DIGITAL CHATBOT FOR HOSPITAL BILLING QUERY MANAGEMENT: AN INNOVATIVE APPROACH

A Smart Solution to Simplify Hospital Billing Queries

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Abstract— Efficient patient service in hospitals is critical for improving patient satisfaction and reducing administrative workload. Billing queries often constitute a significant portion of hospital inquiries, leading to delays and operational inefficiencies. This paper presents the design, implementation, and evaluation of a digital chatbot that addresses patient billing queries in real-time. The chatbot leverages natural language processing (NLP) and integrates with hospital billing systems to provide accurate responses, reduce human workload, and enhance patient experience. Experimental results demonstrate a 70% reduction in manual billing query handling and improved response time, highlighting the potential of AI-driven solutions in healthcare administration.

Index Terms— Digital Chatbot, Hospital Billing, Natural Language Processing, Healthcare Innovation, Patient Query Management

I. INTRODUCTION

Hospitals handle thousands of patient queries daily, among which billing-related inquiries are frequent and time-consuming. Traditional methods rely on manual intervention by administrative staff, which can lead to delays and errors. With the increasing adoption of AI technologies, chatbots have emerged as an effective solution for automating routine interactions. This paper proposes a hospital-specific billing query chatbot designed to provide instant and accurate responses, reduce administrative burden, and improve patient satisfaction.

II. RELATED WORK

Previous work in healthcare chatbots has largely focused on clinical assistance, such as symptom checking, appointment scheduling, and patient triage. Systems like Babylon Health and Ada Health demonstrate the viability of conversational AI in patient engagement.

Research in AI-assisted billing primarily explores error detection and fraud prevention, but very few studies address direct patient-facing billing interactions. This paper bridges this gap by presenting a specialized chatbot designed to handle hospital billing queries in real time.

1. **Health Chatbots:** Used for symptom checking and appointment scheduling.
2. **AI in Billing:** Some AI systems can predict billing errors but are limited in direct patient interaction.
3. **Hospital Chatbots:** Examples like Babylon Health demonstrate successful patient interaction but are not specialized in billing queries.

This study bridges the gap by focusing specifically on **billing query automation.**

III. METHODOLOGY

A. SYSTEM ARCHITECTURE

The proposed system consists of the following components:

1. **User Interface:** Accessible through the hospital website and WhatsApp integration.
2. **NLP Engine:** Performs intent recognition and entity extraction using machine learning models.
3. **Billing Database Integration:** Secure API connection to the hospital billing system.
4. Response Generator: **Produces accurate, context-aware responses based on query intent**.

IV. WORKFLOW

a) Patient submits a billing query.
b) The NLP engine interprets the question and classifies the intent.
c) The system retrieves relevant information from the billing database.
d) The chatbot generates a validated and real-time response.
e) Unresolved queries are escalated to human billing staff.

V. TOOLS AND TECHNOLOGIES

a. Python, TensorFlow / PyTorch
b. Rasa / Dialogflow
c. REST APIs for HMIS integration
d. SQL / NoSQL database
e. Secure communication protocols and encryption

VI. IMPLEMENTATION

The chatbot was deployed within a tertiary care hospital environment and included the following features:

1. **Billing Query Handling:** Invoice details, payment status, tariff charges, refund guidance, and insurance-related inquiries.
2. **Multilingual Support:** English and local languages to improve patient accessibility.
3. **Security:** HIPAA-compliant data handling, encrypted communication, and authentication for sensitive information.

Pilot testing was conducted using real hospital workflows, and the chatbot was refined based on staff feedback and performance analysis.

VII. RESULTS AND EVALUATION

Metric	Before	After
Manual Billing Queries/Day/week	200-250	70–90
Avg Response Time	10–15 min	3–5 sec
Accuracy Rate	75%	92%
Patient Waiting Time	High	Reduced by 60%
Staff Satisfaction	Moderate	Improved by 80%

i. The system was evaluated over a four-week period.
   a. Performance Metrics
ii. Manual Workload Reduction: 70% decrease in staff-handled queries.
iii. Response Time: Reduced from 15 minutes to 5 seconds on average.
iv. Accuracy: 92% query resolution without human assistance.
v. Escalation Rate: Only 8% of queries required manual intervention.

VIII. USER FEEDBACK

- 89% reported faster resolution
- 76% felt information was clearer
- 93% satisfied with WhatsApp accessibility

IX. STAFF FEEDBACK

BILLING TEAM NOTED:

- Reduced interruptions
- More time for complex cases
- Better workload distribution

X. CONCLUSION

The chatbot system implemented at Saifee Hospital demonstrates significant improvements in query response time, accuracy, and overall operational efficiency. AI-driven automation in billing reduces workload on hospital administration, enhances patient satisfaction, and sets a foundation for advanced digital transformation.

Future enhancements include voice-based chatbots, AI predictive billing estimates, automated insurance approval tracking, and expansion to pharmacy, OPD, and laboratory query handling.

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