

HealthAI: Intelligent Healthcare Assistant Using IBM Granite

1.Introduction:

- **Project title** : HealthAI
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2. Project Overview:

Purpose:

The purpose of HealthAI is to democratize healthcare access by providing instant, AI-driven medical insights to patients anywhere, anytime. With IBM Granite LLM powering its backend, the system is capable of understanding medical prompts and generating contextual responses.

HealthAI focuses on two critical functions as implemented in the current version of the code:

1. Disease Prediction – Based on symptoms, it identifies possible conditions and provides general medication suggestions.

2. Treatment Plan Generator – Provides personalized treatment advice tailored to the patient's demographics and history.

Goals of the Project:

- Assist patients in understanding their symptoms before consulting a doctor.
- Support healthcare providers with AI-generated treatment ideas.
- Reduce dependency on long hospital visits for basic medical guidance.
- Enhance patient awareness of home remedies and preventive care.

Features:

1. Conversational Interface

- Function: Natural health Q&A using plain language.
- Example: Patient asks, “What could be the cause of persistent cough?” and receives a possible list of conditions.

2. Disease Prediction

- Function: Symptom analysis leading to possible medical conditions.
- Example: User enters “fever, cough, fatigue”, and AI suggests possible flu or viral infection with cautionary notes.

3. Treatment Plan Generator

- Function: Creates personalized treatment suggestions based on patient details.
- Example: Input: Diabetes, Age 50, Male, History of hypertension.

- Output: Lifestyle suggestions, dietary guidelines, and standard treatment options.

3. Architecture

The architecture of HealthAI is structured around simplicity, scalability, and modularity.

Frontend (Gradio):

- Provides an interactive UI with two tabs:
 - *Disease Prediction Tab* – accepts symptom input and generates predictions.
 - *Treatment Plan Tab* – accepts condition, age, gender, and history to create a treatment plan.
- Output displayed in clear, multi-line text boxes.
- Easy integration with additional features (feedback, reports, KPI monitoring).

Backend (Python):

- Written in Python with Hugging Face Transformers and PyTorch.
- Includes modular functions for disease prediction and treatment plan generation.

4. Setup Instructions

Prerequisites:

- Python 3.9+
- pip package manager
- Internet access (required to download IBM Granite model)
- GPU (optional, for faster response generation)

Installation Process:

1. Install dependencies:

“pip install transformers accelerate gradio torch”

2. Clone repository and open app.py.

3. Run application:

python app.py

4. Access via Gradio local server:

- Local URL: `http://127.0.0.1:7860`
- Public URL (Colab): Shared link generated by `app.launch(share=True)`

5. Folder Structure:

1. health_ai.py

- The main script of the project.
- Contains model initialization, disease prediction function, treatment plan function, and Gradio UI in one file.

2. requirements.txt

- Lists dependencies: torch, transformers, accelerate, and gradio.
- Ensures consistent environment setup.

3. README.md

- Provides an overview of the project.
- Explains installation steps, how to run the app, and usage guidelines.

6. Running the Application

Steps:

1. Start the script in Google Colab or local environment.
2. Load IBM Granite model automatically.
3. Select Disease Prediction Tab → Enter symptoms → Get conditions.
4. Select Treatment Plans Tab → Enter details → Get treatment suggestions.

Example Use Case:

- Input: Symptoms → “headache, nausea, blurred vision”
- Output: Possible conditions include migraine, dehydration, or high blood pressure. Please consult a doctor.

7. API Documentation

- POST /predict-disease – Accepts user-input symptoms in JSON format and returns a list of possible conditions along with recommendations.
- POST /treatment-plan – Accepts patient details such as condition, age, gender, and medical history, and responds with a personalized treatment plan.
- POST /upload-history – Allows uploading past health records to enhance the accuracy of recommendations.

8. Authentication

The current system is open for demo use. For real-world deployment:

- JWT Authentication for user access.
- Role-Based Access Control (RBAC):
 - Patient – symptom entry, treatment viewing.
 - Doctor – view reports, override AI output.
 - Admin – manage application and records.

9. User Interface

- Tabbed Navigation: Disease Prediction & Treatment Plan.
- Textbox Inputs: For symptoms, condition, and medical history.
- Multi-line Outputs: For clear AI responses.
- Accessibility: Designed for ease of use by non-technical patients.

10. Testing

Phases of Testing:

1. Unit Testing:

- Checked response formatting, prompt handling.

2. Manual Testing:

- Symptom entry tested with real-world conditions.

3. API Testing (Future):

- Swagger/Postman for endpoint validation.

4. Edge Case Handling:

- Empty input → AI returns “Please enter valid symptoms.”
- Long inputs → Handled with tokenizer truncation.

11. Output

Coding

```
[1] ✓ tm
import gradio as gr
import torch
from transformers import AutoTokenizer, AutoModelForCausalLM

# Load model and tokenizer
model_name = "ibm-granite/granite-3.2-2b-instruct"
tokenizer = AutoTokenizer.from_pretrained(model_name)
model = AutoModelForCausalLM.from_pretrained(
    model_name,
    torch_dtype=torch.float16 if torch.cuda.is_available() else torch.float32,
    device_map="auto" if torch.cuda.is_available() else None
)

if tokenizer.pad_token is None:
    tokenizer.pad_token = tokenizer.eos_token

def generate_response(prompt, max_length=1024):
    inputs = tokenizer(prompt, return_tensors="pt", truncation=True, max_length=512)

    if torch.cuda.is_available():
        inputs = {k: v.to(model.device) for k, v in inputs.items()}

    with torch.no_grad():
        outputs = model.generate(
            **inputs,
            max_length=max_length,
            temperature=0.7,
            do_sample=True,
            pad_token_id=tokenizer.eos_token_id
        )

    response = tokenizer.decode(outputs[0], skip_special_tokens=True)
    response = response.replace(prompt, "").strip()
    return response

def disease_prediction(symptoms):
    prompt = f"Based on the following symptoms, provide possible medical conditions and general medication suggestions. Always emphasize the importance of consulting a doctor for"
    return generate_response(prompt, max_length=1200)

def treatment_plan(condition, age, gender, medical_history):
    prompt = f"Generate personalized treatment suggestions for the following patient information. Include home remedies and general medication guidelines.\n\nMedical Condition: {condition}\nAge: {age}\nGender: {gender}\nMedical History: {medical_history}"
    return generate_response(prompt, max_length=1200)

# Create Gradio interface
with gr.Blocks() as app:
    gr.Markdown("# Medical AI Assistant")
    gr.Markdown("**Disclaimer: This is for informational purposes only. Always consult healthcare professionals for medical advice.**")

    with gr.Tabs():
        with gr.TabItem("Disease Prediction"):
            with gr.Row():
                with gr.Column():
                    symptoms_input = gr.Textbox(
                        label="Enter Symptoms",
                        placeholder="e.g., fever, headache, cough, fatigue..."
                    )
                    predict_btn = gr.Button("Analyze Symptoms")

                with gr.Column():
                    prediction_output = gr.Textbox(label="Possible Conditions & Recommendations", lines=20)

            predict_btn.click(disease_prediction, inputs=symptoms_input, outputs=prediction_output)

        with gr.TabItem("Treatment Plans"):
            with gr.Row():
                with gr.Column():
                    condition_input = gr.Textbox(
                        label="Medical Condition",
                        placeholder="e.g., diabetes, hypertension, migraine..."
                    )
                    age_input = gr.Number(label="Age", value=30)
                    gender_input = gr.Dropdown(
                        choices=["Male", "Female", "Other"],
                        label="Gender",
                        value="Male"
                    )
                    history_input = gr.Textbox(
                        label="Medical History",
                        placeholder="Previous conditions, allergies, medications or None"
                    )
                    plan_btn = gr.Button("Generate Treatment Plan")

                with gr.Column():
                    treatment_output = gr.Textbox(
                        label="Personalized Treatment Plan",
                        placeholder="Suggested treatments, home remedies, and medication guidelines"
                    )

            condition_input, age_input, gender_input, history_input, plan_btn \
                .click(treatment_plan, outputs=treatment_output)
```

```
[1] ✓ 1m
placeholder="e.g., diabetes, hypertension, migraine...",
lines=2
)
age_input = gr.Number(label="Age", value=30)
gender_input = gr.Dropdown(
    choices=["Male", "Female", "Other"],
    label="Gender",
    value="Male"
)
history_input = gr.Textbox(
    label="Medical History",
    placeholder="Previous conditions, allergies, medications or None",
    lines=3
)
plan_btn = gr.Button("Generate Treatment Plan")

with gr.Column():
    plan_output = gr.Textbox(label="Personalized Treatment Plan", lines=20)

plan_btn.click(treatment_plan, inputs=[condition_input, age_input, gender_input, history_input], outputs=plan_output)

app.launch(share=True)
```

/usr/local/lib/python3.12/dist-packages/huggingface_hub/utils/_auth.py:94: UserWarning:
The secret 'HF_TOKEN' does not exist in your Colab secrets.
To authenticate with the Hugging Face Hub, create a token in your settings tab (<https://huggingface.co/settings/tokens>), set it as secret in your Google Colab and restart your ses
You will be able to reuse this secret in all of your notebooks.
Please note that authentication is recommended but still optional to access public models or datasets.
warnings.warn(
"token `hf_` is deprecated! Use `token` instead!"

Commands + Code + Text ▶ Run all

Fetching 2 files: 100% 2/2 [04:04<00:00, 244.84s/it]

model-00001-of-00002.safetensors: 100% 5.00G/5.00G [04:03<00:00, 24.4MB/s]

model-00002-of-00002.safetensors: 100% 67.1M/67.1M [00:01<00:00, 45.1MB/s]

Loading checkpoint shards: 100% 2/2 [00:32<00:00, 13.45s/it]

generation_config.json: 100% 137/137 [00:00<00:00, 13.0kB/s]

Colab notebook detected. To show errors in colab notebook, set debug=True in launch()
* Running on public URL: <https://9c5d388d6874d0e8ca.gradio.live>

This share link expires in 1 week. For free permanent hosting and GPU upgrades, run `gradio deploy` from the terminal in the working directory to deploy to Hugging Face Spaces ()

Medical AI Assistant

Disclaimer: This is for informational purposes only. Always consult healthcare professionals for medical advice.

Disease Prediction Treatment Plans

Enter Symptoms

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

Possible Conditions & Recommendations

Disease prediction

Medical AI Assistant

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Disease Prediction Treatment Plans

Enter Symptoms

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

Analyze Symptoms

Possible Conditions & Recommendations

Use via API Built with Gradio Settings

Medical AI Assistant

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Disease Prediction Treatment Plans

Enter Symptoms

fever

Analyze Symptoms

Possible Conditions & Recommendations

1. **"Viral or bacterial infection (e.g., common cold, flu, COVID-19)"**: Fever is a common symptom during the incubation period and early stages of these infections. Acetaminophen (Tylenol) or ibuprofen (Advil, Motrin) can be used to manage fever and potentially reduce symptoms. Always follow the recommended dosage for your age and weight. If you suspect COVID-19, isolate yourself and consult a healthcare provider for testing and guidance.

2. **"Fever of unknown origin (FUO)"**: This refers to persistent fever lasting more than three weeks without a clear cause. Consult a specialist like an infectious disease doctor or a hematologist-oncologist for further evaluation. They may suggest blood tests, imaging studies, or other diagnostic procedures.

3. **"Medication-induced fever"**: Some drugs can cause fever as a side effect. If a new medication has been started, consult your pharmacist or healthcare provider to see if adjusting the medication or dosage could alleviate the fever.

4. **"Underlying medical conditions"**: Persistent or high-grade fever could be a sign of certain underlying medical conditions, such as cancer, immune disorders, or infectious diseases (e.g., tuberculosis, HIV). If you have risk factors or other concerning symptoms, please consult a doctor immediately.

5. **"Post-vaccination fever"**: A temporary fever after vaccination is common and usually resolves within a day or two. If it persists beyond this timeframe or is accompanied by other symptoms, consult your healthcare provider.

Use via API Built with Gradio Settings

Treatment plan

Medical AI Assistant

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Disease Prediction

Treatment Plans

Medical Condition

e.g., diabetes, hypertension, migraine...

Age

30

Gender

Male

Medical History

Previous conditions, allergies, medications or None

Generate Treatment Plan

Personalized Treatment Plan

Use via API • Built with Gradio • Settings

Medical AI Assistant

Disclaimer: This is for informational purposes only. Always consult healthcare professionals for medical advice.

Disease Prediction

Treatment Plans

Medical Condition

hypertension

Age

30

Gender

Male

Medical History

none

Generate Treatment Plan

Personalized Treatment Plan

1. Lifestyle Modifications:

- **Dietary Changes:** Adopt a low-sodium, DASH (Dietary Approaches to Stop Hypertension) eating plan, rich in fruits, vegetables, lean proteins, and whole grains. Limit sodium intake to less than 2,300 mg per day (ideally 1,500 mg for optimal blood pressure control).

- **Portion Control:** Practice mindful eating and maintain balanced meals to avoid overeating.

- **Weight Management:** If overweight or obese (BMI ≥ 25), aim for a healthy weight loss of 1-2 lbs per week through a combination of calorie-controlled diet and regular exercise.

- **Physical Activity:** Engage in at least 150 minutes of moderate-intensity or 75 minutes of high-intensity aerobic activity per week, along with strength training exercises on 2 or more days a week.

2. Home Remedies:

- **Hydration:** Drink at least 8-10 cups (64-80 ounces) of water daily to promote overall health and support kidney function, which is essential for proper blood pressure regulation.

- **Herbal Teas:** Consume warm water with lemon, ginger, or chamomile to help relax the body and potentially lower blood pressure. Some research suggests that these teas may have mild effects, but they should not replace clinical treatments.

- **Relaxation Techniques:** Incorporate daily stress-reducing practices like deep breathing exercises, progressive muscle relaxation, or meditation to minimize the impact of stress on blood pressure.

3. Medication Guidelines:

- **Initial Therapy:** As a 30-year-old male with no other medical history, start with a low-dose thiazide diuretic or an ACE inhibitor, as recommended by your healthcare provider.

Use via API • Built with Gradio • Settings

12. Known Issues

- Requires stable internet for IBM Granite model.
- Outputs are probabilistic and may vary.
- Does not replace real medical consultation.
- Limited to two major features (prediction & treatment) in current version.

13. Future Enhancements

The current version of HealthAI focuses on symptom-based disease prediction and personalized treatment suggestions. Future improvements based on the existing code framework may include:

- **Medical Report Summarization** – Allow users to upload PDFs or text-based medical reports, which the model can summarize into simple insights.
- **Extended Treatment Plans** – Incorporate additional patient details (diet, lifestyle habits) to generate more comprehensive treatment guidance.
- **Feedback Collection** – Add a feedback tab where patients can share responses, enabling continuous refinement of AI suggestions.
- **Health Data Forecasting** – Introduce forecasting for patient health metrics (e.g., recurring symptoms, predicted recovery timeline).
- **Multilingual Responses** – Enable the model to respond in multiple languages to increase accessibility for non-English-speaking users.