IntelliScribe: Web Application for EHR/EMR Automation in Physician Offices

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**Abstract** Physicians spend a significant amount of time on data entry for electronic health records (EHRs), impacting patient care and contributing to burnout. This study highlights the problem of excessive time spent on EHRs and its(The abstract should not exceed 250 words. It should briefly summarize the essence of the paper and address the following areas without using specific subsection titles.):Objective:Briefly state the problem or issue addressed, in language accessible to a general scientific audience. Technology or Method:Briefly summarize the technological innovation or method used to address the problem. Results:Provide a brief summary of the results and findings. Conclusions: Give brief concluding remarks on your outcomes. Clinical Impact:Comment on the translational aspect of the work presented in the paper and its potential clinical impact. Detailed discussion of these aspects should be provided in the main body of the paper.

*Index Terms*—Biomedical Computing, Biomedical Communication, Natural Languages, Web Services

# INTRODUCTION[[1]](#footnote-1)

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n a study published by the American Journal of Emergency Medicine, experts found that physicians spend more than 43% of their time with data entry for patients’ electronics health records (EHRs) – while only spending 28% of their time interacting face-to-face with patients and 12% reviewing tests and observations [1].

Almost half of a physician’s time is spent on data entry and administrative work – instead of treating patients and evaluating their needs. This study highlights a serious problem in the healthcare industry, as many studies and accounts have shown that ER physicians are spending too much time on EHR creation and management – taking valuable time away with patients. Instead of seeing more patients or spending more time reviewing patients’ conditions, ER physicians are burdened with the overwhelming documentation required by EHRs. In fact, EHR documentation is one of the main contributors to burnout among ER physicians.

There are many factors that can influence data entry time for patient reports – including server/mainframe responsiveness to typing skills. In addition, the time spent differs by specialty, where internal medicine physicians spend on average 18-22 minutes on EHR reports while sports medicine/rehabilitation physicians spend on average 8-10 minutes on EHR reports per patient. The breakdown of the time spent on EHRs shows that chart review (33%),

documentation (24%), and ordering (17%) are the three main culprits in the reason why physicians spend an excessive amount of time on EHR reports – with documentation being the most frustrating for physicians.

# Analysis of Applicable Standards

Currently, there are two common solutions that physicians are using to reduce the amount of time they spend on EHRs: in-person and virtual medical scribes.

The first solution that most physicians started to implement in their practices and hospitals is an in-person medical scribe that would sit in the office with the doctor and patient and record patient data/history. This notetaking improves patient care quality as it eliminates the need for physicians to physically document the patient’s condition and history. However, there are several limitations to in-person medical scribes. One instance is that there is little regulation/training for medical scribes, restricting the number of tasks that a scribe can do – such as prescribing medicine, scheduling X-rays, and recommending additional tests. This still requires physicians to spend an adequate amount of time on filling out patients’ EHRs. Furthermore, in-person medical scribes inside the medical room often make patients uncomfortable – leaving them less inclined to share vital information about their health and data. This can lead to incomplete data and inconclusive diagnosis of a patient’s condition.

A solution to this privacy issue is virtual medical scribes. These medical scribes would be called in through phone and listen in on the conversation the physician is having with their patients. This perceived sense of privacy A picture containing text, screenshot, diagram, font

Description automatically generatedhas led to more physicians adopting this solution. Nevertheless, the issue with virtual medical scribes is that there is a lack of standard in terms of training and knowledge. In addition, the cost of virtual medical scribes is high for physicians at $50,000/year per scribe. This heavy price is justifiable for large hospital systems; however, smaller hospitals and clinics cannot afford to pay for as many medical scribes – leaving them behind due to their lack of resources.

Figure 1: IntelliScribe Design Overview

In the past couple of years, with advances in machine learning (ML) technologies, a new option has arisen that allows physicians to keep the sense of privacy that virtual medical scribes offer without having to compromise with the high cost and lack of training. These new software platforms use natural language processing (NLP) to read and understand a physician’s notes and voice commands in the same way that human scribes can. With the press of a button, the software can listen in on the physician’s conversations with his/her patients – gathering and analyzing the data on the patient’s health history, current symptoms and illnesses, and test results. The algorithm uses the information gathered to create EHRs and patient documents – saving physicians hours from manual data entry and clerical work and giving them more time to allocate to their patients. These solutions are not only cheaper than a physical/virtual human scribe but also can work around the clock and can be improved through simple software updates.

There are several AI medical scribes in the market currently; yet they contain several flaws in their development. The first is that these models have not been trained to understand physicians with different accents and slag terms for medical terminology. This flaw could result to an inaccurate diagnosis, harming the patient’s health and the physician’s reputation as a healthcare provider. To overcome these challenges AI medical scribes, need to be trained on a diverse, more inclusive dataset. In addition, another concern brought up is that it is hard for these software platforms to create the necessary forms/documents for patients with special illnesses and diseases – often requiring physicians to not always use the AI for their patients. Furthermore, AI medical scribes struggle at extracting and summarizing data from the physician-patient conversation, as the conversations are not structured – containing laymen terms, mental thoughts, and disruptions/distractions caused by outside noise.

# Project Work

1. **Design Overview:**

IntelliScribe is an AI medical scribe that uses NLP and voice processing technologies to build, document, and order patient EHRs for ER physicians. This tool will help physicians spend more time assessing the patient and reviewing their test results. Since the tool eliminates the need for a physician-assistant or scribe to do manual data entry, the patient feels more comfortable talking to their physician about their problems and health concerns. The user will be able to access the model through a web application. The EHR documents created will be stored in a database – linking the patient and doctor to it.

Overall, the application is split into three parts: frontend, backend, and database.

As shown in Figure 1, the physicians would interact with the front-end interface through their web browser, allowing them to insert information regarding their practice and the patient’s private information into the backend server.

The backend portion does all the processing and queries to/from the database and AWS servers. The frontend would communicate with the backend server by sending either GET or POST requests using the axios library. For reference, a GET request retrieves information from the backend server, while a POST request sends information to the server – either to be stored in the database or processed internally. The application server is split into two main parts: Routes and Models. The Routes folder holds all the possible GET and POST requests made by the front-end browser and calls the respective functions in the Models files to either store information into the database or retrieve information from the database. The Models page connects the server to the MySQL database that is running in the background and queries MySQL statements – allowing the backend to interact with the data tables.

The database stores the information and sends information to the application server to be displayed in the front-end browser.

The front-end was built using React.js framework, while the backend server was built using Express.js framework. The relational database was used instead of a non-relational database system because the data was more structured. However, a future implementation of this project will move towards a non-relational database system in order to offer better scalability and flexibility in data management. The relational database was built using MySQL.

1. **Login System**

The first aspect of the web application that was developed was the doctor login system. This allowed doctors to view their own patient’s private health information securely. The doctors would input their email, name, office address, contact information, and passcode into the registration form. The Formik library was used to create forms, retrieve the information that the user inputs, and send the data into the application server in JSON format. The request made by the axios POST request in the form would send two objects - doctor’s credentials and form data. The doctor’s passcode was encrypted and stored in the relational database using the bcrypt library and JSON Web Token (JWT) authentication. This added a layer of security that protects doctor and patient information from getting leaked. Once a physician tries to login into the web application, the frontend sends a request to the application server to check if the encrypted email and passcode given by the physician is the same stored in the database. A future implementation of this login system will use Firebase Authentication, allowing for more security.

1. **Patient Registration**

Patients are registered into the system the same way that physicians register into the application. Patients fill out a form on the front end, then the browser sends their sensitive information into the application server to get stored into the database. The request made by the front end is checked for the physician’s credentials in the backend to secure the data.

1. **AWS Server Setup**

In order to use the AWS Comprehend Medical model, the application server needed to communicate to the

# Conclusion

# Recommendations

References

1. G. O. Young, “Synthetic structure of industrial plastics (Book style with paper title and editor),” in *Plastics*, 2nd ed. vol. 3, J. Peters, Ed. New York: McGraw-Hill, 1964, pp. 15–64.
2. W.-K. Chen, *Linear Networks and Systems* (Book style)*.* Belmont, CA: Wadsworth, 1993, pp. 123–135.
3. H. Poor, *An Introduction to Signal Detection and Estimation*. New York: Springer-Verlag, 1985, ch. 4.
4. B. Smith, “An approach to graphs of linear forms (Unpublished work style),” unpublished.
5. E. H. Miller, “A note on reflector arrays (Periodical style—Accepted for publication),” *IEEE Trans. Antennas Propagat.*, to be published.
6. J. Wang, “Fundamentals of erbium-doped fiber amplifiers arrays (Periodical style—Submitted for publication),” *IEEE J. Quantum Electron.*, submitted for publication.
7. C. J. Kaufman, Rocky Mountain Research Lab., Boulder, CO, private communication, May 1995.
8. Y. Yorozu, M. Hirano, K. Oka, and Y. Tagawa, “Electron spectroscopy studies on magneto-optical media and plastic substrate interfaces (Translation Journals style),” *IEEE Transl. J. Magn.Jpn.*, vol. 2, Aug. 1987, pp. 740–741 [*Dig. 9th Annu. Conf. Magnetics* Japan, 1982, p. 301].
9. M. Young, *The Techincal Writers Handbook.* Mill Valley, CA: University Science, 1989.
10. J. U. Duncombe, “Infrared navigation—Part I: An assessment of feasibility (Periodical style),” *IEEE Trans. Electron Devices*, vol. ED-11, pp. 34–39, Jan. 1959.
11. S. Chen, B. Mulgrew, and P. M. Grant, “A clustering technique for digital communications channel equalization using radial basis function networks,” *IEEE Trans. Neural Networks*, vol. 4, pp. 570–578, Jul. 1993.
12. R. W. Lucky, “Automatic equalization for digital communication,” *Bell Syst. Tech. J.*, vol. 44, no. 4, pp. 547–588, Apr. 1965.
13. S. P. Bingulac, “On the compatibility of adaptive controllers (Published Conference Proceedings style),” in *Proc. 4th Annu. Allerton Conf. Circuits and Systems Theory*, New York, 1994, pp. 8–16.
14. G. R. Faulhaber, “Design of service systems with priority reservation,” in *Conf. Rec. 1995 IEEE Int. Conf. Communications,* pp. 3–8.
15. W. D. Doyle, “Magnetization reversal in films with biaxial anisotropy,” in *1987 Proc. INTERMAG Conf.*, pp. 2.2-1–2.2-6.
16. G. W. Juette and L. E. Zeffanella, “Radio noise currents n short sections on bundle conductors (Presented Conference Paper style),” presented at the IEEE Summer power Meeting, Dallas, TX, Jun. 22–27, 1990, Paper 90 SM 690-0 PWRS.
17. J. G. Kreifeldt, “An analysis of surface-detected EMG as an amplitude-modulated noise,” presented at the 1989 Int. Conf. Medicine and Biological Engineering, Chicago, IL.
18. J. Williams, “Narrow-band analyzer (Thesis or Dissertation style),” Ph.D. dissertation, Dept. Elect. Eng., Harvard Univ., Cambridge, MA, 1993.
19. N. Kawasaki, “Parametric study of thermal and chemical nonequilibrium nozzle flow,” M.S. thesis, Dept. Electron. Eng., Osaka Univ., Osaka, Japan, 1993.
20. J. P. Wilkinson, “Nonlinear resonant circuit devices (Patent style),” U.S. Patent 3 624 12, July 16, 1990.
21. *IEEE Criteria for Class IE Electric Systems* (Standards style)*,* IEEE Standard 308, 1969.
22. *Letter Symbols for Quantities*, ANSI Standard Y10.5-1968.
23. R. E. Haskell and C. T. Case, “Transient signal propagation in lossless isotropic plasmas (Report style),” USAF Cambridge Res. Lab., Cambridge, MA Rep. ARCRL-66-234 (II), 1994, vol. 2.
24. E. E. Reber, R. L. Michell, and C. J. Carter, “Oxygen absorption in the Earth’s atmosphere,” Aerospace Corp., Los Angeles, CA, Tech. Rep. TR-0200 (420-46)-3, Nov. 1988.
25. (Handbook style) *Transmission Systems for Communications,* 3rd ed., Western Electric Co., Winston-Salem, NC, 1985, pp. 44–60.
26. *Motorola Semiconductor Data Manual,* Motorola Semiconductor Products Inc., Phoenix, AZ, 1989.
27. (Basic Book/Monograph Online Sources) J. K. Author. (year, month, day). *Title* (edition) [Type of medium]. Volume (issue). Available: <http://www.(URL>)
28. J. Jones. (1991, May 10). Networks (2nd ed.) [Online]. Available: <http://www.atm.com>
29. (Journal Online Sources style) K. Author. (year, month). Title. *Journal* [Type of medium]. Volume(issue), paging if given. Available: <http://www.(URL>)
30. R. J. Vidmar. (1992, August). On the use of atmospheric plasmas as electromagnetic reflectors. *IEEE Trans. Plasma Sci.* [Online]. *21(3).* pp. 876–880. Available: http://www.halcyon.com/pub/journals/21ps03-vidmar

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