AMRITA VISHWA VIDYAPEETHAM

CliniSim

Disease Diagnosis & Patient Interaction Simulator

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Molecular biology & basic cellular physiology
Ethics, innovative research, businesses & IPR

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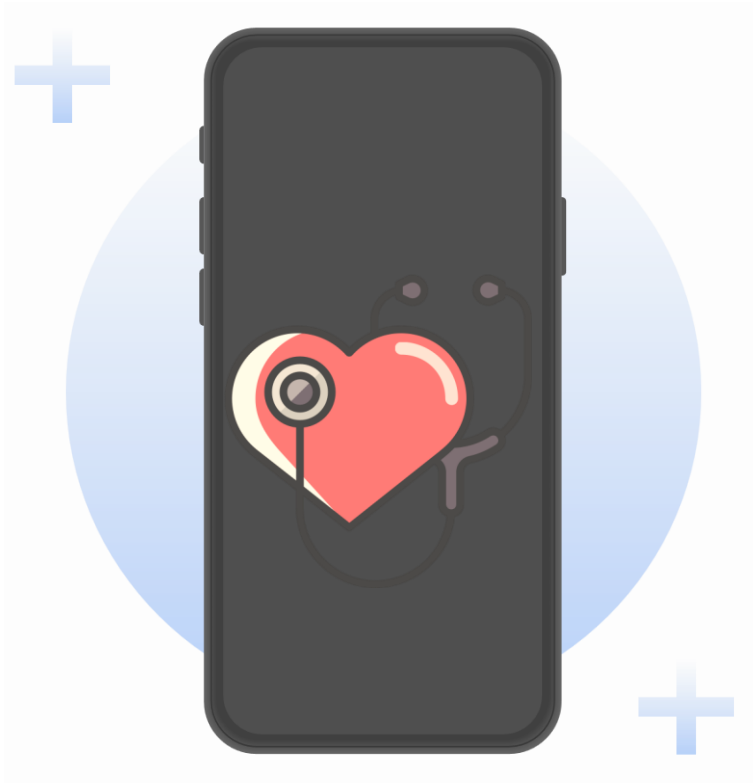
PRESENTATION LAYOUT

- Introduction
- Problem Statement
- Objective
- Literature Review
- Integration of Biology
- Computational Aspects
- Related Ethics and IPR
- Timeline
- References



INTRODUCTION

“Learning by doing, peer-to-peer teaching, and computer simulation are all part of the same equation.”

- **Nicholas Negroponte**

A survey conducted on third and fourth year med students of College of Medicine, Saudi Arabia suggests that 98% of 185 students think that patient simulators are a great addition alongside handling real time patients. 85% students favored the idea of working more on training based simulator, whereas 77% of them believe they were able to apply what they have learnt, using simulation models, to real life.

PROBLEM STATEMENT

How can we develop an **interactive user interface** that can help doctors to practice on simulation for dealing with real-world patients while brushing their clinical as well as patient handling skills?

OBJECTIVES

1. To make an interactive user interface that can simulate clinical conditions for the medical students to practice before their clinical postings.
2. To add up cases of different diseases and allowing user to proceed with the tentative treatment for the particular disease, as per his/her knowledge.
3. To provide feedback, after the clinical simulation session is over, upon the accuracy of selected procedures and drugs.

LITERATURE REVIEW

1 Validating a virtual human and automated feedback system for training doctor-patient communication skills.	• The development of SOPHIE included creating virtual patient scenarios and an automated feedback system. • The participants using SOPHIE improved in communication skills and performed better than others. The most useful feedback metrics were the reading level, speaking rate, hedge words, transcript and turn-taking.
2 Novel Computational Linguistic Measures, Dialogue System and the Development of SOPHIE: Standardized Online Patient for Healthcare Interaction Education.	• Computational linguistic analysis of the transcripts of 383 patient-physician conversations from an essential office visit of last stage cancer patients with their oncologists. • Participants (seven out of eight) mentioned that the speech rate feedback was easy to understand and very useful to improve communication skills

3 Can a mobile app improve the quality of patient care provided by trainee doctors? Analysis of trainee's case reports.	• Case reports were electronic forms completed by participants describing specific events or times when they used the iDoc app. • Having iDoc and the ability to ascertain information was described as facilitating immediate decision-making: for example, it helped to "make a quick decision on whether to send someone to ultrasound."
4 Predicting Simulation-Based Medical Education: An Ethical Imperative.	• SBME (Simulation Based Medical Education) improves trainee skills without exposing parents to harm, especially in critical or high-risk procedures, principle of "first do no harm." • Simulation environments allow trainees to learn from mistakes without real-world consequences, ensuring safety and accountability.
5 Efficacy and Usability of a Virtual Simulation Training System for Health and Safety Hazards Encountered by Healthcare Workers.	• Participants were randomly assigned to either the HHVSTS group, completing three computer-based modules on hazard identification, rationale, and response, or the paper-based group. • For those in the HH-VSTS group, over 83% found the it easy to use, over 94% agreed the HH-VSTS was useful, and over 80% liked it.

COMPUTATIONAL ASPECTS

Interface

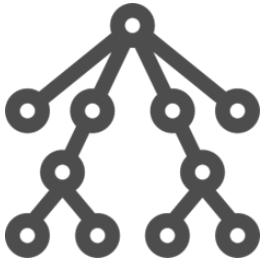
Interactive 2D design to simulate clinical environment.

RNG Case

Randomly selecting a disease and loading its workflow from database.

ChatBot Interact

Talk to patient powered by an LLM, and get to know medical history.



Framework

Create treatment flow framework out of crude data.

Treatment / Tests

Administer treatments and visualize tests.

Prediction

Analyze effects and make prediction of the syndrome.

Evaluation

Evaluate user decisions and overall accuracy of prediction in the process

INTEGRATION OF BIOLOGY

The cases taken here are **genetic disorders**. There is no permanent cure for genetic disorders rather they can be managed and suppressed.

This calls for the need of extreme case and experience while dealing with such patients.

The diseases taken are:

- Marfan Syndrome
- Turner Syndrome
- Down Syndrome
- Fragile X Syndrome
- Gaucher Syndrome

Currently, **crude data** has been collected for two diseases and are yet to be parsed into a treatment flow framework.

We would also incorporate 2D mutated gene models for the user to practice on the mutated coordinates on chromosomal region.

ETHICS RELATED TO CLINICAL INTERACTIONS

I. Patients have an ethical right to **refuse any and all treatment**, no matter the reason, provided they have **decision-making** capacity and their refusal does not put others at risk of harm.

II. If a treatment is **medically futile or inappropriate**, physicians are not ethically obligated to provide it and are justified in refusing to do so, even if the patient or family requests it.

III. AI should have a unitary goal as does medicine (patient health) as a source of solidarity. Practitioners are **required to uphold public interests above business requirements** in the private sector.

IV. AI development should have generations of tried and tested approaches of **principles and working practices** (developed, tested, and renewed by various stakeholders like accreditation boards).

V. AI practitioners, with some exceptions (e.g., **data protection law**) should be subject to external/legal regulatory environments that can censure them for breach of professional norms and otherwise provide the machinery of accountability for answering for wrong-doing.

KEY ETHICAL CONCERNS

1

Consent & Autonomy

Virtual patients shall be designed using anonymized or synthetic data with which real patients' privacy will not be violated.

2

Non-Maleficence

The simulator should supply trainees with accurate, evidence-based information and will not mislead them.

3

Equal Access and Justice

The same tools need to be available to trainees in various parts of the world and institutions regardless of resources.

4

Data Ownership and Usage Rights

It’s unclear who owns the training data generated by the simulator & it cannot be misused commercially.

IPR RELATED TO SUCH SOFTWARE

i. In order to claim patent for a software work, one must show the following important determining factors

- The invention must consist **of patentable subject matter**
- The invention must be capable of **industrial application**
- It must be new (**novel**)
- It must involve an **inventive step** (be non-obvious)
- The disclosure of the invention in the patent application must **meet certain formal and substantive standards**.

ii. The Guidelines for Examination of Computer Related Inventions (CRIs) consider the following aspects when examining CRIs

- Any subject matter, description or information available / disclosed before the date of filing / date of priority will not be considered as novel and therefore non-patentable. It must involve an **inventive step** (be non-obvious).
- Identifying the **inventive concept** in the patent.
- Identifying **common general knowledge** in the state of art on the field, to find steps that require invention.
- Differentiating **claimed** and **cited** inventions.
- Any invention which seeks patent must have an **industrial application**.

KEY TERMS IN IPR

1

Software Licensing

Deciding whether the tool will be open-source (freely available) or proprietary (commercially licensed).

2

Data Protection

The patient data used in training is anonymized and complies with regulations such as GDPR or HIPAA.

3

Software Patenting

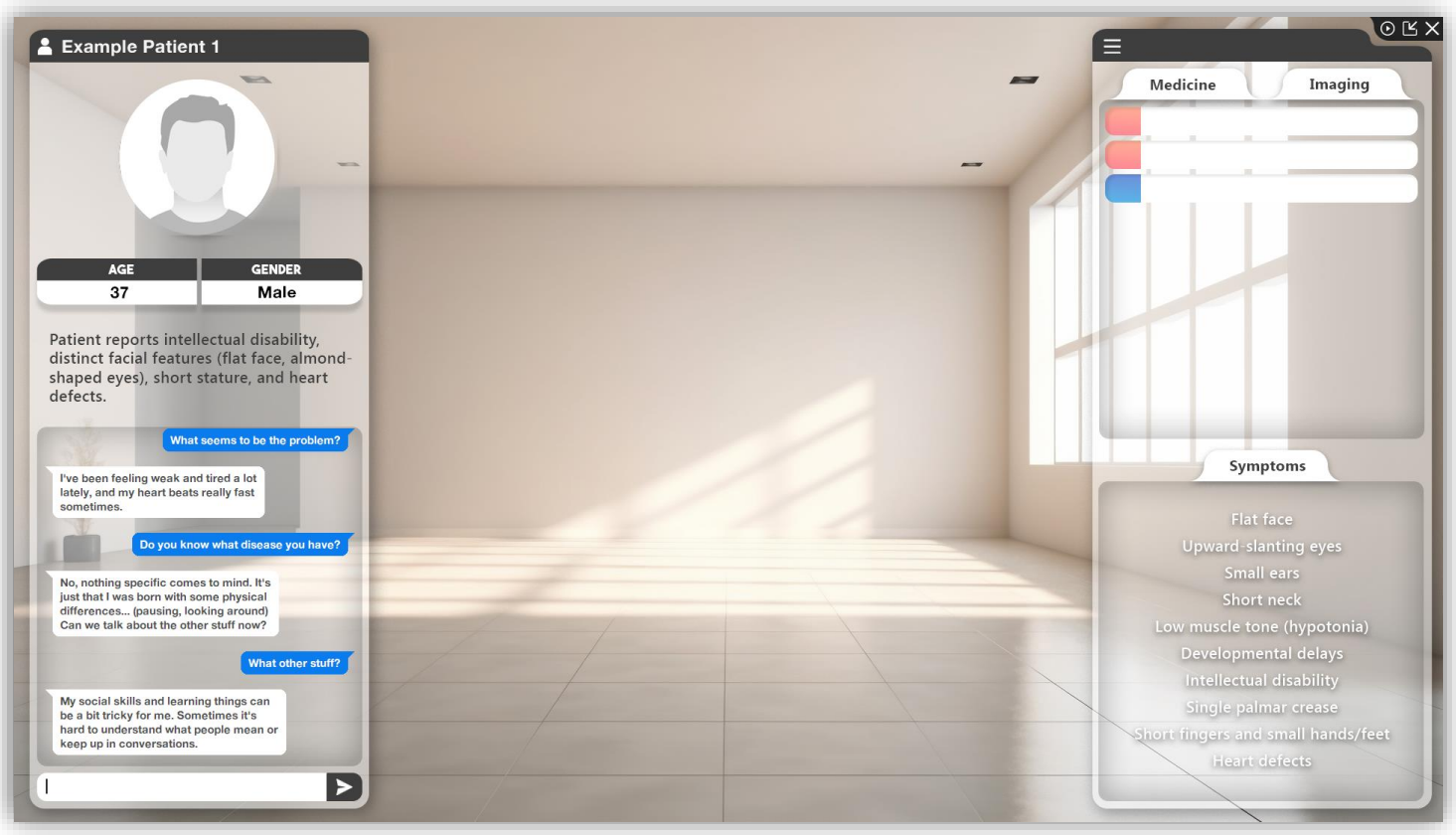
In India, software can be patented if it is part of an invention that is new, useful, non-obvious, and has a technical improvement.

4

Copyright & Trademark

Copyrights protect the creative elements of the software itself while trademarks protect the brand identifiers, like the institution behind it.

PROGRESS SO FAR



- We have implemented the **Chatbot** that is able to interact with the user.
- The model runs on **LLAMA 3.2** which would be fed the patient's history based on selected case.
- We have also made considerable progress in the UI and are working on it's final design.
- Interface is partially coded with some interactive elements.

PROPOSED TIMELINE

Jan 3rd week

Research about existing methods, literature survey and data collection.

First Review

Feb 1st week

Feb 3rd week

Interface deployment, ethics research and documentation

Tentative 2nd Review

March 1st week

March 4th week

Completion of the application front-end and back-end.

Final testing, integration, and documentation completion.

April 1st week

April 2nd week

Tentative final review

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Thank You