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Clinical Support

Intelligent Health Assistant: A Smart Approach for Digital Healthcare in Bangladesh Using BioXNet

Md. Rakibul Islam (2021-3-60-030)

Sagor Ahmed (2021-3-60-117)

Syeda Tasmiah Chowdhury Orpa (2021-3-60-185)

Nushrat Zahan (2021-3-60-213)





- **Shortage of doctors compared to patients leading low quality care**
- **Medication errors due to negligence, wrong dosage, self-medication or mistakes in dispensing**
- **Quick & accurate treatment to avoid serious health risks**
- **Accurate medication requires doctor access patients history**
- **Patient data security and check drug interactions**





Introduction

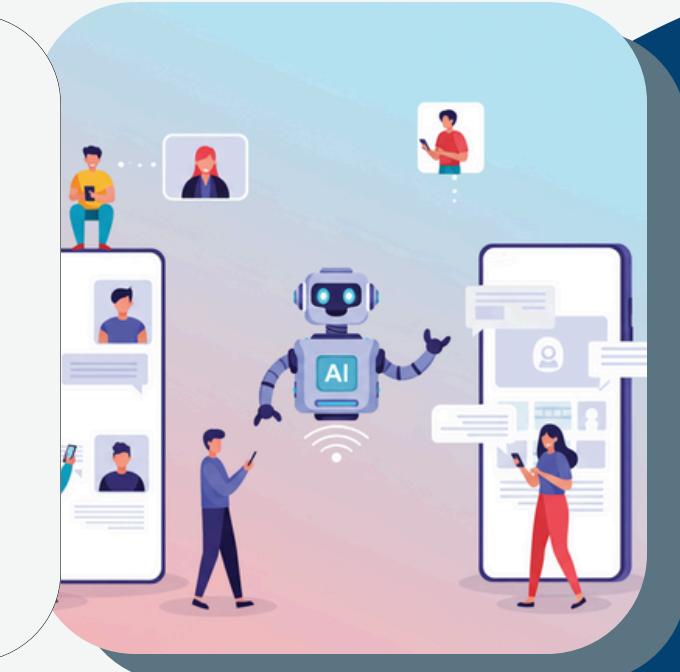
- **Smart Clinical Support to bridge the gap between doctor-patient**
- **FHIR standard ensure secure patient data sharing and EHR access**
- **Proposed BioXNet (Fine-tuned ClinicalBERT) and Hybrid CNN + Bi-LSTM for health suggestion understanding**
- **Digital platform with the facilities of doctor appointments, lab test, patient medical history**



Research Question

This research focuses on finding ways to accurately prevent medication errors in clinical practice. It explores whether checking drug-drug interactions is enough or if extra measures are needed for safer patient care

Can an AI chatbot improve doctor-patient medical support within the challenges of Bangladesh's healthcare system?



How can a doctor access a patient's previous health record?

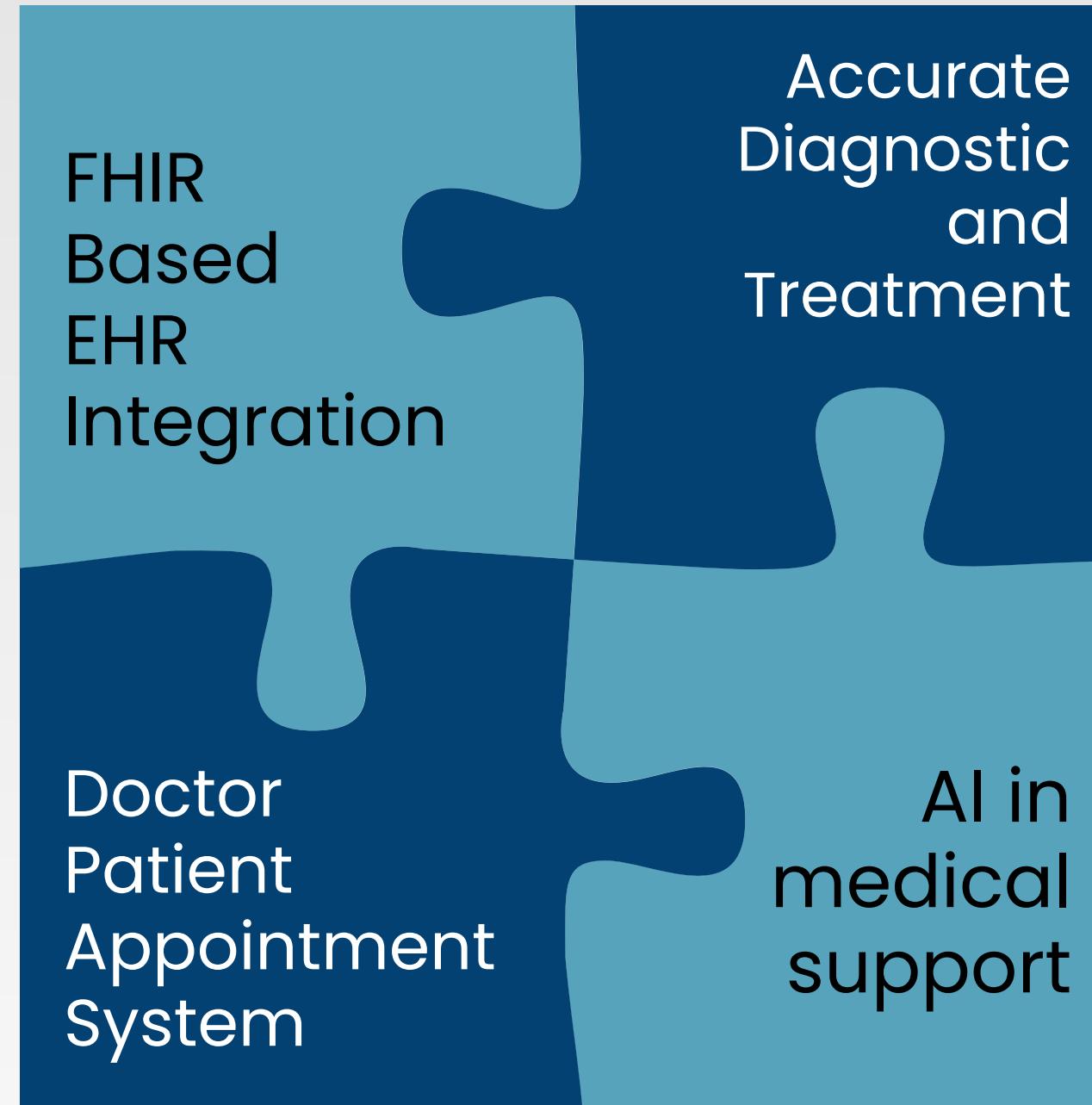




Related Work

F
FHIR
Based
EHR Integration

D
Doctor
Patient Appointment
System



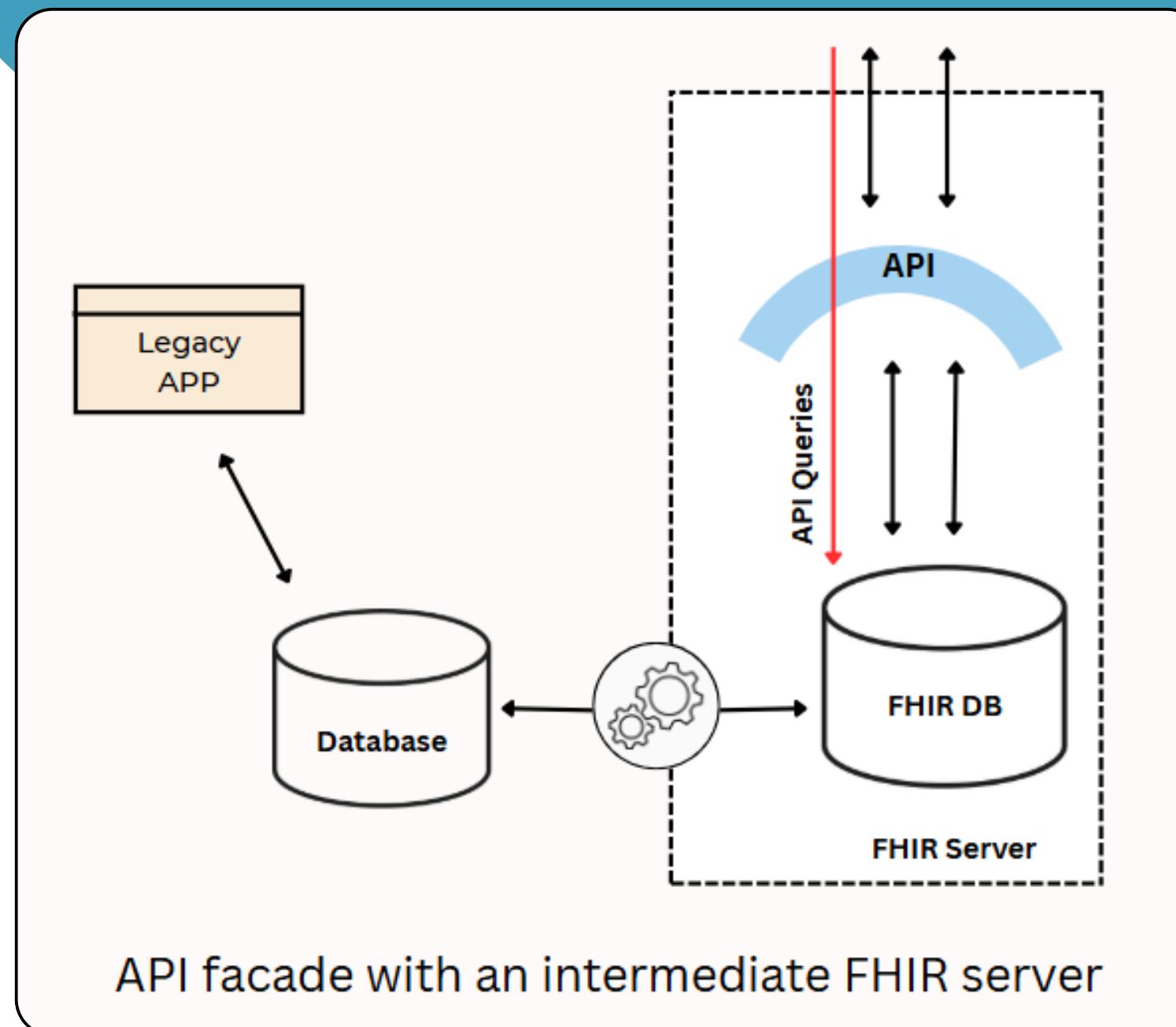
A
Accurate
Diagnostic and
Treatment

AI
AI in medical
support



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FHIR



FHIR

Fast Healthcare Interoperability Resources (FHIR) is a standard for sharing healthcare data between systems. FHIR is used to exchange electronic health records (EHRs) between providers and organizations.



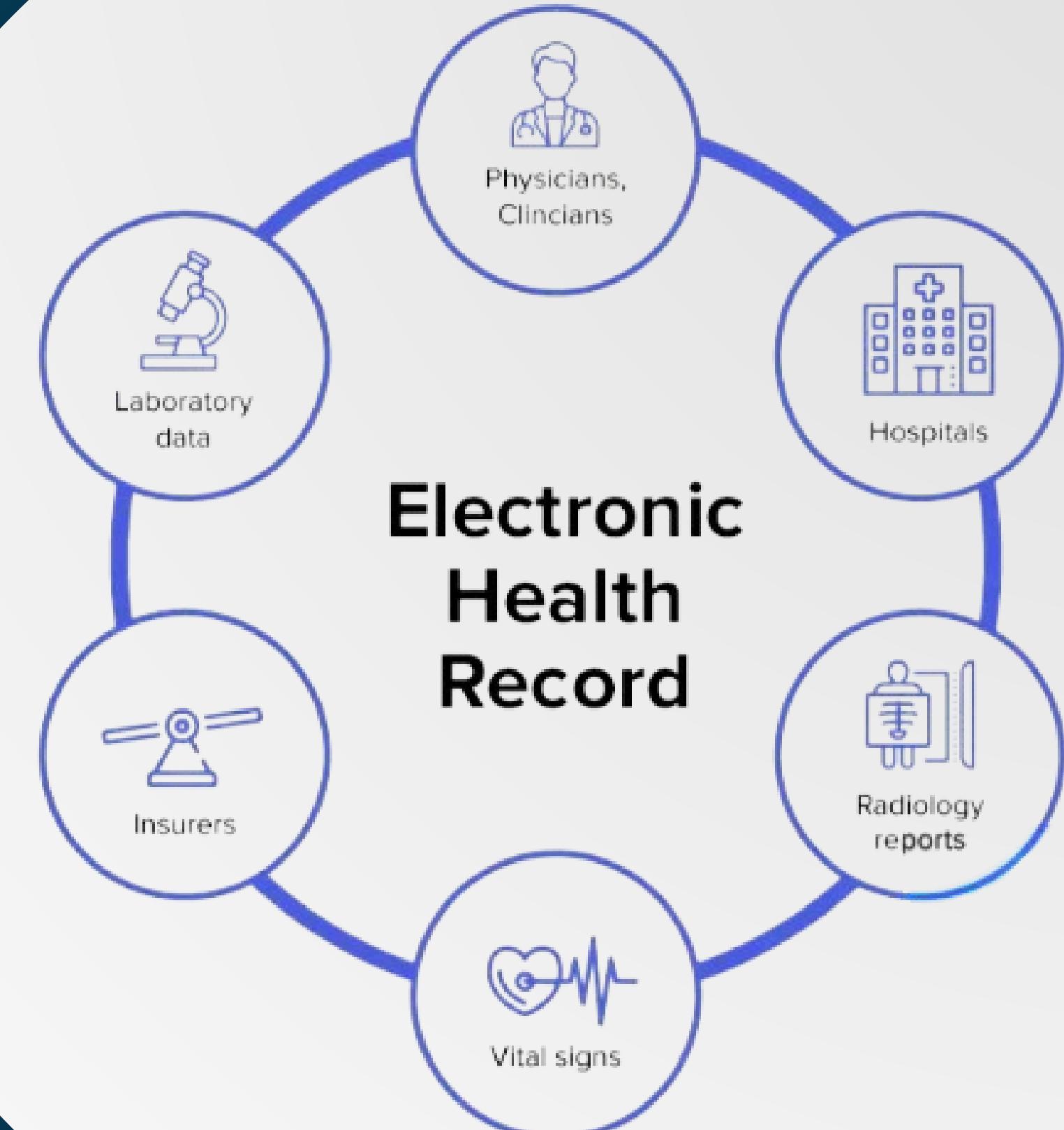
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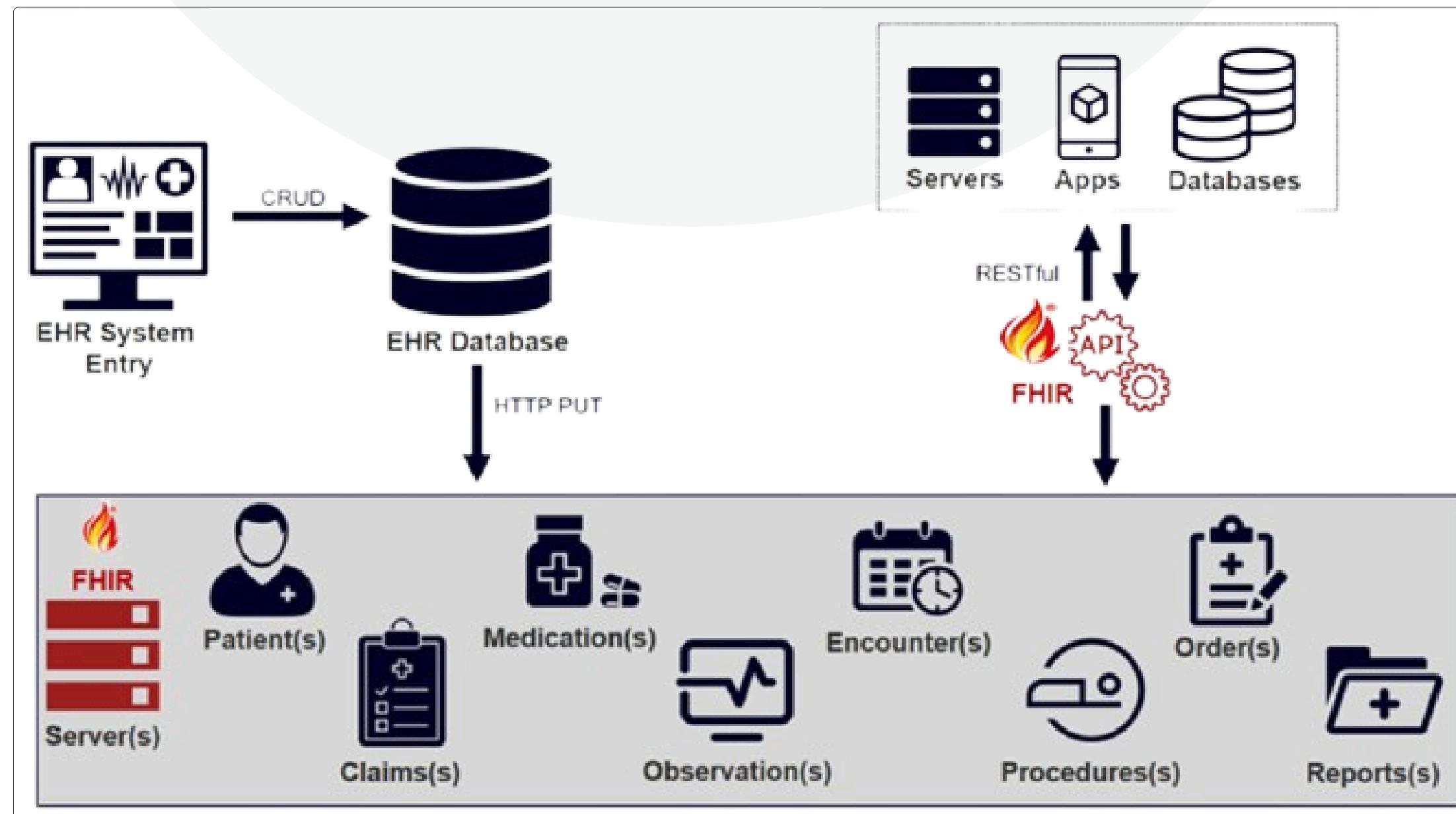
EHR

Electronic Health Record

A digital version of a patient's medical history that securely stores health information, including diagnoses, medications, lab results, and treatment plans, allowing doctors to provide accurate and timely care.

Electronic Health Record





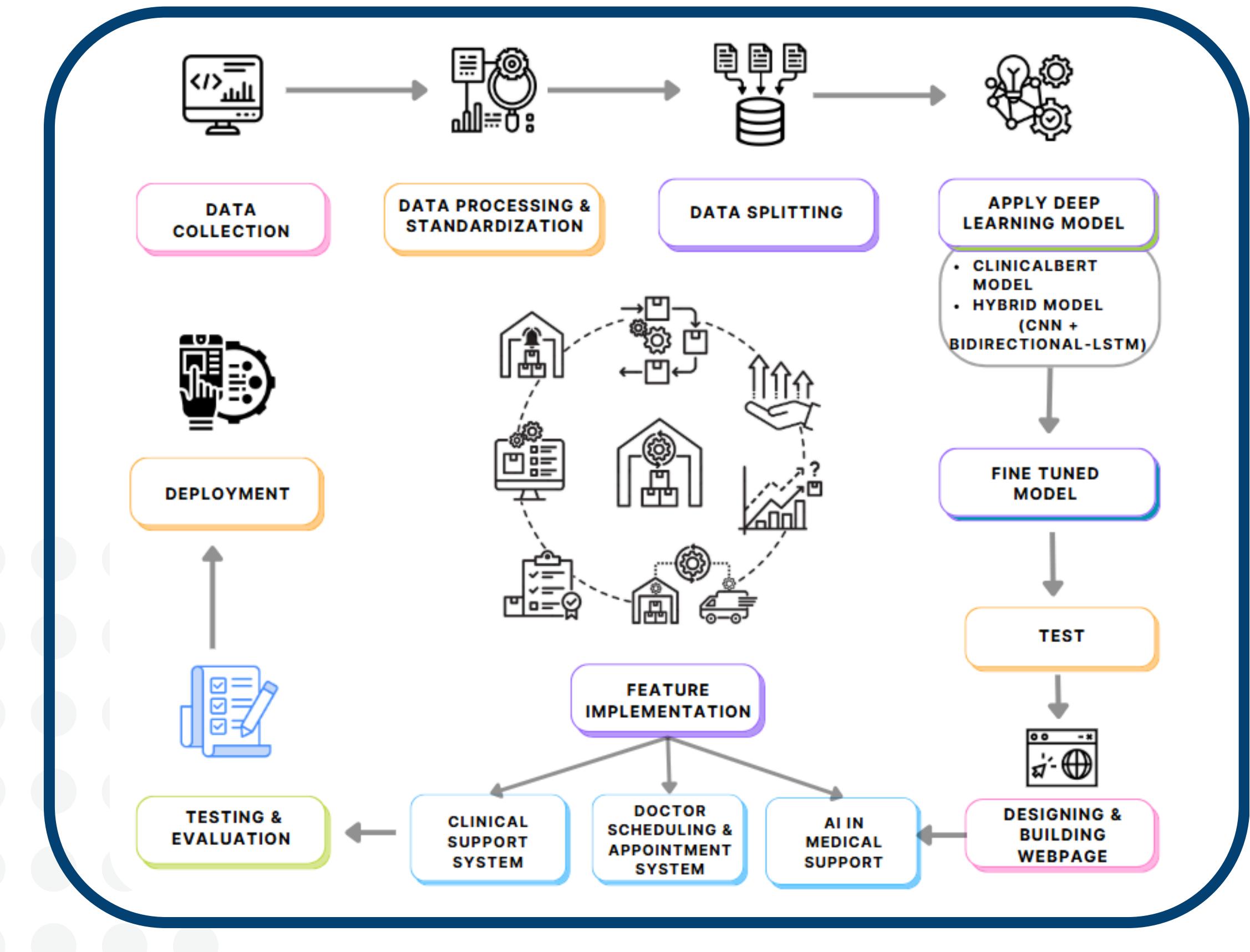
Integrating EHR with HAPI FHIR

This integration allows patient health records to be stored, shared, and accessed securely using the FHIR standard. HAPI FHIR provides a framework to fetch and manage healthcare data on external servers, enabling interoperability, better data analytics



Materials

- Merged clinical data containing 41 disease symptoms
- Applied data augmentation and generated Q/A pair
- Applied fine-tuned deep learning model ClinicalBERT and Hybrid (CNN+BiLSTM) model on our clinical data
- Implemented a webpage using PHP





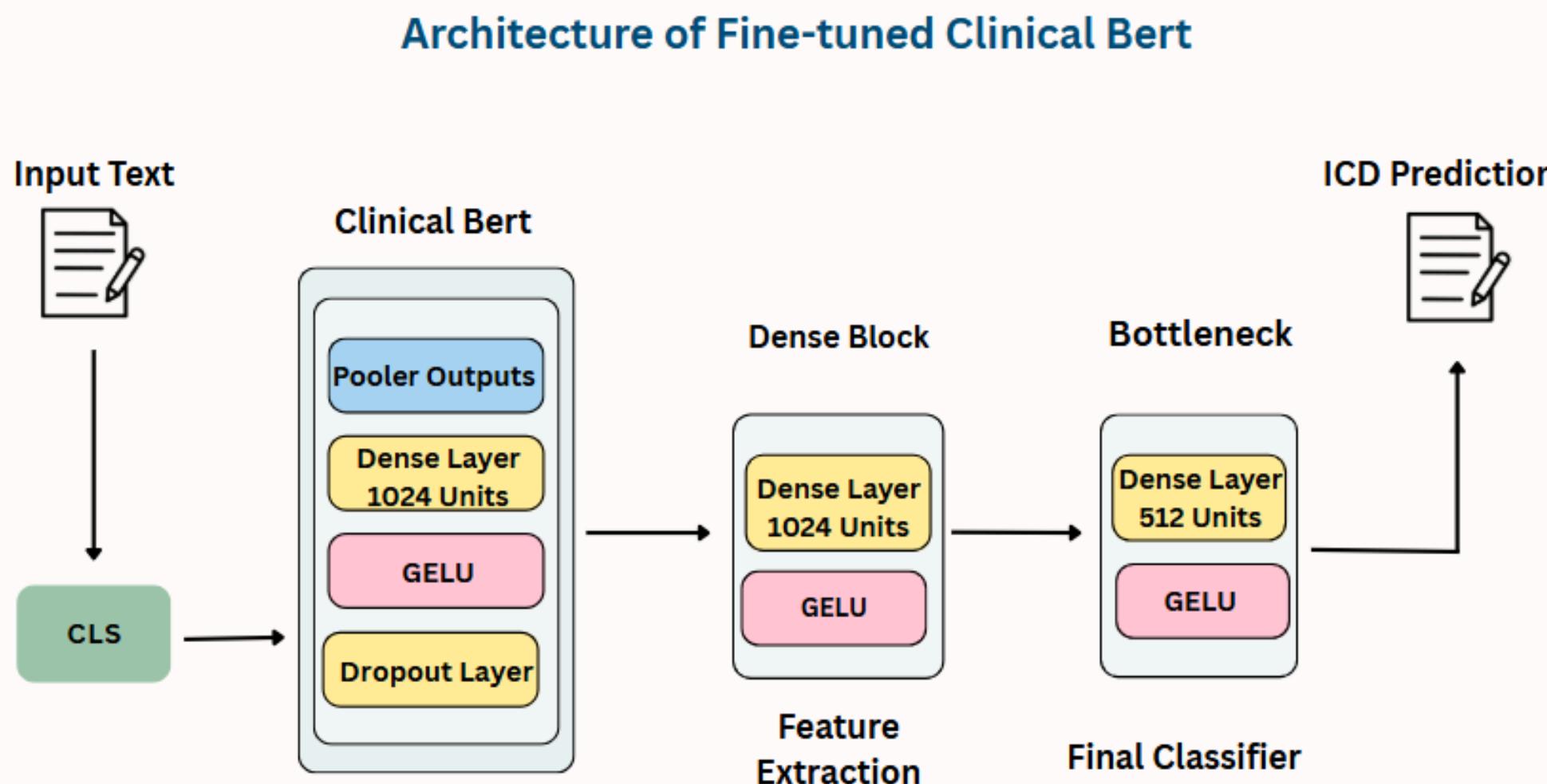
Intelligent Medicine Recommendation System

An intelligent chatbot that capable of engaging with patients through natural language processing (NLP). The chatbot will assist patients providing instant responses to common health related questions, such as symptoms, medication instructions, and general health advice, thus empowering patients with information.

The screenshot shows the "Medical Assistant Chatbot" interface. At the top, there's a blue header bar with the text "Medical AI Assistant" and "Ask about symptoms, appointments, or health info". A message bubble on the right says "I have fever and cold.". Below the header, a card titled "Preliminary Assessment" shows "Allergy" with a confidence level of "81%". The card includes sections for "Description" (Allergy is an immune system reaction to a substance in the environment), "Medications" (Antihistamines, Decongestants, Epinephrine, Corticosteroids, Immunotherapy), "Recommended Diet" (Elimination Diet, Omega-3-rich foods, Vitamin C-rich foods, Quercetin-rich foods, Probiotics), "Precautions" (apply calamine, cover area with bandage, use ice to compress itching), and "Suggested Actions" (Avoid allergenic foods, Consume anti-inflammatory foods, Include omega-3 fatty acids, Stay hydrated, Eat foods rich in vitamin C). At the bottom, there's a text input field "Type your message...", a "Quick Actions" section with buttons for "Check Appointments", "View Medical Records", "Book Appointment", and "General Help", and a "Select AI Model" dropdown set to "Hybrid - Advanced Medical Intelligence". A note at the bottom right says "Hybrid: Robust medical text classifier for quick suggestions."



BioXNet (Fine-tuned ClinicalBERT)



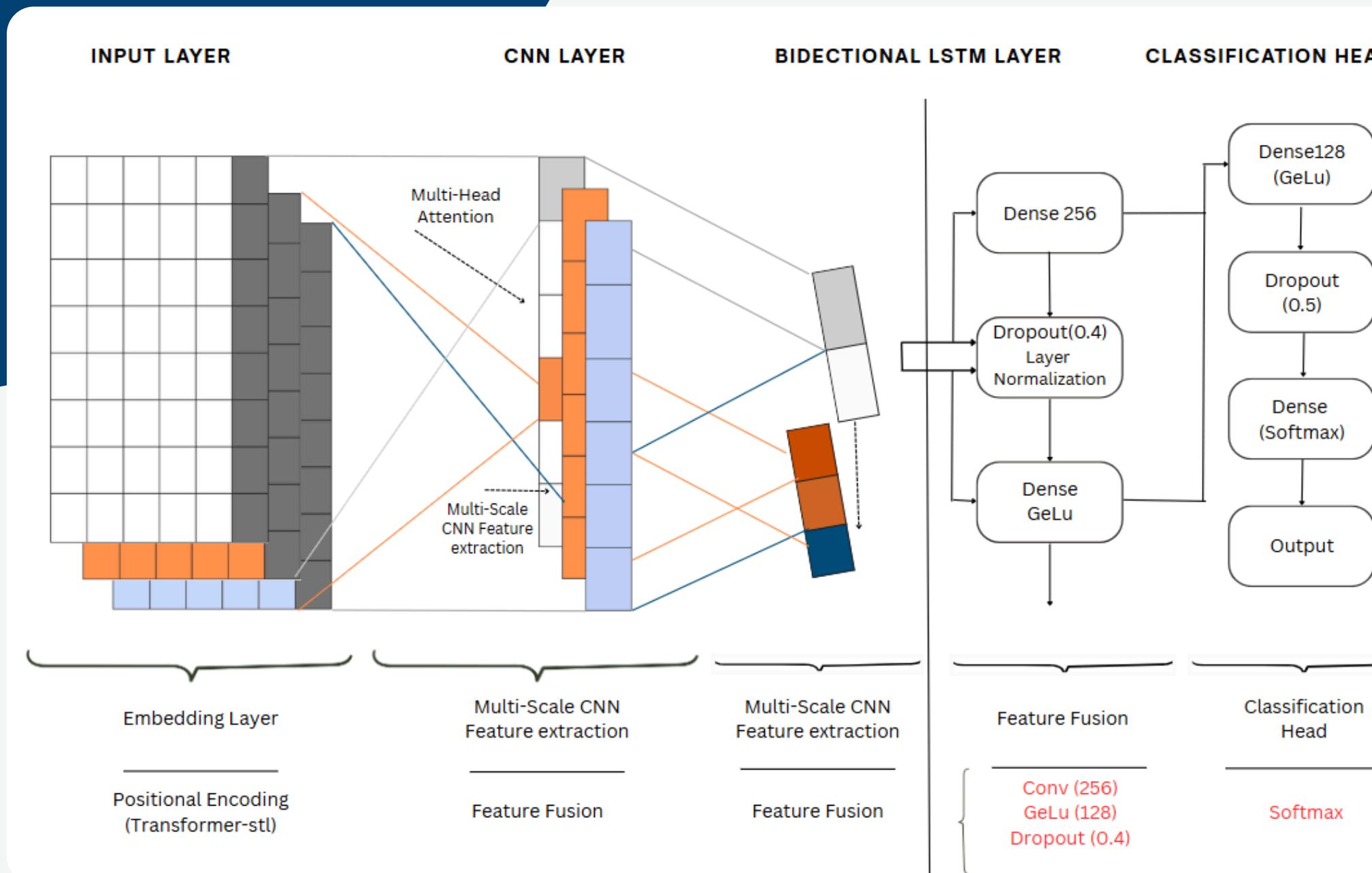
We propose a model named BioXNet, which is a fine-tuned ClinicalBERT backbone for advanced clinical narrative, improved with a custom hierarchical classifier head for robust prediction of health conditions

- **Classifier Head:** Added Two dense layers with normalization, GELU activation, dropout for better prediction and regularization.
- **Contextual Embeddings:** Used ClinicalBERT's [CLS] token representation to capture the full meaning of patient queries.
- **Optimized Training:** Fine-tuned with Adam (2e-5) and cross-entropy loss.



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Hybrid



Hybrid (CNN + BiLSTM) Model

We designed a custom hybrid architecture combining CNN and Bidirectional-LSTM, which is designed with multi-head attention.

- **Multi-head Self-Attention:** Learns and captures context across the entire clinical dialogue.
- **CNN-BiLSTM Combination:** CNN extracts local medical terms and symptom patterns, while BiLSTM understands bidirectional sequence context.
- **Enhanced Classifier Head:** Two dense layers with GELU activation, dropout, and normalization ensure robust and accurate health condition predictions.



96.34%

BioXNet, our best-performing model, achieved an accuracy of 96.34% in predicting disease, with a precision of 96.78%, a recall of 96.34%, and an F1-score of 96.34%.

Our fine-tuned model BioXNet proved to be the most effective approach in this study. BioXNet consistently achieved higher accuracy, precision, recall, and F1-score, which suggests stronger generalization to unseen data. Its superior performance is primarily attributed to the fine-tuning process, which adapts the pretrained ClinicalBERT model to the specific dataset, enabling it to capture domain-specific semantics and contextual relationships more effectively.

In contrast, the CNN+LSTM hybrid model exhibited relatively poor performance. While convolutional layers can extract local patterns and LSTM units capture sequential dependencies, the hybrid model was unable to achieve comparable results, likely due to the limited dataset size and the absence of prior domain-specific knowledge.



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BioXNet

Results of BioXNet and Hybrid (CNN+BiLSTM) Model

Model	Accuracy	Precision	Recall	F1-Score
BioXNet(Fine-tuned ClinicalBERT)	0.9634	0.9678	0.9634	0.9634
Hybrid CNN-BiLSTM	0.834553	0.840650	0.834553	0.837376



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Webpage

Web App Demonstration

We have developed the smart clinical healthcare in Bangladesh integrating an intelligent health assistant web interface, a user-friendly tool designed to aid in efficient healthcare data management and communication.

The screenshot shows the 'Access Portal' page of the HMS Clinical Management System. At the top, there is a navigation bar with links for 'Find Doctors', 'Services', 'About Us', 'Gallery', 'Contact', 'Login', and 'Book Appointment'. Below the navigation bar, the title 'Access Portal' is displayed in bold, followed by the sub-instruction 'Choose your role to access the Clinical Management System'. Three cards represent different portals: 'Patient Portal' (blue icon), 'Doctor Portal' (purple icon), and 'Admin Portal' (orange icon). Each card provides a brief description of its functions and a corresponding login button.

Portal	Description	Login Button
Patient Portal	Book appointments, view medical records, and manage your healthcare journey ✓ Online Appointments ✓ Medical History ✓ Lab Reports	→ Patient Login
Doctor Portal	Manage patients, appointments, and medical records efficiently ✓ Patient Management ✓ Schedule Management ✓ Prescription Tools	Doctor Login
Admin Portal	Complete system administration and hospital management control ✓ System Management ✓ Staff Administration ✓ Reports & Analytics	Admin Login



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Healthcare

--- Thank You

The Power of Prevention: How to Stay Ahead of
Illness



Have a good day

