RiDokita: A viable electronic visit system for remote medical consultation in Nigeria.

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ABSTRACT

One of the major barriers to healthy lives and social well-being is the lack of access to quality healthcare delivery. Several individuals and communities around the world are facing challenges accessing quality healthcare services. Some of the challenges include inadequate infrastructure, shortage of healthcare professionals, financial constraints, and the effect of COVID-19 lockdown recently. Telemedicine is a trending technology that has been revolutionizing the application of Information and communication Technology to healthcare delivery. Meanwhile, Electronic visit (E-visit) is a component of telemedicine with the potential of expanding the scope of healthcare access and cost reductions. This work leverages on the capability of internet and other enabling technologies to design and implement an E-visit platform to provide an efficient and accessible remote medical consultation services. The developed E-visit platform is termed as "RiDokita". The study begins with a comprehensive review of existing healthcare delivery systems, highlighting their features, drawbacks, legal and privacy practices. A Waterfall model was adopted for the development of the system, while the results of the user testing and evaluation processes show the ability and viability of the designed platform to deliver remote medical consultation services effectively. The study also provided some useful recommendations for the improvement and deployment of the system for healthcare delivery services in Nigeria.

Keyword: E-visit, Electronic Visit, Remote Medical Consultation, Access to healthcare Delivery,

INTRODUCTION

The Information and Communication Technology (ICT) has revolutionized every aspect of human lives. Telemedicine is a trending technology that has stimulated the application of Information and communication Technology to healthcare delivery. More importantly, the use of Health Information Technology (HIT) has played a significant role in improving healthcare delivery, especially in developing countries where access to quality healthcare is limited (World Health Organization, 2013). The need for remote medical consultations has increased in recent times due to the COVID-19 pandemic and the long-time challenges of accessing healthcare services in certain areas. One of the solutions to this problem is the development of Electronic visitation (E-visit) platform (Mugisha, Kamanzi, & Karara, 2018).

E-visit is an alternative method for patients to access healthcare service delivery from any part of the world at any time by communicating with medical professionals through telephone or internet technologies (Han et al, 2020). E-visit, which is also known as remote consultation (Gheni, Yousif & Jusoh, 2021), is gaining widespread adoption across the world, especially in the developing countries where access to quality healthcare service delivery is a nightmare, due to several challenges bedeviling them. Studies have shown the effectiveness and viability of E-visit in providing quality healthcare services to patients across diverse countries (Hong et al, 2019; Kessler, 2022; Rai et al, 2022). Apart from providing remote access to quality healthcare, E-visit also provides a significant reduction in patients' healthcare costs, waiting time, transportation cost, and reduces the risk of incomplete care (Gheni, Yousif & Jusoh, 2021).

Nigeria, being one of the most populous countries in Africa should be at the forefront of telemedicine implementation, given the numerous efforts of the Federal Government in ensuring that the health

system is available to all citizens of the country through the Nigerian Health Insurance Scheme. (NHIS). However, many Nigeria citizens and other developing countries are facing significant challenges in accessing healthcare services. The healthcare system is characterized by inadequate infrastructure, shortage of healthcare professionals, and financial constraints (Nigeria National Bureau of Statistics, 2020). The COVID-19 pandemic has also highlighted the need for remote medical consultations, which is currently limited in Nigeria. The implementation of E-visit solutions in Nigeria could help overcome some of these challenges and provide access to quality healthcare services and optimized care delivery (Mugisha et al., 2018).

Therefore, this work leverages on the capability of Internet and web technologies to design and implement E-visit platform named as "RiDokita" for providing an efficient and accessible remote medical consultation services, especially in remote areas, and help overcome the challenges face by patients in accessing medical care in Nigeria.

The system is designed to adhere to informed consent, medical confidentiality, anonymity, medical beneficence, and fidelity. The work contributes to the development of technology in healthcare and presents a viable solution to the challenges of accessing healthcare services remotely.

RELATED STUDIES

This section describes some related studies that have proposed or deployed Electronic visit or other related health solutions for providing improved healthcare remove access and quality healthcare service delivery in different countries.

Hen et al. (2020) conducted a qualitative analysis of several literature published in some reputable academic databases including MEDLINE, Embase, HMIC, PsycINFO, and CINAHL since their inception to February 2020. Their aim was to investigate and summarize the evidence of the impact of E-visit in primary care with the focus on antibiotic prescription. The result of their findings shows there was insufficient evidence to reach a conclusion that remote consultation has a significant impact on antibiotic prescription in primary care. The study further acknowledged a higher prescribing rate in remote consultation when compared to face-to-face consultations.

Gheni, Yousif, and Jusoh (2021) conducted a study to remote consultation could help in controlling the spread of COVID-19 pandemic and how to develop a viable E-visit platform to ensure remote access to medical care amidst the COVID-19 pandemic. following an extensive literature review, the important features of an implementable remote consultation system were determined and later used to developed an E-consultation system using an object-oriented approach in visual studio 2019. Six experts in health and academic sectors were engaged to conduct online expert review of the system. Similarly, eleven users from health and academia were engaged to conduct user evaluation of the system. The result of the usability experience demonstrated the ability of the developed system in delivering remote consultation services to users.

In the study of (Revano & Garcia, 2021), the authors developed a mobile device named as iVital. The device works as a wearable medical expert system to provide both patient and healthcare givers the opportunity to continuously monitor some vital sign measurements remotely. The system also incorporates some mechanisms to detect early signs of clinical deterioration. The system was evaluated and achieved a reasonable user satisfaction. Data mining was integrated into medical expert system in the study of (Cubillas, Ramos & Feito, 2022) to develop a model capable of predicting the number of patients who will be requiring healthcare in a primary health care center on a daily basis using data from Jaen city, Spain. The work built with web technologies was able to predict the number of potential users of the health center effective and improve the hospital management efficiently.

METHODOLOGY

This section presents the software engineering method adopted for the design and implementation of E-visit platform named as **"RiDokita"** and also describe some of the steps undertook while developing the proposed system.

The project employs waterfall model to develop the proposed system. The waterfall model involves the following phases: information gathering, design, implementation, testing, and maintenance. The E-visit was successfully designed and implemented using web technologies and tools including Figma (for designing and prototyping); React and NextJs (for software development); WebRTC API (for the video conferencing); and MongoDB (for database).

The system has a user-friendly interface, accessible via the Internet and also has an expert system features that allows patients to input their symptoms and receive a diagnosis and treatment recommendations. The database contains medical information and treatment options for various medical conditions. The algorithm used to diagnose and treat medical conditions was developed based on medical expertise and knowledge. The system was tested and evaluated, and found to be effective in providing remote medical consultation services.

RESULTS AND DISCUSSION

This section presents some of the interfaces of the developed E-visit system. The system consists of doctor module and patient module. The doctor module involves doctors' dashboard and other relevant pages, while patient module comprises of Patient Dashboard and other pages.

Patient Dashboard

The Patient's Dashboard as shown in Figure 1 contains the most relevant features for the patient to use the app. For example, the Patient would be able to look at their health informatics at a glance, see their medication usage (if any), see doctor's appointment (if any), join call with doctor (already booked appointments), see the summary of their finances and more. The dashboard would summarize the patients most favorite feature, in feature releases, the patient would be able to customize this section of the system.

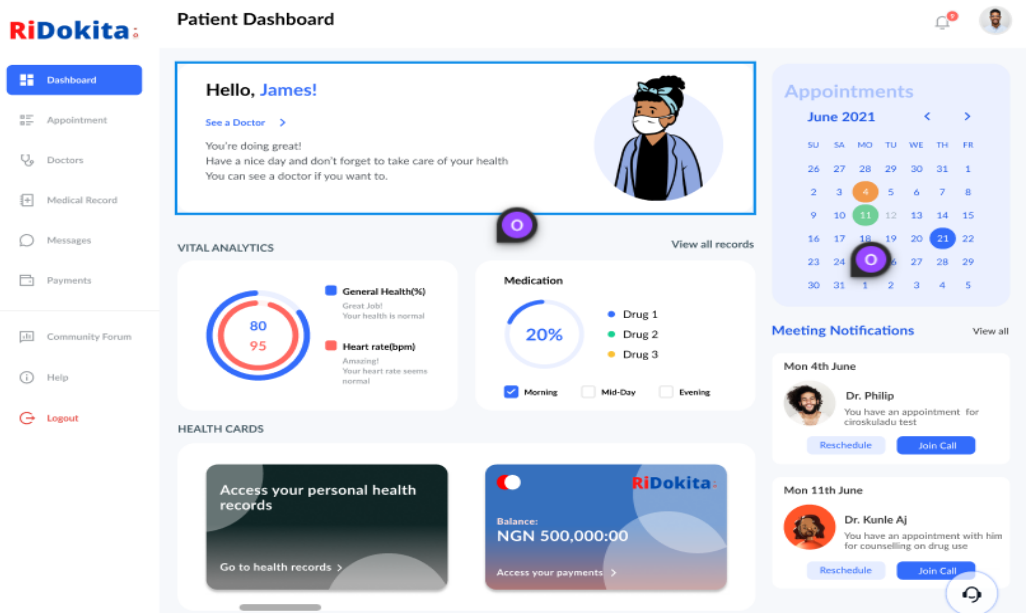

Figure 1: The patient dashboard of the proposed E-visit platform (RiDokita).

Doctor Dashboard

As shown in figure 2, the Doctor's Dashboard is a key feature of the healthcare app, providing doctors with a centralized view of all app features, improving efficiency and productivity. Customizable dashboard views prioritize important information, enabling doctors to better manage their workload. Patient record management, appointment scheduling, medication management, chat functionality, and health forum features allow for comprehensive and accurate patient care, knowledge-sharing, and collaboration among doctors and patients. The real-time patient analytics and insights provide valuable data for decision-making and patient outcomes. This screen is customizable to what the Doctor wants to be able to do, based on the screen added, that particular doctor prefers to see previous calls, current appointments and calendar requests.

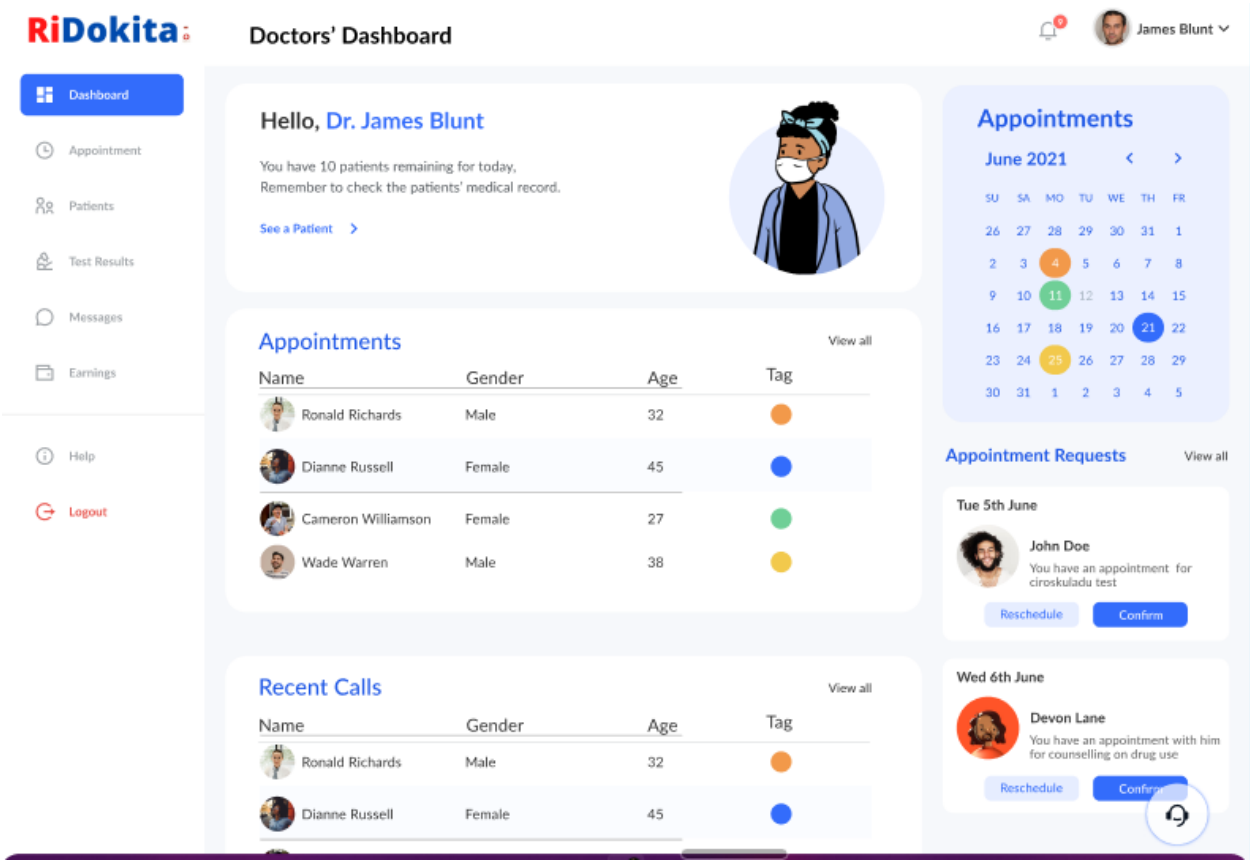

Figure 2: The doctor dashboard of the proposed E-visit platform (RiDokita).

Appointment Booking

The Appointment Booking would make it easy for both the doctors and the patients to regulate and plan their time properly. Unlike in the traditional scenario, where patients would travel miles to visit a doctor that might not be on call (sit) for the during of his/her visit. In a face-to-face medical consultation, patient has to wait hours or even return in days to see a particular specialist or another. The video conferencing (or video call) would solve this problem to great extent as the doctor and patient would have a chance to setup appointments before the visit time get reminded as the time draws closer. The appointment page of the designed system is shown in Figure 3, where each booked appointment is indicated on an inbuilt calendar on the platform.

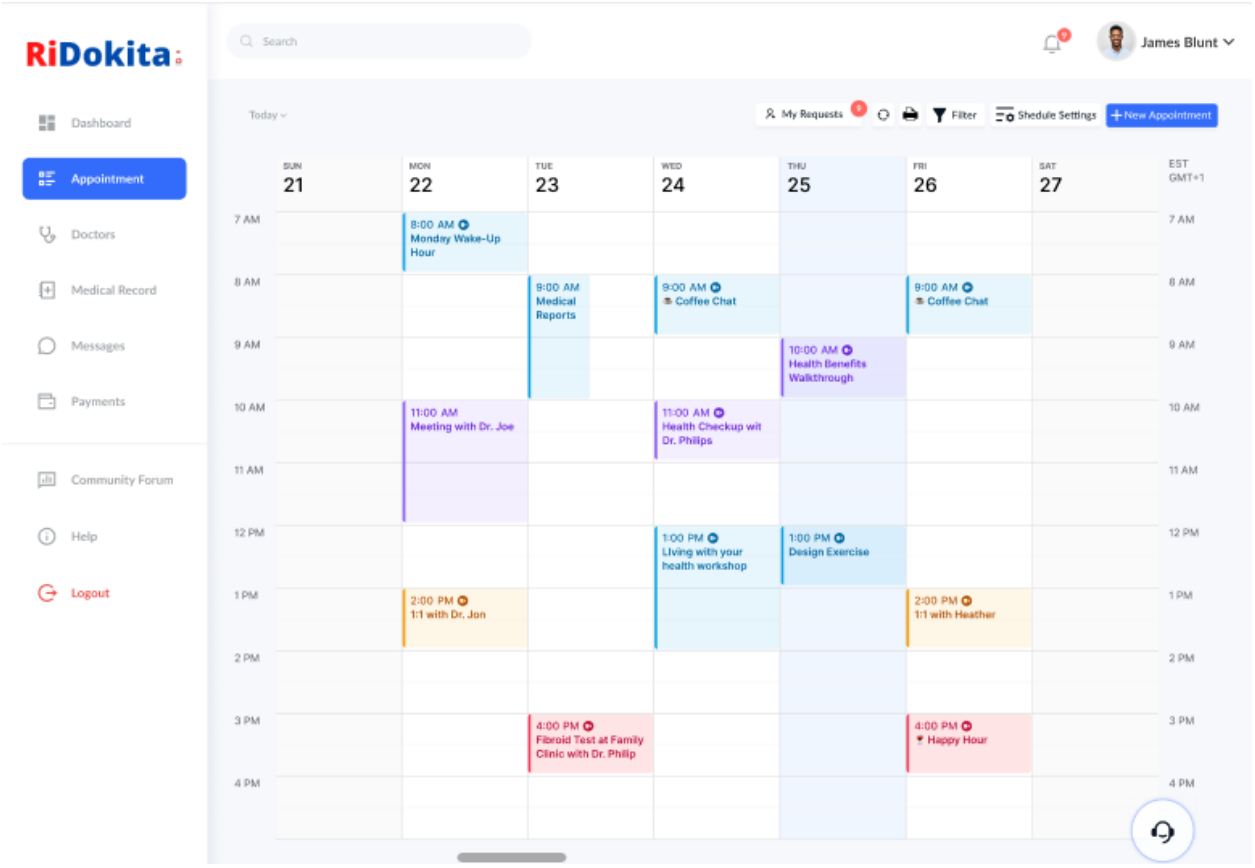

Figure 3: The appointment page of the proposed E-visit platform showing the date and patients' names (RiDokita).

Video Conferencing

Video conferencing is an essential part of this system. The feature allows Doctor and Patient interact with each other. It also allows Doctor to examine the physical appearance of his/her patient for proper ailment diagnosis and drug prescription. Figure 4 shows the video conferencing page where Doctor and Patient can interact and agree on an appointment (if necessary).

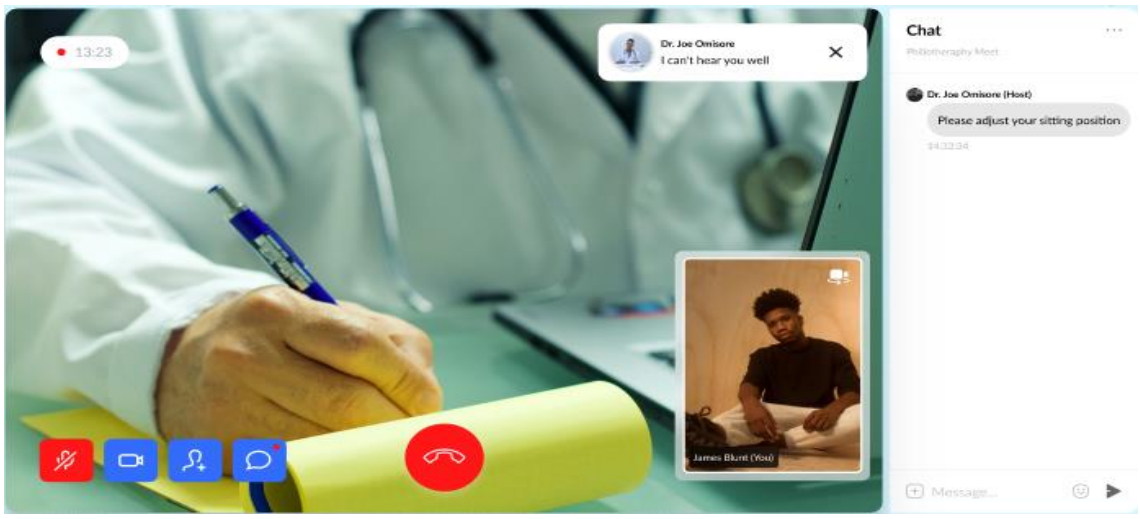

Figure 4: The video conferencing page of the proposed E-visit platform showing a doctor and a patient.

Audio Conferencing

Just like the Video Conferencing, the Audio Conferencing would perform the same task just without the Audio on. This is put in place to enhance service delivery. During the course of the research, it was observed that a lot of patients especially those with conditions that involves private parts or private conversations prefer to have the conversations in a non-face to face scenario (Hewitt, Gafaranga, & McKinstry, 2010). After this is done, both parties can either to return back to the video call to continue the visit or proceed to the next phase of diagnosis. The screenshot of the audio-conferencing page in presented in Figure 5.

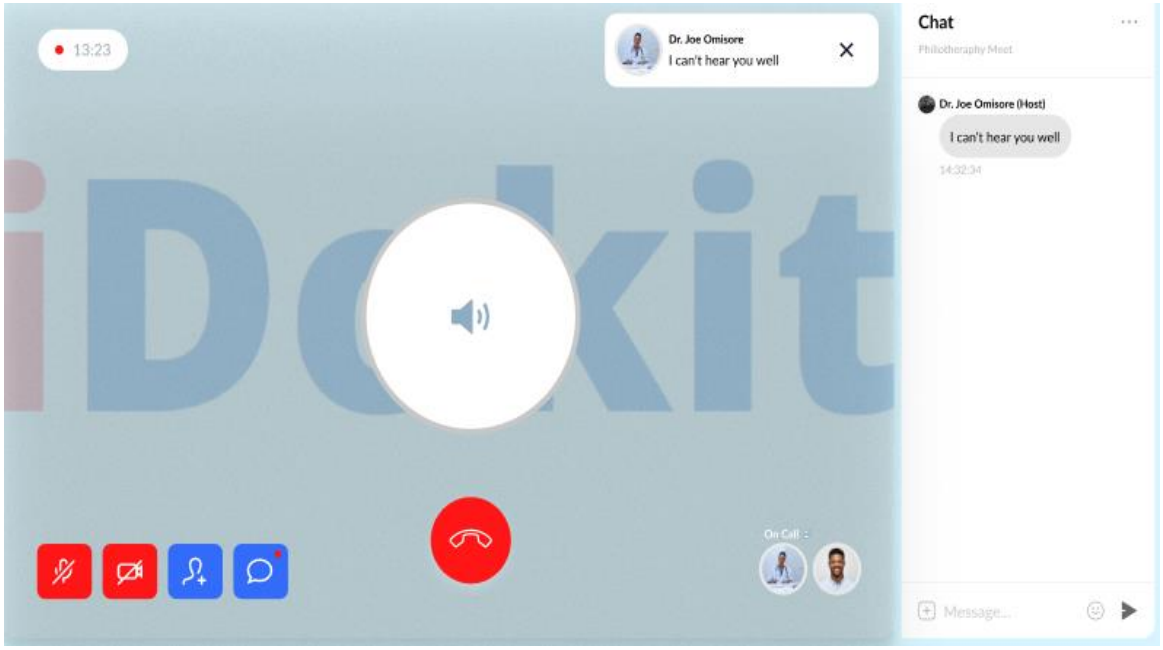

Figure 5: The audio-conferencing page showing the conversation between doctor and patient.

Chat screen

Figure 6 shows a chat screen for the proposed E-visit platform. A chat feature is integrated in the system to facilitate community building. Interactions between patients from different background and locations with the same predicament can greatly influence the healing process. Over time in the use of this system, it would be possible to determine if these interactions have positive or negative influence on the healing process of patients.

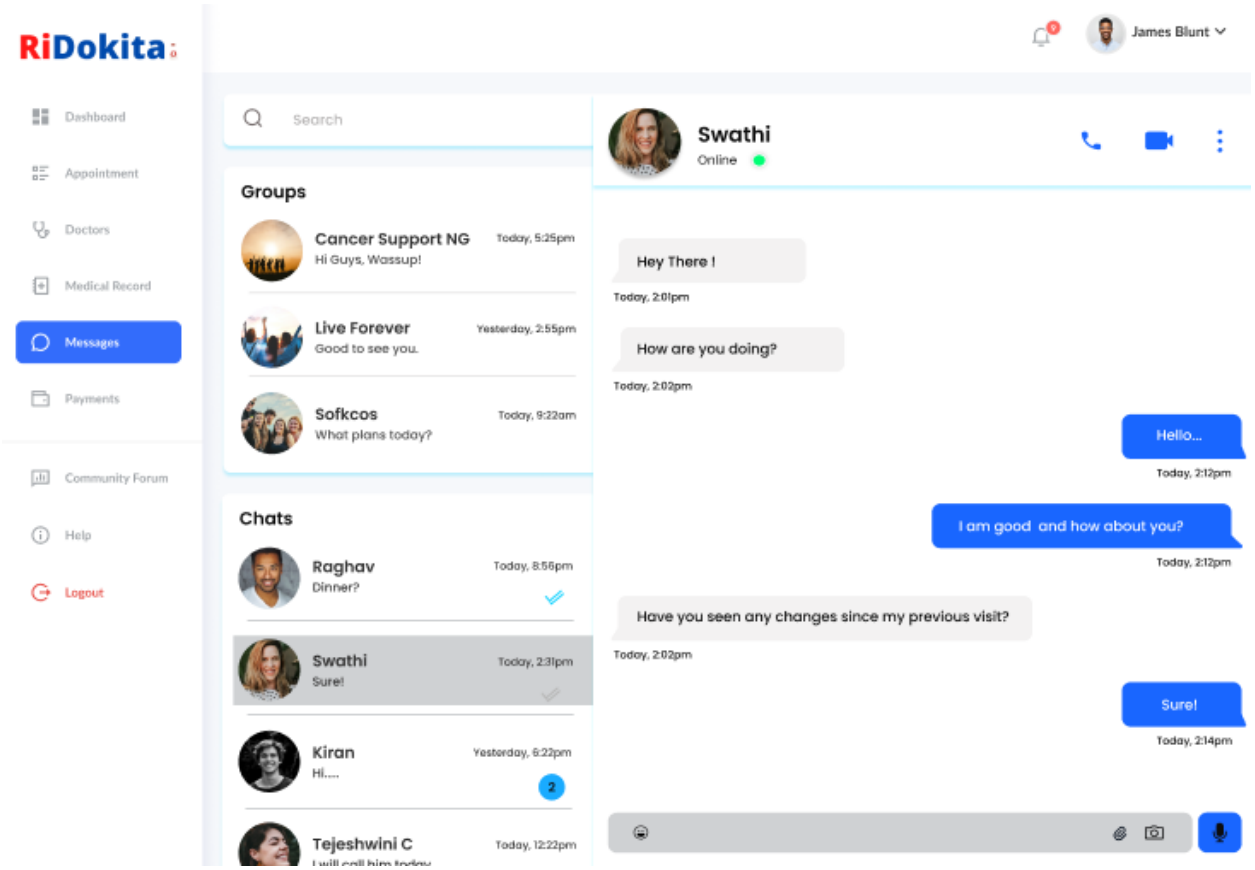

Figure 6: The chat screen of E-visit platform (RiDokita).

Community Forum

Figure 7 shows the health forum which is part of the healthcare app that allows doctors to write on any medical topic of their choosing. The writeups are verified by at least three senior colleagues on the app to ensure that the content is scientifically proven and accurate. Once the content is approved, it can be viewed by all users of the app, who can discuss and comment on it. The health forum also allows patients to ask medical questions and receive responses from available doctors.

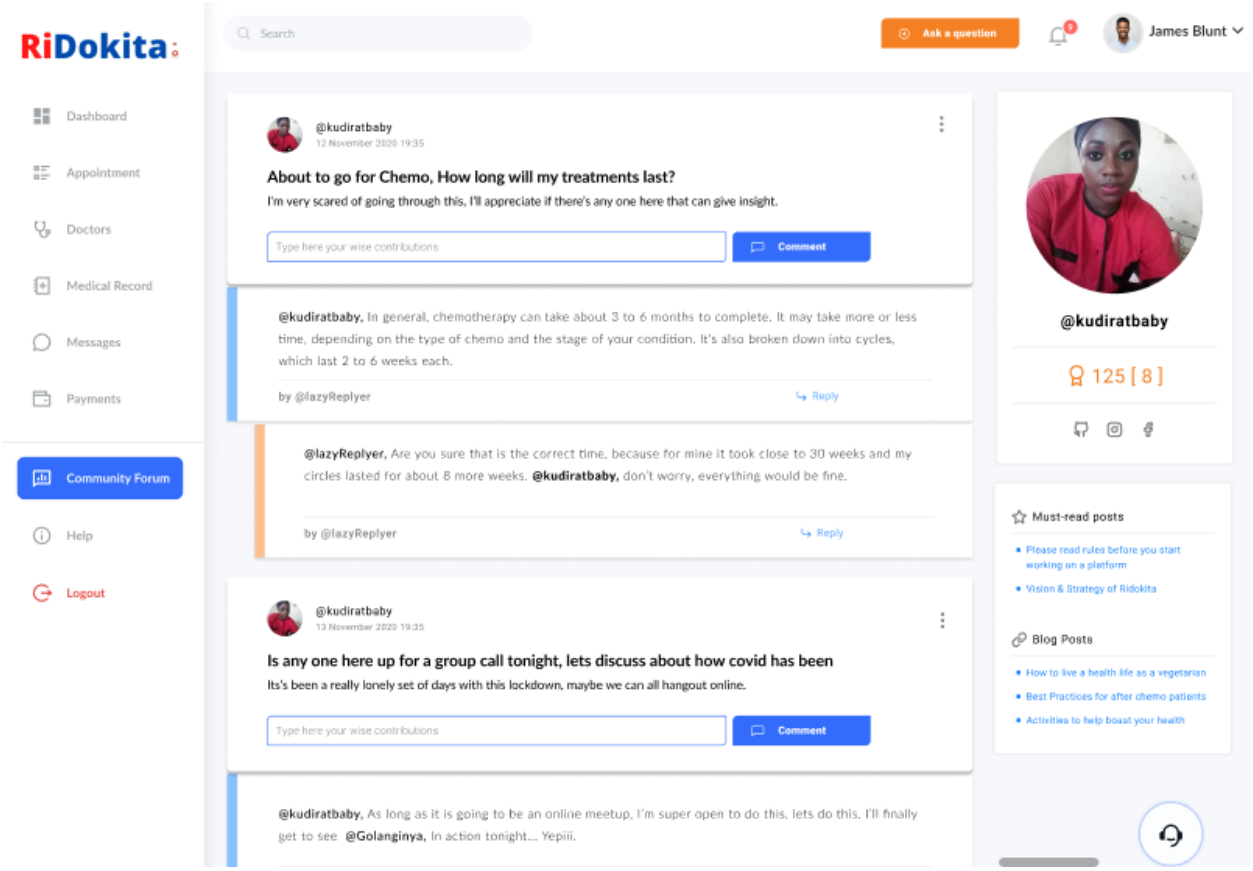

Figure 7: Community screen of E-visit platform (RiDokita).

Medical Record

Electronic Medical Records are a detailed recording of proceedings of every patient-doctor session per time as shown in figure 8. These records are also present in the traditional system, not just in an electronic format. The introduction of electronic record would make it easy to be accountable and also make it easy for new doctors to approach patients with a sense of understanding of the problem even before actually speaking with them.

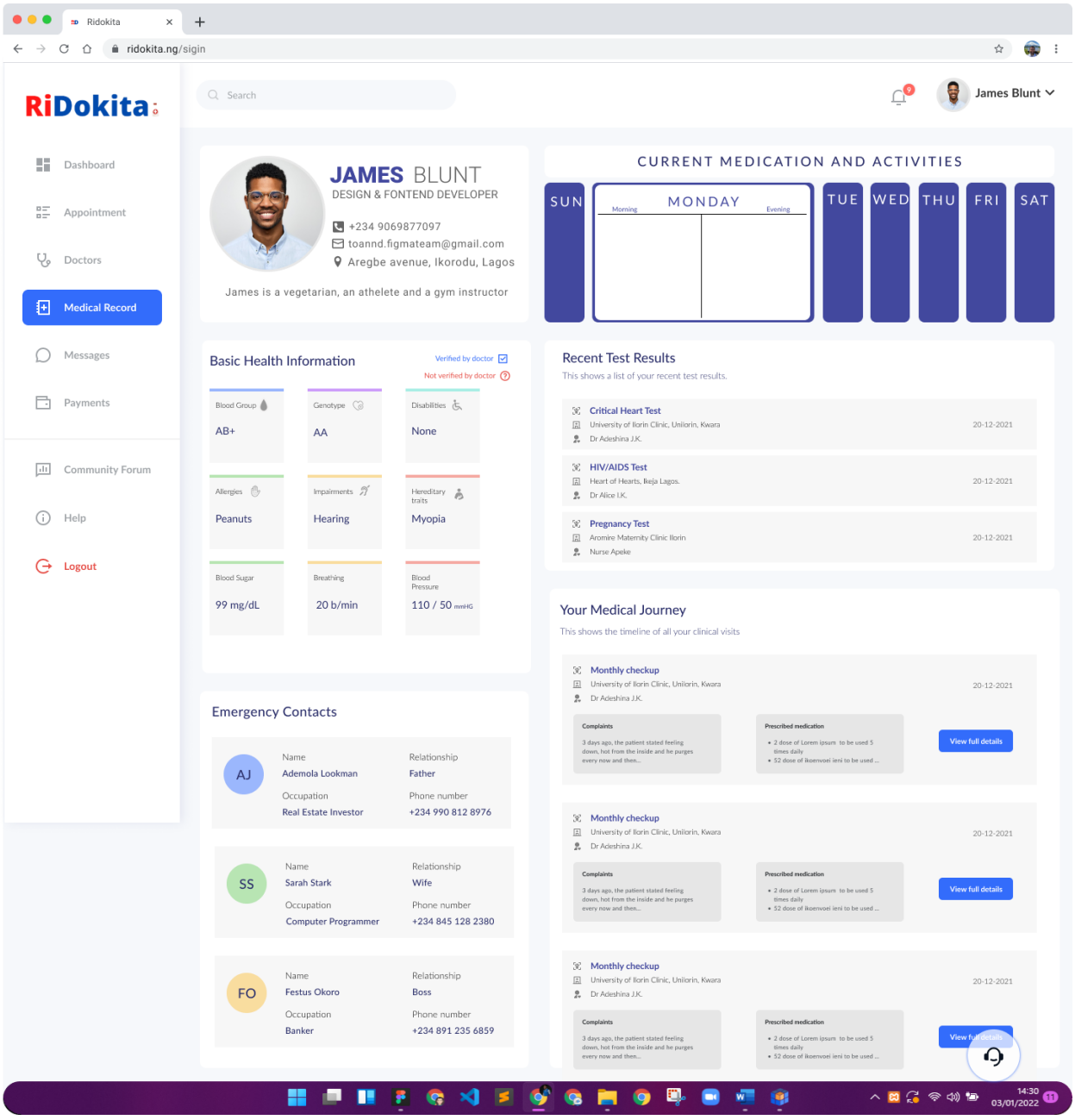

Figure 8: Medical record of a patient on E-visit platform (RiDokita).

TESTING AND EVALUATION

The testing of this work focuses on ensuring that the functional requirements are met. The system's functional report was highlighted in the table below with each of its elements tested. The test results in Table 1 show that the project's goals were met. The basic functional requirement of the system and its test results are summarized as follow:

Table 1: E-visit (RiDokita) Testing and Evaluation Results

	Requirement	Test Process	Expected Result	Result
1	A user should be able to register through the system	User inputs individual details in the appropriate fronted form.	The data is collected through this form and saved in the database as a unique entry for each user	*Passed*
2	A user should be able to login to access all features of the system	Enter input details on the login form	After submitting, the user should be redirected to his/her unique dashboard.	*Passed*
3	A user should be able to initiate a call (E-Visit) A user should be able to join a call	Click on the video link in front of each user to imitate a call with the patient	The call should be initiated and in turn, the patient should be able to join the call from his/her end.	*Passed*
4	A user should be able to create an appointment	Click on appointment tab or create appointment	A request is send to the doctor of this appointment if accepted, the schedule is added to the calendar with a notification	*Passed*
5	A user should get an appointment request and have a choice to either accept or decline	On the dashboard, see a notification to accept a calendar invite	The patient should see notification that such appointment has been accepted	*Passed*
6	A user should be able to see the lists of available patients for the day	A screen with a list of patients to attend to for the day	From the list the doctor should be able to perform the basic tasks	*Passed*
7	A user should be able to see all appointments in an in-built calendar	A simple calendar program that shows shedule and brief about the calender	Every shedule is sync with this calender such that both doctors and patients can see their appointments individually	*Passed*
8	Once on the Call, A user should be able to mute/unmute, show/hide, add someone else and take records/notes.	Click on button on the video screen	The respective action should be observed, either unmute/mute, show/hide or add persons	*Passed*
9.	A user should be able to print/share medical records or prescription	Click on each medical instances and share or print	A pdf version of this report should be exported to the system and printed	*Passed*
10	A user should be able to see global patients' medical history	The doctor clicks on patients to see medical record	Individual patient record is displayed to the doctor independently	*Passed*

11	A user should be able to reach of to support	Click the support tab	Should initiate chat with the technical support team in case of a glitch in the system or enquiries	*Passed*
12	A user should be able to make payment for services	Click on the payment tab	Should take the user to their personal wallet accounts.	*Passed*
13	A user should be able to receive payment for services	Click on the payment tab	Should take the user to their personal wallet accounts	*Passed*

Conclusion and Recommendation

This work developed an E-visit platform known as (RiDokita), a viable solution for remote medical consultation services in Nigeria. The system provides patients with access to medical consultation services from the comfort of their homes, which is particularly important in remote areas with limited access to healthcare services. The system is user-friendly and effective in diagnosing and treating medical conditions. The system was designed and implemented for user use. The results of the various testing and evaluation show that the developed system is effective and satisfy all its functional requirements and usability requirements. Further research and development can be done to improve the system and expand its capabilities.

Based on the results of the project, here are some possible recommendations for further improvement and implementation of the developed E-visit system:

The developed E-visit can be integrated with existing healthcare systems to provide a comprehensive healthcare service to patients. The database can be expanded to include more medical information and treatment options for various medical conditions. In addition, the user interface can be enhanced to improve the user experience and make it more user-friendly. There is a need to increase awareness about remove medical consultation or E-visit among the general public and healthcare professionals to increase its usage and adoption. Robust security measures need to be put in place to ensure the privacy and confidentiality of patient information. Finally, the system needs to be continuously maintained and updated to ensure its effectiveness in providing remote medical consultation services.

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