

## Development of E-Health Portal with Smart Authentication for Rural Deployment

Shaibu Ibrahim Ali, Caroline O. Alenoghena, Nathaniel Salawu

Department of Telecommunication Engineering, School of Electrical Engineering and Technology, Federal University of Technology, Minna, Niger State, Nigeria  
Corresponding email: shuaibza@yahoo.com

### Abstract

The World Health Organization (WHO) labelled the coronavirus disease 2019 (COVID-19) outbreak a global pandemic in March 2020. The pandemic has brought unprecedented hurdles, exposing the frailties and shortcomings of many national health-care delivery systems especially in rural communities. Rural communities often face challenges in accessing quality healthcare due to limited resources and infrastructure. This paper proposes the development of an eHealth portal with smart authentication to promote healthcare services in rural areas by leveraging the power of digital technologies and smart authentication systems, to bridge the gap and enhance healthcare delivery in rural settings. The eHealth platform will serve as an efficient means of collecting and managing patient information, enabling healthcare professionals to have real-time access to accurate data. The platform which is a web based application is designed using Glide Application to create user interface that handles registration and user log-in as well as other relevant information. The backend which handles user authentication, data base and other application functionality is created using google sheet and google drive. Smart authentication is implemented using Two Factor Authentication (2FA) system and Secure Hash Algorithm (SHA-2). The platform was tested for functionality and the result obtained is based on system response and user feedback. The result shows that the platform responds to users' query promptly with latency of 0.125 seconds with positive user experience.

**Keywords:** eHealth platform, Smart Authentication, Glide Application, Digital Technology, Software Development Life Circle

### 1. Introduction

The term health for some means fitness. To others, it is the state of being physically fit and able to withstand disease. Still others use terms like wellness or well-being, to include a wide array of factors that seems to lead to positive health status (Nmorsi, 2019). In 1948, the World Health Organization (WHO) defined health as a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity. (World Health Organization & The World Bank, 2015).

In Nigeria, more than 70% of the population lives in rural areas that are severely underdeveloped and lack the necessary health facilities or programs to significantly enhance the needs of the rural residents in terms of healthcare. It is the function of Local government to provide primary health care services. Primary health care is a whole-of-society approach to health that aims at ensuring the highest possible level of health and well-being and their equitable distribution by focusing on people's needs and as early as possible along the continuum from health promotion and disease prevention to treatment, rehabilitation and palliative care, and as close as feasible to people's everyday environment. World Health Organization and United Nation children Fund

(WHO and UNICEF). A vision for primary health care in the 21st century: Towards UNICEF Universal Health Coverage (UHC) and the Sustainable Development Goals (SDGs.) Apart from this, most of the health infrastructural facilities in the country are concentrated in urban areas to the neglect of rural areas, and the few health facility located in the rural areas are not functioning effectively due to poor funding (Popoola K. O. 2022).

Furthermore, available health care personnel usually refuse to work in the rural setting due to lack of social amenities. Most of the reliable health institutions are located in the urban centres, rather than in the rural areas where 70 per cent of the population resides (Efe, 2013). Distance to some of the health establishments that have the basic health facilities is not encouraging. So the rural dwellers have to travel long distances before they have access to good health services, while those who cannot afford it patronize the quack in the rural areas (Nmorsi, 2019). This has put primary care is under pressure to deliver high-quality, accessible, and inexpensive care to an aging, complicated, and multi morbid population. To meet these issues, primary care providers must adopt new and creative approaches, such as eHealth portal. The applications provide the possibility of overcoming some of the challenges encountered in the primary care of patients with complex medical and social requirements. However, many unsolved problems remain about cost effectiveness, integration with healthcare, and acceptability to patients, carers, and professionals.

Various definitions of eHealth have been presented over the last decade, and no consensus has yet been reached. According to (van der Kleij et al. 2019). Definition, eHealth refers to health services and information given or enhanced via the Internet and related technologies. In a broader sense, the phrase refers to a state of mind, a style of thinking, an attitude, and a dedication to networked, global thinking in order to improve healthcare through the use of information and communication technologies. Although this definition is useful, a more detailed description of eHealth is required. For example, the definition of eHealth presented by (van der Kleij et al. 2019). Delineates three unique purposes of eHealth and discusses how they might contribute to primary care. The first function of eHealth is inform, monitor, and track eHealth technologies and research health factors. The second role of eHealth is interaction, which refers to using eHealth to enhance communication among all healthcare participants. The third eHealth function is data usage, which refers to the gathering, management, and use of health and medical data sources to inform medical decision-making and intervention development.

Electronic health (eHealth), defined by (Fadahunsi et al. 2019). As the application of Information and Communication Technology (ICT) in healthcare, is viewed as a modern driver of universal health coverage and high-quality healthcare delivery.

Telemedicine, Electronic Health Records (EHRs), Clinical Decision Support Systems (CDSS), Mobile Health (mHealth) Applications, Computerized Physician Order Entry (CPOE), Electronic Prescribing systems (EPS), and Web-based Health Services (WHS) have all had varying degrees of success in promoting access to quality health services (Fadahunsi et al. 2019).

Another scholar (Widberg et al. 2020). Define eHealth as the use of Information and Communication Technology (ICT) to deliver treatment and send health information over the Internet and similar technologies. The Application appear to be promising in terms of fostering egalitarian, tailored care, and they could be used to promote accessibility and patient participation in palliative care settings. According to indications, eHealth communication resulted in patients and family receiving more information, which contributed to patient safety and feelings of security. At the corporate and social levels, eHealth may lead to more sustainable development and resource efficiency.

With advancements in Telecommunication, Information and Communication Technology (ICT) and an increase in COVID 19 Pandemic attention shifted from using convectional clinics / hospitals for health care attention to eHealth system in the hopes of resolving some of the problems associated with health centers at the rural areas. As a result, over the years, Engineers and Programmers have built and deployed eHealth systems with varying characteristics based on the conditions and demands.

**2.0 Research Methodology**

The technique and steps for the eHealth portal development are explained in this section. The process for creating an eHealth

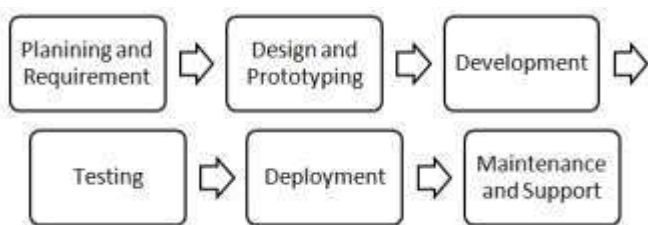


Figure 1 Stages of eHealth Portal Development

**2.1 Planning and Requirements Gathering**

The first step was identification of health care services challenges of rural communities which include lack of functional health facilities and absence of care givers. This was achieved through literatures. Residents of rural communities have to travel along the bad roads to the designated secondary health centre sometimes at odd hours to access health care services during emergency.

Bearing above in mind, the aim of improving access to quality health care services in rural communities using eHealth was conceived by defining the portal's objectives. The portal's stakeholders and users are identified and rural areas' unique demands and constraints, such as limited internet connection and lower technology adoption rates are taken into account.

**2.2 Design and Prototyping**

The eHealth portal is designed based on the requirements acquired in the previous stage. To achieve this, A Gmail account was opened to provide access to Google Drive and Google Sheets. The disk allows us to establish a project folder in which to upload the data that will be used in the application. The data which is used to develop the application is created on Google sheet. The Glide application is accessed at ([www.glideapps.com](http://www.glideapps.com)) by signing in with Google, and selecting a Google Mail account. The Portal interface that displays user registration / login as well as security code fields are designed using ready-made templates in Glide Apps user-friendly drag-and-drop editor. Logic and functionality is applied to the application by importing data via Google Spreadsheet. The process requires adding team members by clicking on New Team (eHealth). The system will load and display all of the data from the spread sheet. Here the various sections that have been built can be viewed. A Click of Icon on the left side of the application will show action tests for Home, Section, and about Us.

The next stage is to publish the application on Play store. In Nativator environment, click on Share, copy the link to the desktop, or scan the QR code. To transform any responsive website into a native mobile app, upload the produced application and type [www.nativator.io](http://www.nativator.io) into the Uniform Resource Locators (URL) address. Download a preview, create a path to the developed app, and then paste it into the Android application configuration. Complete the fields for the Android application and the fields for the iPhone operating system (iOS) application and build. A token is paid to have the application published.

To improve the security of the portal, Smart Authentication alternatives such as Two-Factor Authentication (2FA) and Secure Hash Algorithm (SHA – 2) were considered. The user interface is mobile-responsive, user-friendly, and accessible to a diverse set of users.

The real coding of the eHealth portal begins at this point. The software is constructed based on the design and architecture created in the previous stage. At regular intervals, the code is tested to ensure that it fits the requirements and standards.

**3.0 Testing, Results and Discussion**

This section describes the tests and results obtained from the interaction with the developed eHealth portal. You can access this page by typing this link: <https://www.tclnetwork.org.ng/eHealth/ICT/proj2/index.php>. As illustrated in figure 2, this home page will be presented for you to navigate through the portal once you sign up and sign in. You may also download the eHealth smartphone application using this link: <http://ehealth-solution.glidepp.io> or by scanning the QR code.



Figure 2 Home Page of E-Health App

This is the sign-up form for the eHealth Portal. The patient will be asked to register by providing information as indicated in Figure 3a and 3b, including his first and last names, telephone number, email address, password, gender, and national identity number (NIN).



Figure 3a Sign up Page



Figure 3b Sign up Page

The user must login after successfully registering using the (2FA) code supplied to his email or mobile device and the password he set during sign up, as illustrated in figure 4. After providing both, the user is verified and given access to the medical server.



Figure 4 Two Factor Authentication Login Page

As seen in figure 5, the patient can now browse the platform's services that are offered. The navigation page lists every service provided by the eHealth site (Our specialist Doctors include Infectious Disease, Neurologist, Allergies, Dermatology, Ophthalmology, Obstetrician/Gynecologist, Cardiologist, Gastroenterologist, Endocrinologist, and a toll-free Telephone number).



Figure 5 Portal Navigation Page

It's a live chat with the doctor right now. As shown in figure 6, the portal is connected to the doctor's WhatsApp phone number to allow patients to talk with the doctor and receive appropriate guidance regarding their health.



Figure 6 Live Chat linked to Doctor WhatsApp Phone Number



Figure 7 Live Chatwith Doctor WhatsApp Phone Number

Figure 8 depicts the illness prediction start check up page. When you click start checkup, a quick, safe, and anonymous health checkup is requested as shown in figure 9



Figure 8 Disease Prediction Start up page



Figure 9 Disease Prediction Hallow

You must accurately enter your age on this page in order to receive the disease prediction result depicted in figure 10.



Figure 10 Disease Prediction Age Check

Animation for disease prediction. Parts of the human body are divided. Clicking on the area of your body that hurts will prompt you with basic questions that you must respond to as shown in Figure 11.



Figure 11 Disease Prediction Body Animation

This is a requirement under the terms and conditions of using the checkup services. The illness prediction checkup, as depicted in figure 12, cannot be used unless the terms of service and privacy policy have been read and accepted (checked).



Figure 12 Disease Prediction Terms and Conditions

13 – 16, clicking the chest generates (Yes or No) fields of questions for the user to respond to. Any unanswered question at submission, you will be prompted to go back and respond to it before you can proceed to the next page of questions.



Figure 13 Disease Prediction Drop down Questions



Figure 14 Disease Prediction Follow up Questions



Figure 15 Continuations of Disease Prediction Questions



Figure 16 Last parts of Disease Prediction Drop down Questions

The outcome of the result will be shown, as in figure 17. The page will display the indicated ailment, the underlying cause, and a disclaimer stating that the material is offered primarily for educational reasons and is not a qualified medical opinion and should not be taken as medical advice or a doctor's opinion.



Figure 17 Disease Prediction Result

Table 1 Summary of Test and Results

FEATURE	STATUS	FUNCTION TEST	RESULTS
Register / Signup	Implemented	Tested	Home page was Displayed
Scan QR Code	Implemented	Tested	Home page was Displayed
2FA	Implemented	Tested	OTP was sent to the email as well as the SMS
Login	Implemented	Tested	Displayed (2FA) Window
Live Chat	Implemented	Tested	Successful
Disease Prediction	Implemented	Tested	Successful
Mobile App	Implemented	Tested	Successful

### 3.1 Discussion

Table 1 depicts the summary of the test that were done on the eHealth portal and the findings. As soon as the web address is entered into the Uniform resource Locator (URL) address bar, the sign-up pages appeared. Also visible is the home page. The home page was also shown after scanning the QR code with an Android phone. One Time Password (OTP) was sent to the user's email address and texted to the phone number as an SMS. The code was obtained and used as the authentication method to access the portal. The eHealth portal has the ability to address many of the issues that patients confront when it comes to receiving healthcare services. The portal will improve healthcare access, minimize the stress of travel and time off work for patients, and improve healthcare delivery efficiency by providing a remote option for patients to receive healthcare services.

The portal's smart authentication capabilities, such as Two-Factor Authentication and SHA – 2 Algorithm, will assist in protecting patient data and ensure data privacy. This will help patients and healthcare practitioners gain trust in the portal, as well as boost user acceptability and adoption.

### 4. Conclusion

An eHealth portal has the potential to bring enormous benefits to patients, healthcare professionals, and healthcare systems. The portal will assist bridge the healthcare gaps between rural and urban communities by harnessing technology to increase access to healthcare services in remote locations.

The intelligent authentication system will provide strong security measures to secure patients' sensitive medical information while also maintaining data privacy and confidentiality. The site will also help healthcare providers make better decisions, allowing them to give better treatment to patients. Patient empowerment can also be promoted by increasing access to medical information, health education, and preventive healthcare interventions.

### Reference

- (Efe, 2013). (2013). Health care problem and management in Nigeria. *Journal of Geography and Regional Planning*, 6(6), 244–254. <https://doi.org/10.5897/jgrp2013.0366>
- Fadahunsi, K. P., Akinlua, J. T., O'Connor, S., Wark, P. A., Gallagher, J., Carroll, C., Majeed, A., & O'Donoghue, J. (2019). Protocol for a systematic review and qualitative synthesis of information quality frameworks in eHealth. *BMJ Open*, 9(3). <https://doi.org/10.1136/bmjopen-2018-024722>
- Nmorsi, W. C. (2019). Challenges of Health Care Delivery in Rural Nigeria: Impact on National Development. *Journal of Resourcefulness and Distinction*, 17(1), 1–9.
- Popoola K. O., O. O. & U. E. (2022). <https://dx.doi.org/10.4314/etsj.v13i1.11>. 134–146.
- van der Kleij, R. M. J. J., Kasteleyn, M. J., Meijer, E., Bonten, T. N., Houwink, E. J. F., Teichert, M., van Luenen, S., Vedanthan, R., Evers, A., Car, J., Pinnock, H., & Chavannes, N. H. (2019). SERIES: eHealth in primary care. Part 1: Concepts, conditions and challenges. *European Journal of General Practice*, 25(4), 179–189. <https://doi.org/10.1080/13814788.2019.1658190>
- Widberg, C., Wiklund, B., & Klarare, A. (2020). Patients' experiences of eHealth in palliative care: an integrative review. *BMC Palliative Care*, 19(1), 1–14. <https://doi.org/10.1186/s12904-020-00667-1>
- World Health Organization, & The World Bank. (2015). *Tracking Universal Health Coverage - First Global Monitoring Report*. 1–86