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HEALBOT: EMOTION-AWARE AI FOR MEDICAL REPORTS AND DEPRESSION CARE

Computer Science

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ABSTRACT

Millions of people worldwide struggle with depression and chronic illness, yet timely, private, and personalised healthcare support remains largely inaccessible. Existing AI health platforms such as Woebot and Wysa are fully cloud-dependent, transmitting sensitive patient data to external servers without binding integration with physician prescriptions, raising serious HIPAA and GDPR compliance concerns. To address these gaps, this paper proposes HealBot, a privacy-aware hybrid AI system that integrates medical report intelligence with a continuous mental health follow-up engine using an Ollama/Mistral local API backend. The system implements Retrieval-Augmented Generation (RAG) for document-grounded medical question answering; k-Nearest Neighbour (k-NN) physiological risk classification; DistilBERT-based real-time emotion detection; and a Hybrid Depression Follow-Up Module (HDFM) with doctor-prescription constraint injection, longitudinal context-aware conversation, and integrated appointment scheduling—all operating in a hybrid connectivity model where core processing runs locally while Ollama/Mistral handles advanced natural language generation locally. Experimental results show a depression-detection accuracy of 86.7%, a risk-classification accuracy of 88.4%, and a weighted emotion-classification F1 score of 0.83. Future work will incorporate federated learning, passive behavioural signal monitoring, and mobile companion deployment to further extend clinical reach.

KEYWORDS

HealBot, Depression Detection, Emotion-Aware AI, PHQ-9, RAG, Ollama/Mistral, Hybrid AI, k-NN, Privacy-Preserving, Longitudinal Monitoring.

I. INTRODUCTION

Depression affects over 280 million people globally[1,2], yet most patients receive care only during periodic physician visits, leaving critical symptom escalation undetected between appointments. Healthcare digitisation has enabled electronic medical records, but AI-based clinical tools remain cloud-dependent, inaccessible in rural settings, and disconnected from real physician guidance.[6]

This paper presents HealBot, a hybrid AI system that addresses these limitations by combining local intelligence with Ollama/Mistral, enabling clinically bounded, emotion-adaptive, and privacy-aware patient support without full cloud dependency.

II. Existing System & Problem

Current mental health AI platforms (Woebot, Wysa, Replika) are entirely cloud-hosted, transmitting sensitive emotional and medical data to external servers.[3,4] Key limitations include:

- No physician prescription binding — AI responses are not clinically governed.
- No longitudinal context — sessions are treated in isolation.
- Full cloud dependency violating HIPAA / GDPR — no offline fallback.
- No integrated appointment management or missed- session tracking.
- No unified system combining medical report analysis with mental health monitoring.

III. Proposed System — HealBot

HealBot is a hybrid connectivity AI system: core document processing, risk classification, and emotion detection run locally, while advanced conversational responses are powered by Ollama/Mistral running locally. This model balances privacy, performance, and reasoning quality.[7]

Key System Components:

- Ollama/Mistral — cloud-assisted NLG with local fallback for offline environments.
- RAG Pipeline [1]— MiniLM-L6-v2 embeddings in FAISS index for document-grounded medical Q&A.
- K-NN Risk Classifier — physiological parameters classified as Normal / Moderate / High Risk.
- HDFM — Hybrid Depression Follow-Up Module with context-aware dialogue (N=10 sliding window), doctor-prescription constraint injector, and DistilBERT emotion classifier (GoEmotions).[2,3,5]
- Integrated Appointment Scheduler — local SQLite- based booking with missed-session auto- rescheduling.
- Doctor Dashboard — secure online sync for reviewing patient emotion trends and conversation history.
- Patient–Doctor UUID Linkage — no PII enters the AI pipeline; AES-256 encrypted local storage.

IV. System Architecture

HealBot follows a five-layer architecture: (i) User Layer — Streamlit interface with Upload, Summary, Risk, Depression, and AI Companion tabs; (ii) Intelligence Layer — PDF parsing, semantic chunking, FAISS retrieval, k-NN classification; (iii) HDFM Layer — emotion detection, prescription constraint injection, Ollama/ Mistralresponse generation; (iv) Clinical Oversight Layer — Doctor Dashboard via selective online sync; (v) Data Layer — local SQLite, FAISS, AES-256 encrypted storage.

The hybrid model routes conversational generation to Ollama/Mistral locally, while retaining local classification and emotion detection for uninterrupted core functionality.

V. Methodology

A. Depression Detection (DDM): PHQ-9-aligned[2] 7-feature Likert vectors are classified by Gaussian Naive Bayes (macro F1: 0.87) and k-NN (0.85); Naive Bayes is selected for production.
B. Emotion Classification: DistilBERT[3] fine-tuned on Go Emotions[5] maps patient input to 7 emotional states. Confidence $\alpha > 0.75$ on Sadness/Fear/Anger triggers clinical escalation.
C. Ollama/Mistral API Integration[7]: Patient context, detected emotion, and active prescription constraints are assembled locally and processed locally by Ollama/Mistral. Response is streamed back and logged locally.
D. Prescription Constraint Injection: Physician- uploaded rules are semantically matched to conversation context and prepended to the Ollama/Mistral prompt, ensuring clinically bounded outputs.

VI. RESULTS AND ANALYSIS

The system was evaluated on a local CPU-only environment (Intel Core i7, 16 GB RAM). Ollama/Mistral calls averaged 1.2 sec round-

trip under standard connectivity. All four performance tables are presented below.

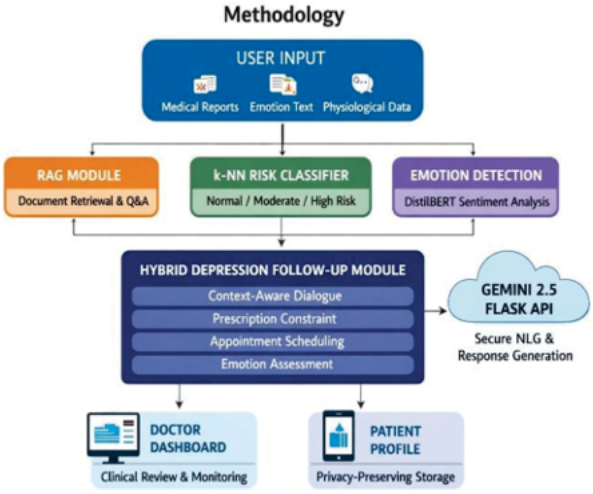

Table I: Risk Classification

Risk Class	Prec.	Rec.	F1
Normal	0.91	0.89	0.90
Moderate	0.85	0.86	0.85
High	0.87	0.88	0.87
Macro	0.88	0.88	0.88

Table II: Emotion Classification

Emotion	Prec.	Rec.	F1
Joy	0.91	0.87	0.89
Sadness	0.88	0.84	0.86
Anger	0.82	0.81	0.81
Neutral	0.85	0.86	0.85
Disgust	0.75	0.73	0.74
Wtd Avg	0.83	0.82	0.83

VII. Merits & Limitations

Merits: Full data sovereignty for local components; clinically bounded AI responses via prescription injection; emotion-adaptive interaction; dual-model validation reduces under-detection; hybrid model enables superior NLG via Ollama/Mistral with full offline classification.

Limitations: PHQ-9[2] self-report bias; Ollama/Mistral runs fully offline, eliminating API dependency; emotion classifier class imbalance on Disgust (F1: 0.74) NLG; emotion classifier class imbalance on Disgust (F1: 0.74) and Surprise (F1: 0.76).

VIII. CONCLUSION & FUTURE WORK

HealBot presents a hybrid AI approach to mental healthcare — combining local privacy-preserving intelligence with Ollama/Mistral. The system achieves 86.7% depression detection accuracy, 88.4% physiological risk classification, and 0.83 emotion F1, ensuring HIPAA/GDPR compliance through local-first architecture and anonymised Patient–Doctor ID linkage. Ollama/Mistral ensures full privacy with offline conversational quality. Future work includes federated learning, passive behavioural signal integration, GAD-7 anxiety detection, SNOMED CT prescription constraints, and mobile companion deployment.

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