Collection of doctor diagnose prescription and/or conversation contents online for creation of audio type dataset.
2. Voice recognition methods implementation, analysis and comparison studies.
3. Implementation of Chinese language processing with dictionary based on medical terms.
4. Development of prototype to demonstrate the proposed work of EHR auto-filling which completing the objectives 2 and 3.

3 Project Plan

Stage 1 Planning and Feasibility Analysis

1.1 Ethics form signed and approval.

1.2 Requirements identification and specification of this project.

1.3 Articles reading and accomplishment of proposal.

Stage 2 Project Design

2.1 Decision of the format and content of database.

2.2 Further articles and websites reading to find useful voice recognition and nlp libraries or API.

2.3 User interface design for the software.

Stage 3 Project Implementation and Integration

3.1 Collection of doctor diagnose prescription and/or conversation contents online for creation of audio type dataset.

3.2 Development of user interface of EHR form with all basic functions provided.

3.3 Implementation and combination of speech recording, voice recognition, and Chinese language processing.

*3.4 Interim report writing and validation.

3.5 Classification of keyword from the result of Chinese language processing.

Stage 4 Test and Maintenance

4.1 Test on speech recording, voice recognition, and Chinese language processing functions.

4.2 Test on the performance of keyword classification.

4.3 Test on the application interaction.

4.4 Maintenance of repository, implementation of advanced function and optimization of the code.

*4.4 Final report writing and validation.

The following Gannt chart demonstrates the project plan, using Waterfall methodology. Some of the tasks can be implementing in parallel due to the importance levels and risk management. Most of the research part is in the first semester and most of the heavy work as challenges in completing this FYP will be complete in next semester because my module arrangement in this semester is heavier and there are TOEFL and GRE tests for me to take. As a result, only obtain a prototype of the application is acceptable in this semester.

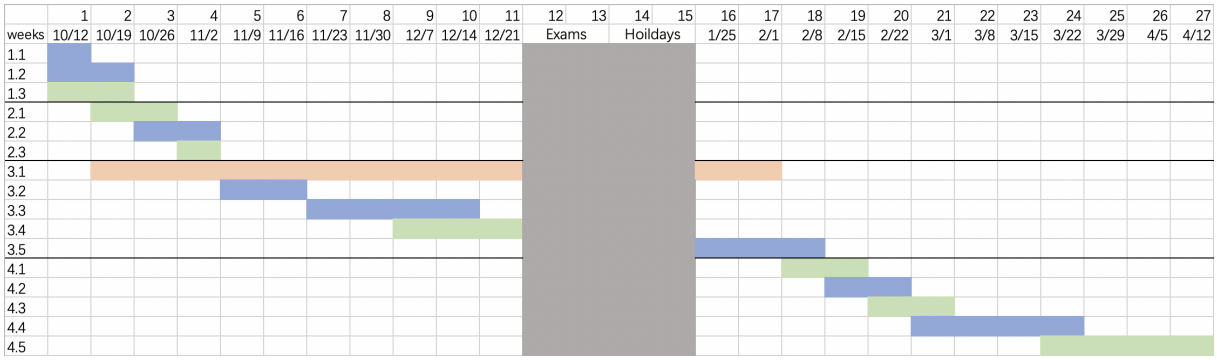

Figure 1: Gantt Chart

References

[1] Joseph Owusu-Marfo, Zhou Lulin, Henry Asante Antwi, and Maxwell Opuni Antwi. Electronic health records adoption in china's hospitals: A narrative review. 2019.

[2] Yaa A Kumah-Crystal, Claude J Pirtle, Harrison M Whyte, Edward S Goode, Shilo H Anders, and Christoph U Lehmann. Electronic health record interactions through voice: a review. *Applied clinical informatics*, 9(3):541, 2018.

[3] Jennifer King, Vaishali Patel, Eric W Jamoom, and Michael F Furukawa. Clinical benefits of electronic health record use: national findings. *Health services research*, 49(1pt2):392–404, 2014.

[4] Tait D Shanafelt, Lotte N Dyrbye, Christine Sinsky, Omar Hasan, Daniel Satele, Jeff Sloan, and Colin P West. Relationship between clerical burden and characteristics of the electronic environment with physician burnout and professional satisfaction. In *Mayo Clinic Proceedings*, volume 91, pages 836–848. Elsevier, 2016.

[5] Gangmin Li, Yifu Qian, Yingjian Huang, Jiamin Chen, and Xuming Bai. Building electronic health record using voice recognition and big data techniques. In *2nd Symposium on Health and Education 2019 (SOHE 2019)*. Atlantis Press, 2019.

[6] Sean Doyle. Determining voice recognition accuracy in a voice recognition system, February 23 2010. US Patent 7,668,710.

[7] PyPI. Google voice recognition api. https://pypi.org/project/SpeechRecognition/.

[8] Baidu. Baidu voice recognition api. https://ai.baidu.com/tech/speech.

[9] Wanxiang Che, Zhenghua Li, and Ting Liu. Ltp: A chinese language technology platform. In *Coling 2010: Demonstrations*, pages 13–16, 2010.

[10] Amazon. Alexa voice assistant of amazon. https://www.digitaltrends.com/home/what-is-amazons-alexa-and-what-can-it-do/: :text=While

[11] Saykara. Saykara mobile ai assistant for physicians. https://www.saykara.com.

[12] Suki. Suki ai-powered, voice-enabled digital assistant for doctors. https://www.suki.ai.

[13] Iflytek. Iflytek voice ehr system. https://www.iflytek.com/index.html.