

# Project Documentation

## Introduction

**Project title:** Health AI: Intelligent Healthcare Assistant

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## 1. Project overview

**Cura Synth Assistant** is an AI-powered medical assistant designed to offer informative, non-diagnostic support in various healthcare-related areas. It utilizes IBM Granite's granite-3.2-2b-instruct large language model to perform:

- Patient Q&A (chat-based interaction)
- Disease prediction based on symptoms
- Personalized treatment plan generation
- Health metrics analytics

## 2. Architecture

Components:

- **Frontend:** Gradio web UI with tab-based interaction
- **Backend:** PyTorch-based LLM (Granite 3.2B Instruct) via transformers
- **Model:** ibm-granite/granite-3.2-2b-instruct from HuggingFace
- **Frameworks/Libraries:**
  - gradio
  - transformers
  - torch

Functional Modules:

- `generate_response(prompt)`: Core function generating LLM output
- `disease_prediction(symptoms)`: Returns conditions based on symptom list
- `treatment_plan(condition, age, gender, history)`: Returns a mock treatment plan
- `health_dashboard(...)`: Analyzes metrics (BP, glucose, HR, temp)
- `ai_chat(query)`: General Q&A function

### 3. Setup Instructions

Prerequisites:

- Python 3.8+
- GPU (optional but recommended for faster inference)
- Virtual environment (optional)

Installation Steps:

```
# Clone the repository
git clone https://github.com/your-username/cura-synth-assistant.git
cd cura-synth-assistant
```

# Create and activate virtual environment (optional)

```
python -m venv venv
source venv/bin/activate # or venv\Scripts\activate on Windows
```

**Run the Application:**

```
python app.py
```

Gradio will provide a local and/or public link (via `share=True`) to access the app in your browser.

### 4. Folder Structure

```
cura-synth-assistant/
├── app.py           # Main application file
├── requirements.txt # Python dependencies
├── README.md        # Project description
└── assets/          # (Optional) Images, icons, resources
```

### 5. Running the Application

Once you run `app.py`, the Gradio interface launches with 4 tabs:

1. **Patient Chat** — General Q&A
2. **Disease Prediction** — Input symptoms, get possible diagnoses
3. **Treatment Plans** — Input patient details, get suggested plans
4. **Health Analytics** — Analyze vitals and get recommendations

Each tab has clearly labeled input fields and buttons for user interaction.

### 6. API Documentation

Currently, the application is not exposed via an API (only UI). However, you can wrap each function into an API using FastAPI or Flask.

## 7. Authentication (Optional for Deployment)

For now, this app is unauthenticated and publicly shareable using Gradio's `share=True`.

To add authentication:

- Add a login screen using `gradio.Auth`
- Use basic auth or OAuth with deployment frameworks (e.g., FastAPI + Firebase Auth)

## 8. User Interface

- Built using **Gradio Blocks**
- Clean UI with Markdown headers, tabbed navigation, and labeled inputs
- Easy usability for non-technical users

Tab	Purpose
Patient Chat	Ask any medical-related question
Disease Prediction	Enter symptoms to get a mock diagnosis
Treatment Plans	Input age, condition, and history for a care plan
Health Analytics	Analyze vitals like HR, BP, and glucose

## 9. Testing

**Manual Testing:**

Feature	Input Example	Expected Output
Disease Prediction	fever, cough, headache	List of conditions like flu or COVID
Treatment Plan	diabetes, 45, Male	Plan with medication & lifestyle changes
Health Dashboard	HR: 90, BP: 140/90	Suggest reducing salt intake
AI Chat	What are symptoms of malaria?	Symptom list and doctor recommendation

## 10. Future Improvements

- Add **user session history**
- Integrate **medical knowledge bases**
- Add **voice input/output**
- Improve **UI responsiveness** on mobile
- Add **multilingual support**

## Project Details

# Cura Synth – AI Health Assistant

An AI-powered healthcare helper using Gradio and IBM Granite.  
For informational purposes only – not a real medical tool.

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## Features

- ☐ **Health Chat** – Ask general health questions
- ☐ **Disease Prediction** – Get possible conditions from symptoms
- ☐ **Treatment Plan** – Basic treatment suggestions based on inputs
- ☐ **Health Analytics** – Analyze vital signs and get advice

## To Run

1. **Install Python** (3.8 or higher)
2. **Install dependencies:**

```
pip install gradio torch transformers
```

3. **Run the app:**

```
python app.py
```

## How It Works

- Uses the **IBM Granite 3.2B Instruct** model from Hugging Face.
- Sends your input (symptoms, condition, etc.) as a **prompt** to the AI.
- The AI generates a **text response** with suggestions or insights.

## Tabs in the App

Tab	What You Do	What You Get
Patient Chat	Ask any health question	AI gives an informative answer
Disease Prediction	Enter symptoms	AI suggests possible conditions
Treatment Plans	Enter age, gender, condition	AI gives treatment suggestions
Health Analytics	Input vitals (HR, BP, etc.)	AI provides health insights

## ✓ Example Use

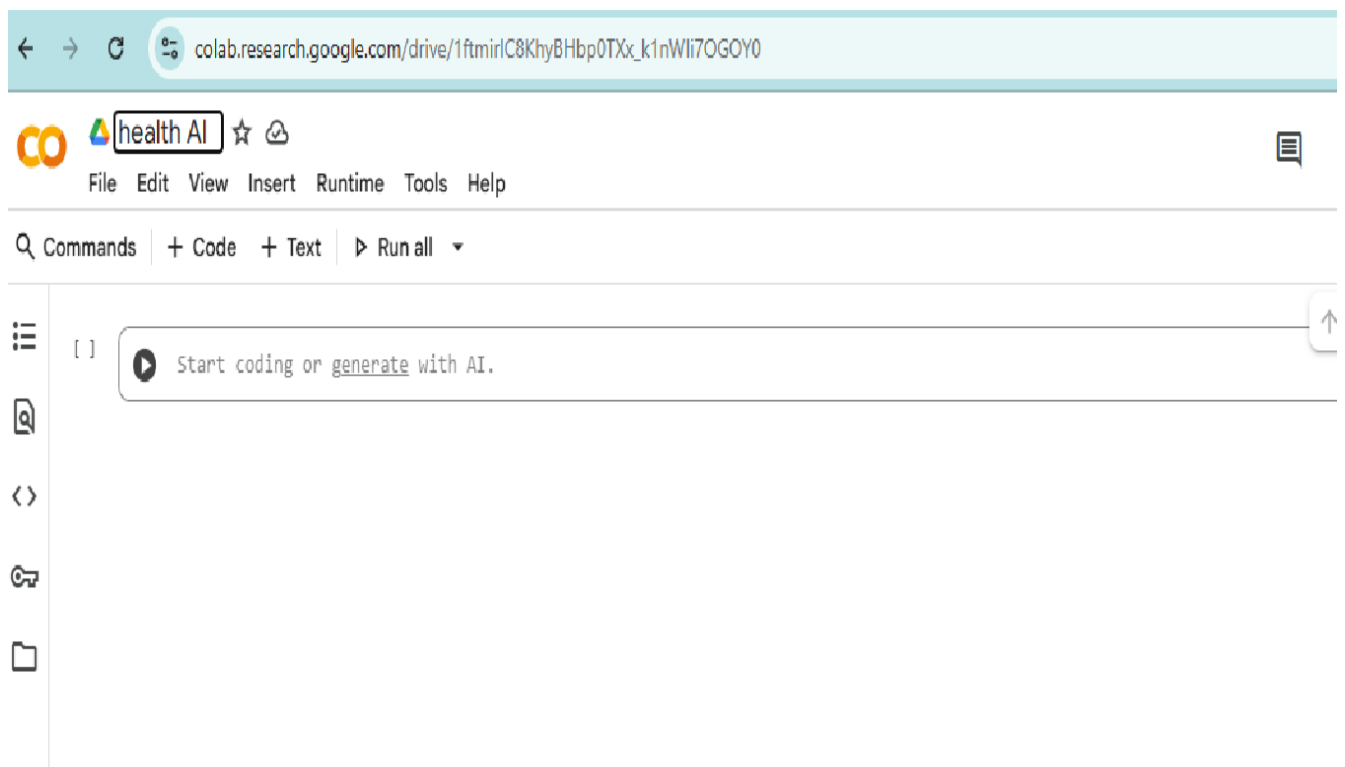
- "What are the symptoms of flu?"
- "I have fever and cough. What could it be?"
- "Treatment plan for diabetes, male, 45 years old"

## Tabs in the App

Tab	What You Do	What You Get
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## Visual Examples

### Home Page



Patient Chat Tab

Cura Synth Assistant

Disclaimer: This tool is for informational purposes only. Do not input personal identifiers. Always consult a medical professional.

Patient Chat

Disease Prediction

Treatment Plans

Health Analytics

Ask a Health-Related Question

Ask anything about your health... (e.g., 'What are the symptoms of diabetes?')

Ask

AI Response

Disease Prediction Tab

Cura Synth Assistant

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Patient Chat

Disease Prediction

Treatment Plans

Health Analytics

Enter Symptoms

e.g., fever, headache, cough, fatigue...

Analyze Symptoms

Possible Conditions & Recommendations

# Treatment Plans

Patient Chat   Disease Prediction   **Treatment Plans**   Health Analytics

Medical Condition

Hypertension

Age

20

Gender

Female

Medical History

headache

Personalized Treatment Plan

**\*\*1. Medication:\*\***

- Initial therapy: Start with a thiazide-type diuretic (e.g., hydrochlorothiazide 12.5mg once daily) to help control blood pressure.

- Consider adding an angiotensin-converting enzyme (ACE) inhibitor or angiotensin receptor blocker (ARB) if blood pressure remains above goal or there's evidence of target organ damage (e.g., left ventricular hypertrophy, diabetic nephropathy). Examples include lisinopril 20mg once daily or losartan 50mg once daily.

- If the patient has a history of headaches, monitor for any potential side effects related to blood pressure medications (e.g., flushing, dizziness) and adjust accordingly.

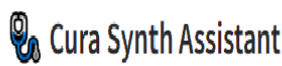
**\*\*2. Lifestyle Changes:\*\***

- **\*\*Diet:\*\*** Adopt a DASH (Dietary Approaches to Stop Hypertension) eating plan, which emphasizes fruits, vegetables, lean proteins, and low-fat dairy. Limit sodium intake to less than 2,300 mg daily.

- **\*\*Physical Activity:\*\*** Engage in at least 150 minutes per week of moderate-intensity aerobic activity (e.g., brisk walking, cycling) and include strength training exercises on 2 or more days a week.

- **\*\*Weight Management:\*\*** If overweight or obese (BMI > 25), aim for a weight loss of 4-7%.

# Health Analytics



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Patient Chat   Disease Prediction   Treatment Plans   **Health Analytics**

Heart Rate (bpm)

72

Blood Pressure (mmHg)

120/80

Glucose Levels (mg/dL)

90

Temperature (°F)

Health Insights

1. Heart Rate: 72 bpm - This value indicates a normal resting heart rate. It suggests the cardiovascular system is functioning efficiently, and the person may have good overall fitness.

2. Blood Pressure: 120/80 mmHg - The blood pressure reading falls within the desirable range. It indicates that the circulatory system is effectively delivering oxygenated blood to body tissues while maintaining optimal tension.

3. Glucose Levels: 90 mg/dL - This low glucose level is generally considered safe and indicates no immediate risk of hypoglycemia (low blood sugar). However, if this value persists, it might suggest a dietary issue or underlying health condition, such as diabetes or an overactive thyroid. It is crucial to monitor and address any patterns in glucose levels over time.

## Future Enhancements

Enhancement	Description
<b>Model fine-tuning</b>	Fine-tune the model on medical Q&A datasets (e.g., MedQuAD, PubMedQA) for higher accuracy
<b>API integration</b>	Integrate with real-time medical databases or APIs like WebMD, DrugBank, or Mayo Clinic
<b>User authentication</b>	Add login and session management for personalized data and security
<b>Save/download reports</b>	Allow users to download health reports as PDFs
<b>Voice interaction</b>	Add support for speech-to-text and text-to-speech
<b>Multilingual support</b>	Enable interaction in multiple languages for non-English speakers
<b>Mobile app</b>	Convert to a Flutter or React Native app for wider accessibility
<b>Unit testing</b>	Add test coverage for functions to improve reliability
<b>Database storage</b>	Save symptom history and user inputs for future analysis (with privacy compliance)

## Conclusion

The **Cura Synth Assistant** demonstrates the potential of AI in augmenting healthcare support through intelligent conversation, disease insights, treatment suggestions, and health data analysis. By leveraging large language models like **IBM Granite 3.2B**, this project provides users with an accessible, informative, and responsive interface for basic medical guidance.