DIGITAL AUSCULTATION ANALYSIS APP

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CIS 485

ABSTRACT

- This project proposes a web-based remote patient monitoring system leveraging machine and deep learning to analyze digital lung auscultation. It aims to provide patients with a platform capable of analyzing digital auscultation performed remotely, helping them make informed decisions and communicate effectively with healthcare providers.
- The system will feature audio uploads, preprocessing pipelines, classification, visualization, and automated report generations. Machine learning and deep learning models trained on currently available datasets (ICHBI 2017) will be compared for effectiveness. This app will demonstrate the feasibility of this software in the real-world.

INTRODUCTION

- The quality of digital stethoscopes have become nearly 1:1 with analog stethoscopes.
- COVID-19 accelerated the remote care health industry. This has opened the doors for many new potential telehealth and remote care services. This project will explore how remote digital auscultation analysis will allow patients to monitor their own respiratory health.

SYSTEM PURPOSE

- Provide patients with an automated process that analyze their lung sounds for symptoms such as wheezing or crackling.
- Generate a report after each use. Track history and identified patterns.
- Allows patients to upload the audio files and report to physician for review.

TECHNICAL GOALS

- Train ML/DL models for sound classification
- Full-stack app development
- Managing requirements
- Optimizing system architecture
- User friendly design

PERSONAL GOALS – HAYDEN

- Gain working and applicable knowledge of healthtech practices.
- Create a project to complement previous clinical experience.
- Build impactful patient-centered tools.

PERSONAL GOALS – JARED

- Develop backend and UI/UX skills.
- solve unfamiliar problems.
- strengthen portfolio with machine learning experience.

PROJECT STATUS

- We plan to communicate regularly over platforms like Discord for messaging and file exchanging with occasional physical meetings to work more productively.
- We will utilize GitHub to maintain a repository of all work completed so far.
- Languages used:
  - HTML, CSS, JS
  - Python
- After initial research, we have gained summarized insight into the methods and system infrastructure to implement into the application.
- We have gained not only more insight into ML/DL practices, but also how digital auscultation can be used effectively to treat patients.

LITERATURE REVIEW

- Customized Spectro-Temporal Convolutional Neural Networks (CNN) Feature Extraction and Extreme Learning Machines (ELM)-Based Classifier for Accurate Respiratory Obstruction Detection
- M. Muthulakshmi et al. (2025) Amrita School of Engineering, India
  - Implemented Convolutional Neural Networks (CNN) to distinguish respiratory diseases with 97.5% accuracy.
  - Utilized audio preprocessing techniques to ensure optimal performance.
  - Audio data was converted into Mel Spectrograms for analysis.

LITERATURE REVIEW CONT.

- StethAid: A Digital Auscultation Platform for Pediatrics
- Arjoune, Shekhar et al. (2023) Children's National Hospital, AusculTech Dx, George Washington University
  - Digital auscultation platform designed for telehealth and AI-driven analysis.
  - Purposed for clinical settings and to allow parents to assess their children's asthma severity from home.
  - The platform consists of a wireless digital stethoscope, a mobile application, customized patient-provider portals, and DL algorithms.

LITERATURE REVIEW CONT.

- Breathing Cycle Detection System for Respiratory Sounds Using Deep Learning
- Stas, Steckel. (2026) University of Antwerp, Belgium
  - Wheeze and crackle detection has been implemented using Deep Learning models.
  - This study aims to identify inspiration and expiration phases; these give more context to the conditions being observed.
  - Explores audio preprocessing techniques to improve accuracy.
  - F1 score of 80% and an Intersection over Union of 0.82.

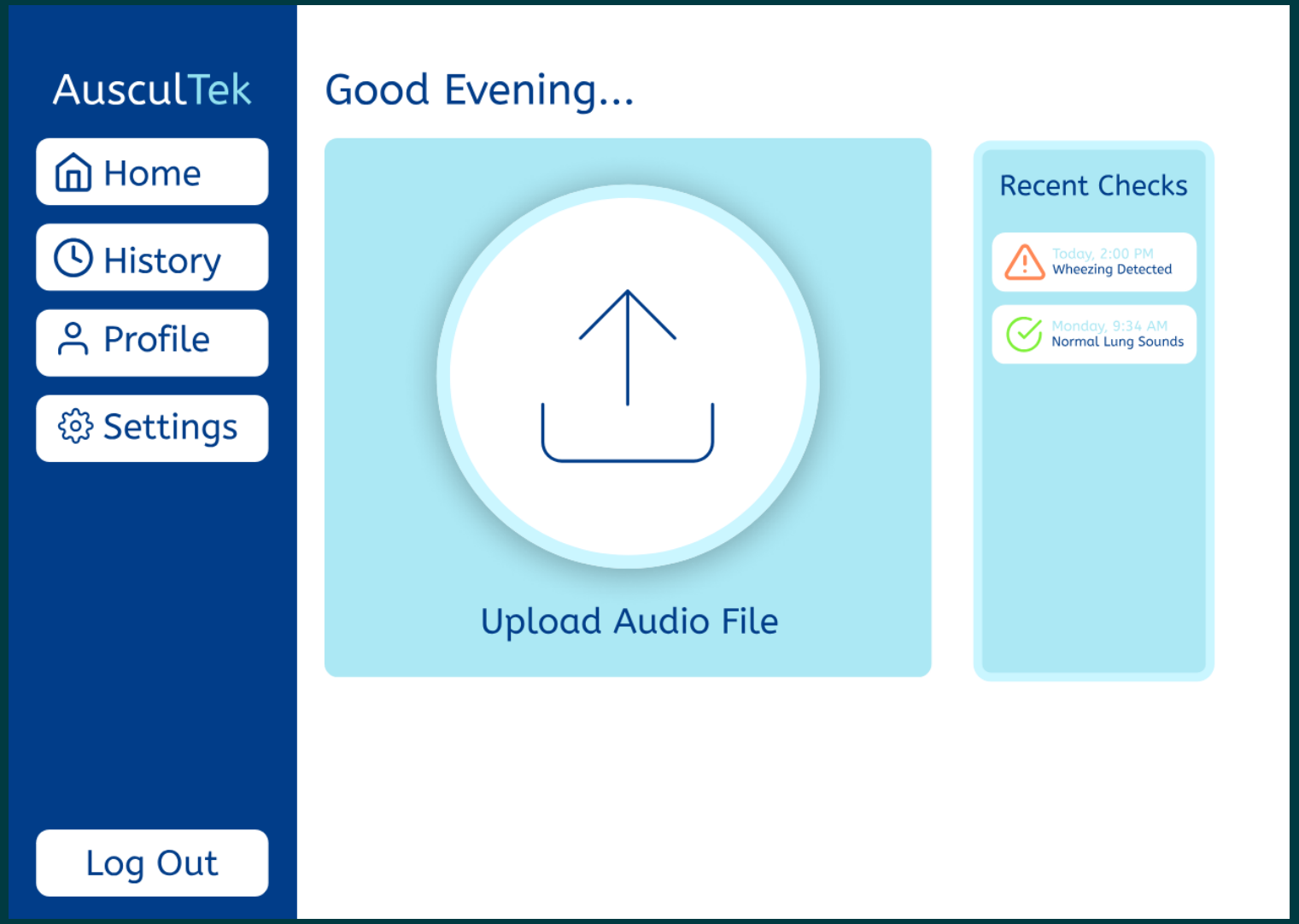
LITERATURE REVIEW CONT.

- Preliminary Study on Real-Time Phonocardiogram Signal Acquisition and Analysis Using Machine Learning and IoMT for Digital Stethoscope
- M. Kalimuthu, C. Hemanth. (2025) School of Electronics Engineering, Vellore Institute of Technology, India
  - Introduced a system for heart sound preprocessing, analysis, and remote communication through digital auscultation.
  - Identifies patterns such as regurgitation and murmurs.
  - Achieved 92.5% maximum accuracy, 97.91% predictability for normal HS, as well as 95.70% accuracy and 98.63% predictability for abnormal HS.

APP DESCRIPTION

1. Patient uploads audio.
2. Dashboard shows patterns & trends.
3. Optional physician report.
4. Physician reviews & decides if a visit is appropriate.

VISUAL MOCKUP



MVP SCOPE

- Interactive web app: upload → preprocess → classify → return detected patterns.

MIDTERM EXPECTATIONS

- For midterm, we expect to have a web app with a simple interface capable of receiving uploaded audio data, which is analyzed by a WIP model, and results returned on a basic analysis report.
- After midterm, we plan on improving model accuracy and building a more robust application by enhancing report metrics, app features, and developing a clean user interface.

TENTATIVE SCHEDULE

- **Weeks 1-2:** Explore ML models, research DL; begin data preprocessing; initial model training and testing; implement audio upload functionality.
- **Weeks 3-4**: Optimize audio processing pipeline; improve model accuracy; develop basic UI; implement basic analysis reporting.
- **Weeks 5-6:** Enhance GUI elements with a user-friendly approach; generate more detailed reports.
- **Weeks 7-8**: Implement history view with historical trend insights.
- **After:** Enhance existing features or add more depending on available time.

CONCLUSION

- With this project, we plan to explore emerging healthtech practices in an effort to gain real-world knowledge of ML/DL, audio preprocessing methods, and full-stack development while building a patient-centered platform with real clinical relevance.

QUESTIONS?