Design And Implementation Of An Sms And Email Based Interactive Online Medical Record Management System

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Abstract

In contemporary time, the increasing cost involved in running an SMS and email-based interactive online medical record management system make it difficult for medical practitioners such as medical doctors, laboratory scientists vis-à-vis their patients' not to have easy access to medical records of their clients. Hence, the existing medical system could be said to be devoid of SMS and email notification. This paper was borne out of the necessity to develop an online medical record management system that would allow both medical practitioners and their patients to exchange vital information is core their wellbeing, especially via online platforms such as SMS and emails notifications. This paper is an ex-post facto research, wherein content analysis was utilized as a method of data analysis. Nevertheless, the Object-Oriented Analysis and Design Methodology (OOADM) was adopted as the model for the new system. The project implementation was done using HTML, CSS, JavaScript and PHP. MySQL was used to design the database while the code was written in Notepad++ IDE. The paper proposed that online medical record management system with SMS and email notification would create and update patient's profile, manages schedules between a doctor and a patient, gets patient's symptoms, saves laboratory test results and doctor's prescriptions as well as utilize SMS and email to notify users when necessary. The system was tested and the results of the test showed that the system was quite efficient, fast, accurate and secured. Similarly, the paper revealed that vital notifications are communicated instantly using SMS or email. Human errors like omission and mutilation are not obtainable in the new system. Medical records are safely stored in a secure server and globally accessible to every authorized user irrespective of time and location.

Keywords*: SMS, Email, Medical Record, Electronic Medical Record, Interactive Online Medical Management System*

I.   Introduction

Medical records constitute essential tools that hospitals need to achieve the missions and visions unique to each institution. The terms medical record, health record, and medical chart are frequently used interchangeably to refer to the systematic documentation of an individual patient's medical history and treatment over time within a particular healthcare provider's domain [1]. Having timely access to sufficient medical records streamlines the patient's medical care, making it easier, faster, more precise, efficient, and effective. Undoubtedly, the significance of medical records cannot be overstated. With the rise of Information and Communication Technology (ICT), diverse fields of human endeavor are progressively employing technologies to boost accuracy, efficiency, and operational speed.Consequently, the medical sector is no different. Aligning with the above view, [2] observed that the deployment of ICT in the medical field came a necessity following the surge in the quality of patient healthcare in contemporary times as it depends so much on availability, timely acquisition and processing of clinical information as it pertains to patients in hospital. [3] Further noted that the above development in the health care sector, has shown a significant paradigm shift from the era of physician centeredness to emphasize more on the quality of patient care from an isolationist based practices by care givers to networking in a globalized world for a more effective collaboration amongst health practitioners. Aligned with this trend, according to [4], recent advancements, deployment, and enhancements in information systems have bolstered the business strategies of the healthcare sector, thus enhancing the quality of life for patients. Nigerian hospitals have embraced this global phenomenon-. However, the adoption of information technology in Nigerian hospitals is currently rudimentary, with most hospital using manual medical record management systems. This system has caused stress and as such consumed time for medical practitioners, as patients' records cannot be accessed easily outside the hospital. More so, the manual medical record management system also has its own flaws as patients' records are often exposed to disasters and unauthorized access. There are also cases where medical practitioners had to report cases of damage to records by rodents and loss of patient data confidentiality by cleaners, patients who waiting in vain for doctor's appointment as well as the likelihood of patience

experiencing repeated visits to hospital for laboratory test results [5, 6].

Consequently, it is against the above backdrop, that this paper seeks to design and implement an SMS and email based interactive online medical record Management system for Nigerian hospital in bid to addressing some of the challenges inherent on manual medical record management systems in Nigeria. This paper also suggests a novel system enabling doctors and patients to coordinate schedules and exchange patients' laboratory results through email and SMS. Essentially, the proposed system aims to enhance the efficiency of hospital medical record management systems, thereby elevating the quality of patient care in Nigerian hospitals.

II.   Related Works

Extant literatures have shown that there are growing concerns on the orthodox method of record keeping in most Nigerian hospitals and as such, this worries have led to the quest for the deployment of ICT in the area of management of patients' information system in Nigeria [5, 6, 7]. To achieve the transition from the traditional health record system of patients to a new innovative electronic record requires the comprehension of certain key concepts such as Information System, Management of Information system, Electronic Medical Record System (EMR), Benefits of EMRS and some of the existing challenges facing EMRS.

Information System (IS): Information Systems (IS) consist of interconnected components that gather, store, handle, and transmit both data and digital information [8]. It is conglomerate of data, hardware, software, processes working harmoniously with computer system to transform raw data into useful information. [9] affirmed that IS has wide applicability aside from playing significant roles in decision making. Thus, it supports numerous business functions such as those related to accounting, finance, human resource management, marketing, operational and supply chains of businesses. It is pertinent to note that IS, is different from Information Technology (IT). While IS supports knowledge management and communication, IT on the other hand; aids data sharing across departments. Thereby providing a consistent data for analysis across variety of teams [8].

Management of Information System (MIS): This represents a significant computer-based information system that includes an Enterprise Resource Planning (ERP) System, Customer Relationship Management (CRM) System, Transaction Processing System (TPS), and Decision Support System (DSS). Its aim is to meet the informational requirements of an organization [10, 11]. Emphasizing on the MIS, [12] observed that Management Information Systems (MIS) transform internal data into actionable information, enabling managers to make informed decisions for planning, directing, and controlling their responsibilities. Similarly, [13] suggested that the healthcare sector is a domain where Management Information Systems (MIS) find application. Additionally, the author suggested that Health Management Information Systems (HMIS) offer a more adaptable approach to healthcare information administration and management. This approach hinges on the tactical, strategic, and operational utilization of diverse IT and advanced systems concepts to enhance healthcare service delivery from both group and organizational perspectives. [14] verified that in contemporary times, there is a range of Health Management Information Systems (HMIS) applications, which encompass Integrated Enterprise data systems such as Computer Physician Order Entry (CPOE) and Clinical Decision Support System (CDSS). These systems are devised to enhance integrated healthcare delivery systems worldwide.

Electronic Medical Record System (EMR): This refers to an automated organizational record system documenting all patient interactions with medical facilities and personnel. It encompasses diverse sources pertaining to patient treatment, diagnosis, laboratory tests, medical history, prescriptions, and allergies, accessible across multiple platforms. Electronic Medical Records (EMR) could be applied in the management of real-time patient health records by providing access to evidence-based decision support tools to assist decision-making processes within an organization [15, 16, 17]. EMR systems are typically automated and aligned with a clinician's workflow to ensure comprehensive communication of clinical information, thereby minimizing delays and gaps in healthcare delivery. Furthermore, EMRs can streamline data collection for purposes extending beyond clinical care, such as billing, quality management, outcome reporting, public health disease surveillance, and reporting. Moreover, they may incorporate features like a Clinical Decision Support System (CDSS), a Computerized Provider Order Entry system (CPOE), and a controlled medical vocabulary or result reporting system. Interoperability among EMR systems are achieved when they exchange data using standardized data transmission formats [17]. In Nigeria, EMR, could serve as a clinical data repository, decision support system, and controlled medical vocabulary. It is pertinent to note that it was introduced in 2007 as a component of a three-year strategic plan aimed at reforming the National Health Management Information System. During this period, efforts were directed towards enhancing data collection capabilities and system integration to support the planning, monitoring, and evaluation of health services in the country. As part of this initiative, the Public Health Care Information System was introduced to monitor child health outcomes and immunization rates [18]. According to [19] in 2015 Nigeria was among the lists of countries having E-health profile for 2015. This indicates that we are yet to achieve this.

Benefits of Electronic Medical Record System (EMRS)

A review of empirical literatures showed that EMRS has numerous merits. EMR has not only enhanced clinical decision as well as flow of patient medical information but also ensure the accuracy of patients' medical data. From the work of [20], it was deduced that EMR has aided medical provider with easy access to patient's medical history thereby reducing the unnecessary protocol associated with the orthodox record system. Similarly, it has also helped to reduce errors which is associated with the use of handwritten orders vis-à-vis assisting patients to read discharge instructions perfectly. Furthermore, [14] observed that, EMR has brought about increased satisfaction for both patients and medical service provider. Suffice it to say that it helped to reduce the level of corruption associated with health care service provider. On the other hand, EMR system has been able to ensure easy access to patient information, medical test and a list available medical history within a given health centre. In similar vein, it is expected that EMRs would guarantee accountability for funds and medical supplies. The introduction of EMR system amongst different health care system could help to reduce the rate of corruption or issues or cases associated with patients having to pay cash directly to health care systems around the world. Aligning with the above view, [21] observed that computerized system has helped track supplies, accounts for profit and losses as well as controlling inventory and process payroll. More so, it has enhanced automated storage and retrieval of Patient data. It's essential to highlight that affordable EMR technologies have significantly reduced reliance on paper, which is a common practice in many conventional healthcare systems worldwide. Consequently, EMR system technologies enable extensive electronic storage of sensitive paper files, ensuring the protection of health information. Through various hardware and software devices, EMR systems can securely capture, print, scan, store, and retrieve medical documents. According to [22], EMR systems optimize clinical time through effective communication and enhanced compliance with regulatory guidelines. Similarly, [23] noted that EMR systems are highly effective educational tools for training doctors and medical students, offering significant potential in research and clinical protocol development.

Existing Challenges of Electronic Medical Record System

Scholar such as [24, 25, 26] and [27] amongst other posited the following under listed points as some of the challenges of EMR system adoption in any given health care system.

1. Resistance to the implementation of EMR amongst user is one of the major challenges facing EMR adoption in any country. This is mainly caused by the attitudinal disposition of clients in some health sector. For instance, [24] noted the level of mixed feelings associated with the adoption and IT implementation in health care systems in developing countries. He observed that the natural inclination of most users to the orthodox form of recording keeping has impeded the acceptance of EMR in most health sector in such regions.
2. Removing the human aspect of the health care system: This challenge stems from the analogy that EMR adoption has the tendency to turn provider-patient relationship into a proxy system. [25] observed that EMR implementation nationwide has the capacity to diminish human touch between healthcare providers and their patients.
3. Perception of Patients about E-health policy: According to [27] pinpointed that hospitals are not likely to adopt EMR system in their centers'; if patients conceive that its adoption would not guarantee their safeguard. Based on this most government, especially those in developing countries are currently developing or at one point in time have developed Act or law geared toward ensuring security of Information.
4. Public perception of EMR investment: According to [24], one of the major constraints facing EMR adoption and implementation in any country is that the public might be reluctant to permit government allocation of tax-payers' money to E-health policy. As exemplified by the aforementioned scholar, only four (4) in every ten (10) US citizens favored government funding and investment to support EMR adoption and implementation, this was based on a national wide survey of American consumers on Healthcare reform.
5. Legal Requirement: According to [28], hospitals can eliminate paper-based patient records, potentially making patient registers unnecessary. Computer systems can replace these registers, reducing their relevance and posing a challenge to EMRs adoption in hospitals.

III. Methodology

This paper used the Object-Oriented Analysis and Design Methodology (OOADM), a technical approach that integrates object-oriented programming and visual modeling to analyze and design applications. Unlike other methodologies, OOADM was deemed appropriate for this paper because its requirements are organized around objects, which integrate both behaviors (processes) as well as modelled after world objects that systems interacts with. More so, the project implementation was done using HTML, CSS, JavaScript and PHP. MySQL was used to design the database while the code was written in Notepad++ IDE. This system is deemed efficient, fast, accurate and secured.

The use of case diagram entails the proposed online medical record system. It is made up of three classes of users namely patients, doctors and lab scientist. The system allows the patient to register or login, enter bio-data, pay, enter symptoms, view lab result, view prescriptions, manage schedule and logout. The doctor is allowed to register, login, view patient's bio-data, view patient's symptoms, and view patient's lab result, make prescriptions, and manage schedules and logout. The lab scientist can register, login, select a patient, and enter patient's lab test result and logout.

IV.   System Design and Result

Registration Page/Log In: This is an interface where the user register of the system and access the necessary patient health resources.
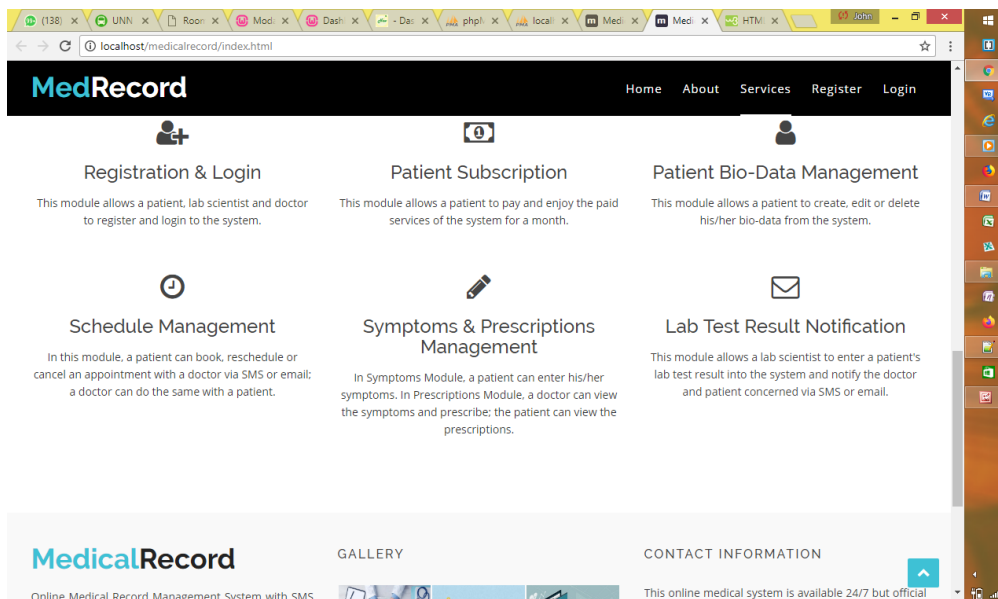

Figure 23: User Interface Implementation
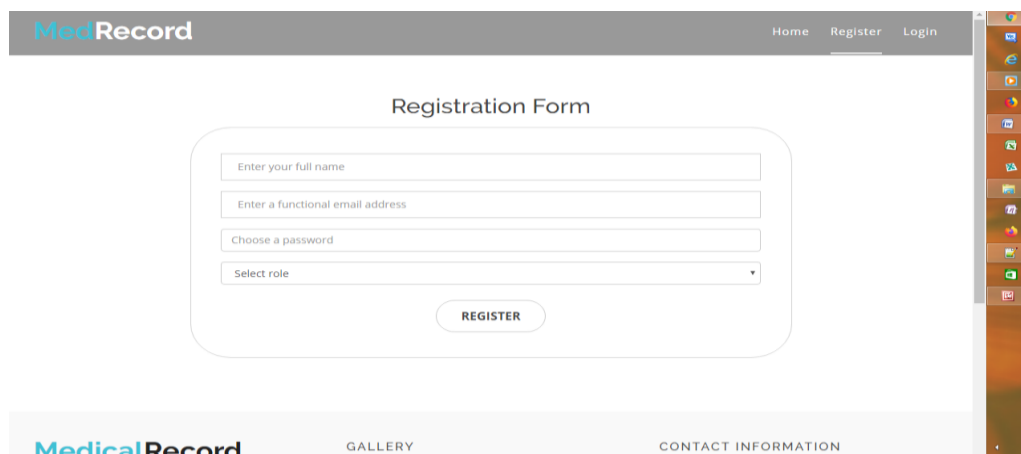

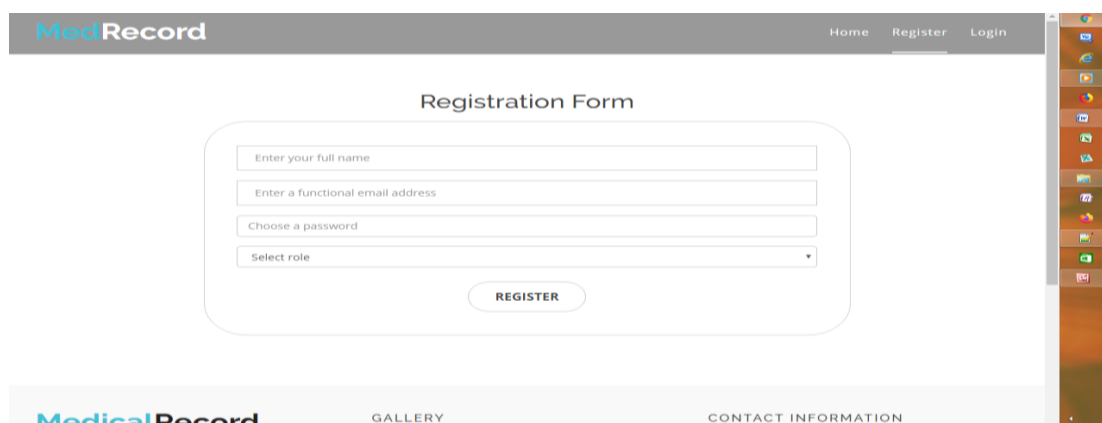**Figure 24: User Registration Implementation**

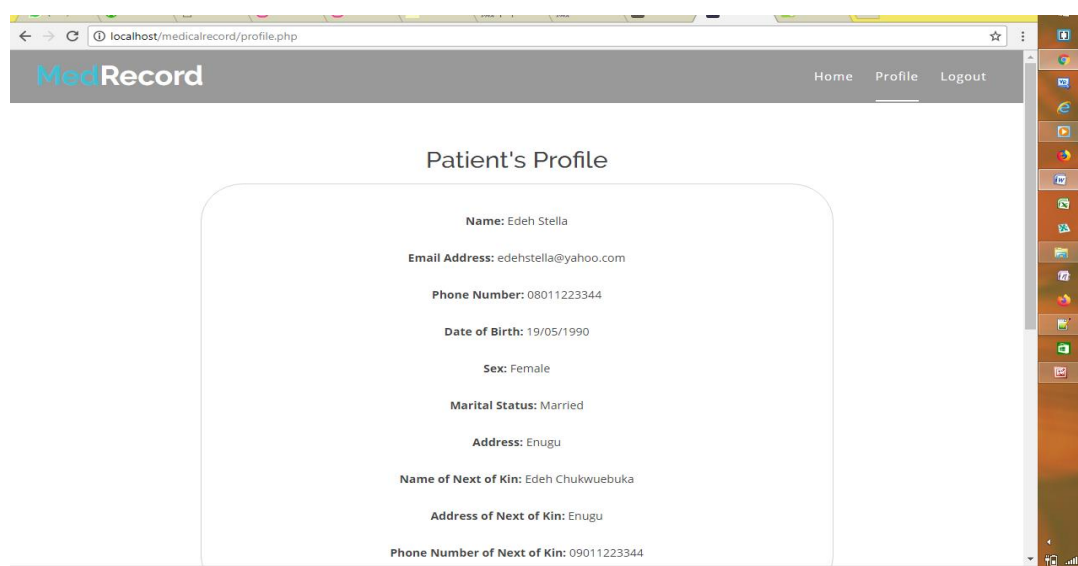**Figure 24: User Registration Implementation**

Figure 26: Patient Profile Implementation

V.   Discussion And Conclusion

At the end of the software development exercise, the following achievements were recorded:

• The researchers designed and implemented a web-based system that allows a patient to register, login, enter bio-data, pay, enter symptoms, view lab result, view prescriptions, manage schedule and logout; allows a doctor to register, login, view patient's bio-data, view patient's symptoms, view patient's lab result, make prescriptions, manage schedules and logout; and allows a lab scientist to register, login, select a patient, enter patient's lab test result and logout.

• The system was verified and found to be consistent with the predefined system specifications. It was also validated to be sure it satisfies user expectations. The verification and validation exercise proved that the developed system is of high quality and that it works as expected.

• The performance of the proposed system was equally evaluated and it was found that the system performs optimally. The response time of the system is reasonable given an average of 50 concurrent users.

In peroration, this paper successfully designed and implemented an online medical record information management system that includes SMS and email notifications. The development of this system allows a patient to register, login, enter bio-data, pay, enter symptoms, view lab result, view prescriptions, and manage schedule and logout. A doctor is allowed to register, login, view patient's bio-data, view patient's symptoms, and view patient's lab result, make prescriptions, and manage schedules and logout. A lab scientist can register, login, select a patient, and enter patient's lab test result and logout. Given the results of the system testing and system performance evaluation exercises, the system can be adjudged to be of high quality and high performance.

VI.   Recommendations

The paper puts forward several recommendations. Firstly, it suggests that hospitals, laboratories, and analogous institutions in Nigeria should adopt the proposed online medical record information management

system, along with SMS and email notification features. This implementation is expected to improve speed, accuracy, data security, accountability, and overall performance in their hospital record management systems. Secondly, to ensure the effective operation of the proposed system, hospitals should ensure adequate power supply and a strong Internet connection for online doctors and lab scientists. Lastly, hospitals transitioning to the new system should raise awareness among the public about its importance and organize literacy programs to ensure both literate and illiterate individuals can effectively use the system.

In line with these recommendations, the paper suggests that future research should explore the concept of virtual doctors. These virtual doctors could offer quick prescriptions for minor health cases in the absence of a human doctor. Patients should have the option to choose this service if they prefer.

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