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ORIGINAL

Transforming rural healthcare: a mobile app for digital consultation and diagnostics

Transformar la sanidad rural: una aplicación móvil para consultas y diagnósticos digitales

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ABSTRACT

Access to quality medical care is essential for maintaining a healthy life, yet it remains challenging for many, particularly in addressing health issues promptly and effectively. Digital diagnostics and virtual consultations are transforming healthcare by leveraging technology to enhance patient care and streamline medical processes. These tools enable remote communication between patients and healthcare professionals, eliminating geographical barriers and increasing access to expert medical advice. This is especially beneficial in rural areas of India, where timely consultations and proactive health management can be difficult. To address this need, we have developed a mobile application powered by Recurrent Neural Networks (RNNs) that simplifies remote healthcare through online consultations. The app analyses symptoms—submitted as text or images—generates relevant medical insights and provides appropriate prescriptions. Acting as a virtual medical mentor, it educates patients about their health conditions and recommended treatments. The application features a chatbot that utilizes both text and image inputs to accurately identify diseases and deliver tailored medical guidance. This diagnostic bot not only improves patient-doctor communication but also minimizes unnecessary lab tests and costly treatments. It complements traditional in-person care by enhancing diagnostic accuracy, reducing the need for physical visits, and significantly cutting down waiting times.

Keywords: Digital Consultation; Medical Care; Patients; Mobile Application; Disease; RNN.

RESUMEN

El acceso a una atención médica de calidad es esencial para mantener una vida sana, pero sigue siendo un reto para muchos, sobre todo a la hora de abordar los problemas de salud con prontitud y eficacia. Los diagnósticos digitales y las consultas virtuales están transformando la asistencia sanitaria al aprovechar la tecnología para mejorar la atención al paciente y agilizar los procesos médicos. Estas herramientas permiten la comunicación a distancia entre pacientes y profesionales sanitarios, eliminando barreras geográficas y aumentando el acceso a asesoramiento médico experto. Esto es especialmente beneficioso en las zonas rurales de la India, donde las consultas a tiempo y la gestión proactiva de la salud pueden resultar difíciles. Para responder a esta necesidad, hemos desarrollado una aplicación móvil basada en redes neuronales recurrentes (RNN) que simplifica la atención sanitaria a distancia mediante consultas en línea. La aplicación analiza los síntomas -en forma de texto o imágenes-, genera información médica relevante y proporciona las recetas adecuadas. Actuando como un mentor médico virtual, educa a los pacientes sobre su estado de salud y los tratamientos recomendados. La aplicación cuenta con un chatbot que utiliza texto e imágenes para identificar con precisión las enfermedades y ofrecer orientación médica personalizada. Este robot de diagnóstico no solo mejora la comunicación entre el paciente y el médico, sino que también minimiza las pruebas de laboratorio innecesarias y los tratamientos costosos. Complementa la atención tradicional en persona mejorando la precisión del diagnóstico, reduciendo la necesidad de visitas físicas y acortando significativamente los tiempos de espera.

Palabras clave: Consulta Digital; Atención Médica; Pacientes; Aplicación Móvil; Enfermedad; RNN.

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INTRODUCTION

In a vast Country like India more than two thirds population reside in rural areas In Cities, where only 27 % of population live ,75 % of health development is focused. The ability to pay for healthcare is a significant hurdle for those in rural India So healthcare is still a challenge in Rural India because of the factors like Limited Healthcare Facilities, Shortage of Healthcare Personnel, Inadequate Medical Supplies, Equipment and Transportation Issues, Healthcare Disparities among States. Limited availability of physicians, nurses and specialists is usually experienced by rural regions as compared to urban areas. There may be inadequate infrastructure and health care facilities in rural areas. By combining telemedicine and digital diagnostics, the application strives to link people in rural areas with healthcare professionals. This means they can receive timely consultations, accurate diagnoses, and personalized treatment plans. This Research paper takes dive into status of the healthcare system in rural India. Looking at previous studies and data from Google datasets. It Discusses about initiatives taken by Ayushman Bharat, which is aiming to improve Primary Healthcare and support Economically weaker population of India.

Rural Healthcare is equally important to that of the Urban Healthcare and needs more attention because of the above mentioned constraints. Thus, a Digital Consultation and Diagnostics Application is a very effective solution as it surpasses all these constraints single handedly. addition, the digital assistant is a reminder to take medication on time, permitting users to correctly reveal their health. Figure 1 explains about Artificial Intelligence in daily life and figure 2 explains Artificial Intelligence in medicine.(1)

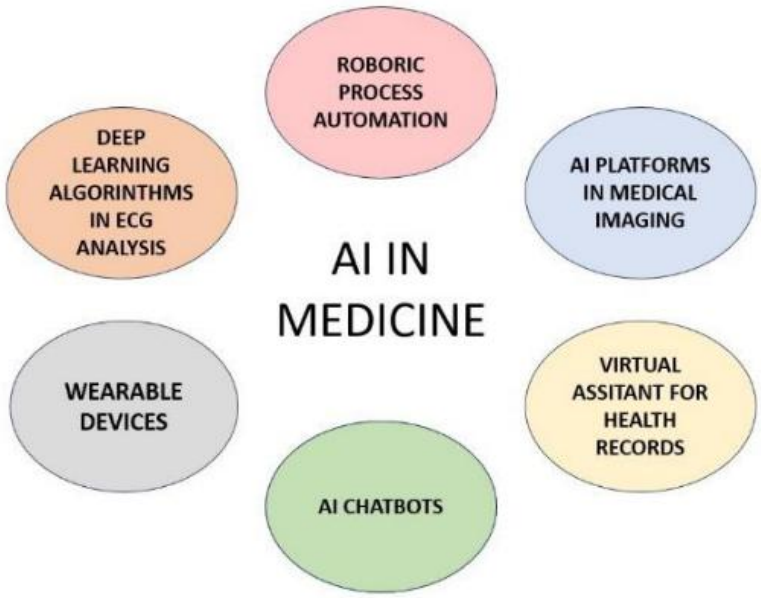
Rural people often forget about minor fitness issues, allowing extra severe problems to broaden over the years. To combat this, we've advanced a loose chatbot that works everywhere and provides support without the want for direct clinical input. This application aims to transform healthcare by making medical expertise and diagnostics accessible to everyone, regardless of location.

The principal motive of using system mastering is to provide users with primary records approximately their health before contacting scientific specialists. This text- and image-based totally clinical chatbot presents an open alternate of facts about health troubles, saving medical doctor's valuable time. As Designed application is category based and patient can seek their medication clicking on the specialised bot according to their respective symptoms.

Figure 1. Artificial intelligence in daily life



Figure 2. Artificial intelligence in medicine



Literature survey

Vaibhav Tode et al.(2), A Chatbot for Medical Purpose using Deep Learning, The Author of this paper focuses to develop Conversational AI Powered Chatbot for Medical Diagnostics using Deep Learning. This System has an ability to understand the symptoms of patient and interact with them through a web user interface.

However, its communication abilities are restricted, it has limited knowledge and conversational capabilities. It cannot learn from ongoing discussion and cannot engage in Lengthy conversations. Prathamesh Kandpal et al.(3)Contextual Chatbot for Healthcare Purposes (using Deep Learning), In this paper Author used neural networks in training data and various packages which provides better results. This chatbot integrates which heavily depend on Artificial Intelligence and Machine Learning are still at initial stages of development.

They constantly explore the concepts of Natural Language Processing with Deep Learning to get good results. Chatbots still encounter some limitations and Challenges in recent years. Papiya Mahajan et al.(4)Healthcare Chatbot using Natural Language Processing, The Author of designed system aims to provide text to text or voice assistance through which users can communicate in their preferred Language.

This chatbot can determine the type of disease based on symptoms and even suggest doctors. However, Chatbots take some time to respond to users Questions. Additionally, there are charges associated with accessing live chat services.

Dange Anas et al.(5), AI Based Healthcare Chatbot System Using Natural Language Processing, The Author of this project wishes to create a healthcare chatbot powered by Artificial Intelligence and Natural Language Processing. This chatbot can diagnose diseases and offers detailed information about specific illness before consulting doctor. But it is unpredictable. Alexander Muachevich et al.(6) Artificial Intelligence (AI) Chatbots in Medicine: A Supplement, not a Substitute, Author discusses the task of artificial intelligence chatbots in the healthcare sector, it has potential as supplement to medical Professionals. While they can be assisted with knowledge and provide valuable information. But AI still lacks Empathy and intuition. Author is striving to convey that Ai can complement the work of medical professionals but cannot fully replace. It may require more keystrokes. Akshay Mendon et al.(7)Automated Healthcare System Using AI Based Chatbot, The Author of this Paper developed this Chatbot when it was challenging for getting timely appointments with specialists for various medical issues.

When pandemic hit world globally. It has put immense pressure on healthcare industry to needs of patients by avoiding direct contact with people to avoid contact. That was difficult situation that calls for innovate solutions like AI chatbots to bridge the gap and provide support.

But it had limited Information. Manish, Subhi Gupta et al.(8), Artificial Intelligence Health-Care Chatbot System, keeping in view about growing birth rate and dropping death rate Author developed this, However, the number of doctors may not be enough doctors available to meet the needs of the increasing population.

In such cases there is risk of medical errors occurring, which can have many consequences for patients It highlights the importance of addressing healthcare. Inaccurate Data and Reliance on Big Data and AI. Apeksha Umbare et al.(9), In this Author discussed about a bot, when a case wants to appoint any sanitarium or clinic, carrying former medical reports and medicines helping with better treatments and specifics. It cannot hold long discussions and lacks the ability to learn from the discussed context.

Sudarshan Madane et al.(10), Artificial Intelligence Based Chatbot for Healthcare Applications, The Author developed this Considering rural areas, Chatbots can be a good tool in promoting health advises where healthcare services are not easily accessible. But Misleading Medical Advice. P. Anandhan; S. Kokila et al.(11), Artificial Intelligence based Chat Bot for Patient Health Care, The Author of the paper intends to build medical chatbot using Ai thinking about vast population. But it has limited functions and works for specific tasks only.

Socher R. et al.(12), Chatbot for Health Care and Oncology Applications Using Artificial Intelligence and Machine Learning: Systematic Review, Author focused on cancer treatment, with discussions, examples of diagnosis, treatment, monitoring, workflow efficiency, and health promotion.

Limited Accuracy of Diagnosis. J. Pawlowski N. et al.(13), HEALTHCARE CHATBOT, The Author's intension was to develop a chatbot which diagnoses the disease, gives details about the disease before visiting a doctor.

That helps reduce medical costs and improve availability of medical knowledge through chatbot. Can't handle complex cases Cannot provide hands-on learning experiences. Laranjo L. et al.(14), The Development and Use of Chatbots in Public Health: Scoping Review, Author of this paper discusses the suggestions for further research on the growth and deployment of chatbots for public health considering the assessment and evidence for the use.

Generate Incorrect Information, may provide harmful Instructions. L. Atota et al.(15), AI-Powered Health Chatbots: Toward a general architecture, Proposed idea of this Author is to create Chatbot based on Artificial Intelligence with help of NLP. Limited Information Security Concerns.

Yash Gupta et al.(16), The Health Chat Bot in Telemedicine: Intelligent Dialog System for Remote Support, The Author of this paper idea was aiming to improve the patient's communication with health care system with NLP and speech recognition algorithms, plan that analysis and arrange free text and voice input data as symptoms. Inaccurate Data, Reliance on Big Data and AI. Akshay Mendon et al.(17), Author developed it using Artificial-Intelligence based chatbots which provides personalisation in engaging and required health-promotion. But it was giving Misleading Medical Advice and Increased costs.

Tagore Mandan et al.(18), A Chatbot for Medical Purpose using Deep Learning, The Author of this Project developed this when it was very difficult to allocate healthcare equipment as seen during COVID-19 difficult situations that condition in India was getting bad because of absence of medication.

Incomplete assessment, Data hacking. Dange Anas et al.(19)Personal Healthcare Chatbot for medical Suggestions using Artificial Intelligence and Machine learning through this paper, Author goal was to design chatbot using NLP, program that uses Al, which analyse, understand natural human language.

Paper describes that system which allows text-text supports communication with bot in user friendly way. Lack of accountability, User Privacy. S. Ilango P. Gopinath P. Sudarsan et al.(20), Overview of Chatbots with special emphasis on artificial intelligence-enabled ChatGPT in medical science, in this Paper, author explored the idea of Chatbots, their progress and the chance of using the technology in medical purpose. Less Effectiveness, Lack of empathy, and natural emotions. P. Anandan et al.(21), Artificial Intelligence–Based Chatbots for Promoting Health Behavioural Changes: Sequential Analysis, The Composer of this Editorial aimed in the structured assessment to examine workability, efficiency and mediation properties of Al chatbots which promotes health behaviour swap. Unable to handle exceptions, Less Security.(22,23,24,25)

A Mobile Application serves as an interactive agent capable of engaging users in everyday language. Numerous mobile apps, like ELIZA, a renowned artificial therapist, employ text communication to facilitate dialogue.

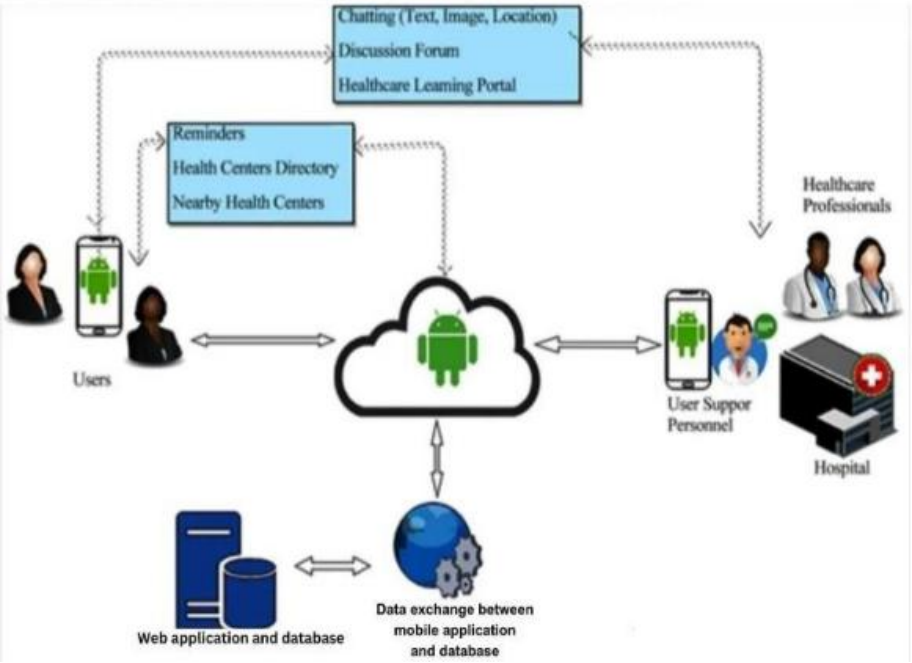
These bots often modify client queries and respond based on specific keywords. In the absence of keywords, ELIZA relies on predetermined phrases to sustain the conversation. It also misleads medical advice and provides inaccurate data.(26,27,28,29,30)

METHODS

This Mobile Application is developed to reduce the Expenses and to increase health care accessibility in every remote corner. The core concept behind the proposed system involves developing a mobile application Chatbot aimed at recognizing an individual's illness and furnishing relevant information without requiring doctor involvement. Certain mobile applications function as reference books, guiding patients to identify their sickness and promoting better health. Figure 3 is the detailed architecture of proposed system according to which we have built a mobile application that facilitates three features:

- User Verification and Symptom Extraction.
- Using Trained Datasets, Symptoms Were Extracted.
- Identifying the Illness and Making a Medical Referral.

Figure 3. Proposed system architecture



User Verification and Symptom Extraction

This is where the user login credentials are validated. Substrings describing the symptoms are then found in the natural language text input and used to extract symptoms using String Searching Algorithm. The system will recognize a symptom when users provide its name explicitly. However, the system should also be able to process data such as "I read normally at first, but after a while, I feel like my eyes are tired and I see double." Instead of extracting substrings like "read" or "okay" the algorithm need instead extract phrases like "eyes are tired" and "see double" in this instance.

Using Trained Datasets, Symptoms Were Extracted

Based on a user-inputted substring, we produce list of recommended close symptoms. Next, we inquire if the user is experiencing any of the recommended indications. A few disorders will be selected based on their response. Next, by asking users a series of questions, more symptom definition and suggestions are made, and the symptoms are mapped with the condition.

Identifying the Illness and Making a Medical Referral

Every symptom that is input which matched with signs of common diseases as part of this process, it carries database's list of diseases. Until a corresponding symptom is discovered, the next symptom is examined. Based on the end users' feedback on the question evaluation, a shortlist of them is created. The chatbot provides end-user with the accurate ailment. Using built-in conditions, chatbot determines if the diagnosed ailment is serious or small problem.

The chatbot sends the user the doctor's details if the problem is serious enough to require a referral to a specialist. Additionally, if the problem is minimal, the chatbot identifies the illness and notifies the user with first aid or medication and requests a quick medical appointment.

Algorithm Used

The Algorithms used here are:

a) Recurrent Neural Networks, RNN.

b) Text To Text, TTT.

In our application, we used RNN for long sequence of text and TTT for getting the rural patient's symptoms in words and diagnosis them and provide Relevant Consultation. In text-to-text framework (RNN's) Recurrent neural network. A particular type of RNN called Long Short-Term Memory (LSTM) is well-suited for this task because it excels at handling long sequences of text, like medical descriptions. Using this data is trained by categorizing and structuring the training data would consist of a massive amount of text categorized by disease and medication. This could include clinical reports and medication database. Ideally, the data would be pre-processed to identify entities like diseases, symptoms, and medications. This helps the RNN understand the relationships between them.

This process includes user input Analysis, prediction and Medication Recommendation. The user describes their symptoms in text format. The LSTM processes the user input, analysing the sequence of words and referencing the learned relationships from the training data. Based on the analysis, the RNN predicts the most likely disease associated with the symptoms, and Using the predicted diseases, the RNN recommends potential medications based on the learned associations between diseases and medication categories within the training data.

Text to Text algorithm

Data pre-processing: clean and normalize the user's symptom description before feeding it to the LSTM model.

LSTM Disease Prediction: use a pre-trained LSTM model (specific implementation not provided here) to predict potential diseases based on the symptoms.

Disease Filtering and Prioritization: refine the disease predictions based on confidence scores from the LSTM and

knowledge from the medical knowledge base. For example, prioritize diseases with higher confidence scores or those with strong symptom-disease associations in the knowledge base.

Medication Recommendation: retrieve potential medication categories or specific medications (depending on your knowledge base) for the most likely diseases.

RESULTS

Figure 4. Left side: home page and right side: menu page

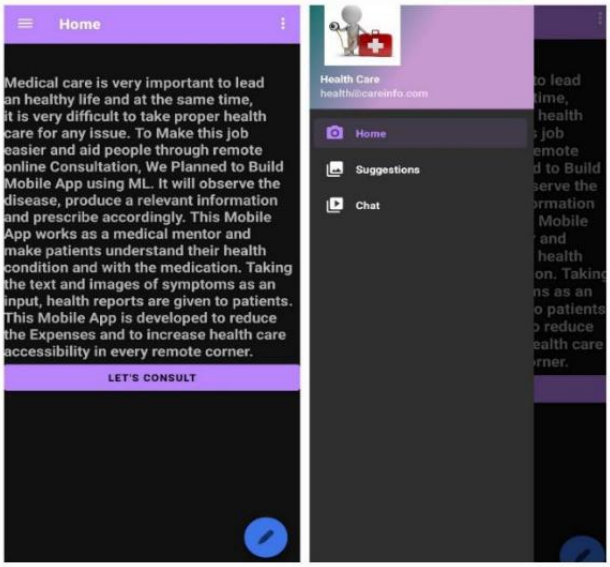
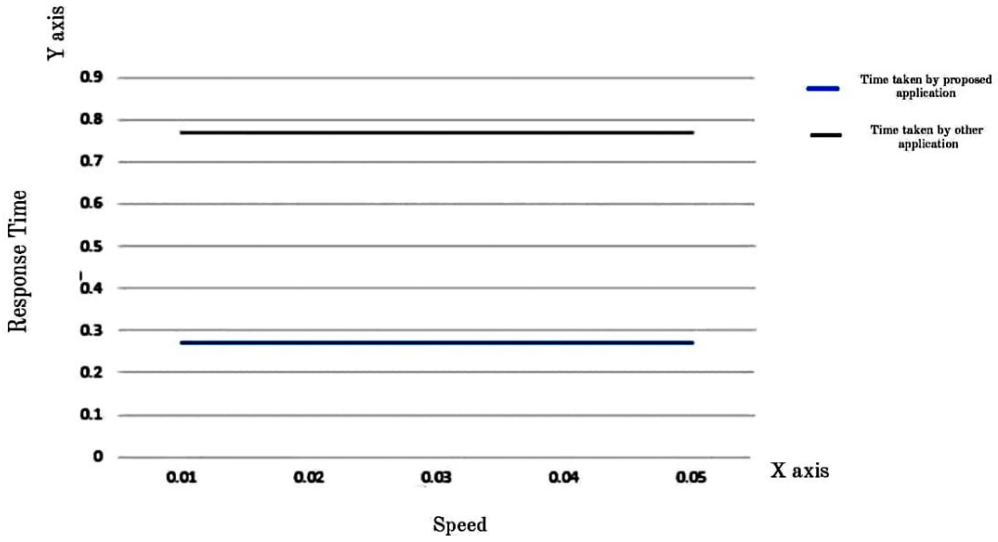


Figure 5. Left side: chat box and right side: categories



This application serves as a virtual medical assistant. Upon opening the homepage, users will find a menu button at the top left, providing access to Home, Suggestions, and Chat sections. The settings option is located at the top right. In the middle of the homepage, users will see a "Let's Consult" button, while a pen button at the bottom right guides users to a category-based diagnosis. The output of the proposed system is shown in figure 4 and 5.

Figure 6. Comparison between response time



DISCUSSION

The core concept behind the proposed system involves developing a mobile app chatbot aimed at recognizing an individual's illness and furnishing relevant information without requiring doctor involvement. Certain mobile apps function as reference books, guiding patients to identify their sickness and promoting better health.(31,32,33,34,35)The mobile app chatbot can accurately identify diseases and offer suitable information.(36,37,38)A text-to-text and image based diagnostic bot facilitates communication with patients about their medical concerns, delivering appropriate medical support based on their symptoms. It helps patients avoid unnecessary lab tests and other costly treatments. Augmenting in-person care to reduce the need for in person visits. Improved accuracy in Analysis. Reduced waiting time. Immediate Analysis of reports and quick medical attention. Chance of accessing the Healthcare experts across the globe.(39,40,41)

CONCLUSIONS

In conclusion, the development of an AI-based chatbot for rural healthcare holds great promise in improving rural patient engagement and accessibility to medical information. This technology offers round-the-clock support, efficiently addressing user queries and providing personalized quality and timely health advice. Leveraging natural language processing, the chatbot ensures a user-friendly interaction experience, catering to individuals with varying levels of health literacy and empowering them to manage their well-being effectively. However, while the chatbot demonstrates significant potential, certain limitations and ethical considerations must be addressed. Its effectiveness hinges on the accuracy of underlying algorithms, and challenges remain in handling complex medical inquiries or emergencies. Additionally, ensuring user privacy and maintaining the confidentiality of health data are paramount in the deployment of such systems. Despite these challenges, the continuous advancement of technology holds the promise of further enhancing the capabilities of AI-based chatbots, ultimately revolutionizing healthcare interactions and improving overall patient care.

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CONFLICT OF INTEREST

None

AUTHORSHIP CONTRIBUTIONS

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