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The electronic Patient Diagnosis Management System in Naguru Teenage Information and Health Center

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ABSTRACT

Electronic diagnosis management system is intended to help medics and clinicians in diagnosing clinical cases. Most of the clinicians are still relying on manual clinical diagnosis process. A manual clinical diagnosis is a very complex, cumbersome and error prone process; even very experienced doctors sometimes fail to diagnose a clinical condition correctly at an early stage. Clinical decision support systems assist the clinician in applying new information to patient care through the analysis of patient-specific clinical variables. Many of these systems are used to enhance diagnostic efforts and include computer-based programs such as Dxplain that provide extensive differential diagnoses based on clinical information entered by the clinician. Other forms of clinical decision support systems, including antibiotic management programs andanticoagulation dosing calculators, seek to prevent medical errors and improve patient safety. The electronic patient diagnosis management system is basically to help diagnose medical healthproblems (sickness) of patients by enabling them input the symptoms they are experiencing, the system then analyses them and gives feedback to what the patient could be suffering from. It as well helps to find more information on the symptoms or signs of the disease a patient is suffering from.

Keywords: Patients, Clinicians, Electronic diagnosis management, Clinical decision support systems, Diagnostic efforts.

INTRODUCTION

Clinical diagnosis is diagnosis or the process of accessing the nature of the disease based on its signs, symptoms and laboratory findings. In computer assisted diagnosis, a computer program identifies the disease(s) that fit the identified abnormalities best. Clinical diagnosis can also be defined as an act/process of identifying the nature and cause of a disease or a medical element through carefully studying patient's symptoms and signs, evaluation of patient history, clinical and laboratory examinations [1]. A clinical diagnosis is the most important and critical part of medical and health care system and is vital for treating patients. Many research organizations and companies researched have developed clinical diagnosis similar support systems using various software and computer technologies. Clinical diagnosis support software systems help clinicians in diagnosing clinical cases. Most clinicians are still relying on manual clinical diagnosis processes [2, 3]. A manual clinical diagnosisis a very complex, cumbersome and error-prone process; even very experienced doctors sometimes fail to diagnose a clinical condition correctly at an early stage. This project was purposely intended to design and implement a reliable electronic patient diagnosismanagement system to be used at Naguru Teenage Information/Health Center. Since ancient times, human beings have been trying to solve human problems with inventions and technology. Such inventions and technologies are no exception to solving human illness. Scientists and doctors have always tried to use the latest technological inventions in healthcare for example Rontgen did not invent X-rays to diagnose human elements but it was successfully implemented in healthcare and the technology saved millions of human lives; similar story with other technologies like Microscope, CT Scan, MRI, pacemaker, artificial hearts, prosthetics, robotic surgical arms, digital ECG, EEG and so on, last but not least computers and information technology also includes in that technological adaptations [4]. In the early days of medical-related computer technology, the notion of that computer

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technology could help solve healthcare problems developed much interest and enthusiasm and was prompted for pursuing the use of computers in the medical field. For the past four decades, a new branch of information technology is emerged and proliferated called Health Informatics or Medical Informatics. The case study of this project was Naguru teenage information/health centre (NTIHC). It is located in Bugolobi, approximately 6km from the heart of Kampala city. NTIHC is a pioneer program in providing adolescent sexual reproductive health services in Uganda. It was started as a voluntary activity in 1994 by a group of professional volunteers. Using the recommended method of manually entering key findings, the list of diagnoses suggested by Isabel contained the correct diagnosis in 48 of the 50 cases (96%). Typically, 3–6 key findings from each case were used. The 2 diagnoses that were not suggested (progressive multifocal encephalopathy and nephrogenic fibrosing dermopathy) were not included in the Isabel database at the time of the study; thus, these 2 cases would never have been suggested, even withdifferent keywords. Using the copy/paste method for entering the whole text, the list of diagnoses suggested by Isabel contained the correct diagnosis in 37 of the 50 cases (76%). Isabel presented 10 diagnoses on the first web page and 10 additional diagnoses on subsequent pages up to a total of 30 diagnoses. Because users may tend to disregard suggestions not shown on later web pages, we tracked this parameter for the copy/paste method of data entry: The correct diagnosis was presented on the first page in 19 of the 37 cases (51%) or first two pages in 28 of the 37 cases (77%). Similar data were not collected for manual data entry because the order of presentation depended on which key findings were entered. Both data entry approaches were fast: Manually entering data and obtaining diagnostic suggestions typically required less than 1 minute per case, and the copy/paste method typically required less than 5 seconds. Diagnostic errors are an underappreciated cause of the medical error, and any intervention that has the potential to produce correct and timely medical diagnosis is worthy of serious consideration. Our recent analysis of diagnostic errors in Internal Medicine found that clinicians often stop thinking after arriving at a preliminary diagnosis that explains all the key findings, leading to context errors and 'premature closure', where further possibilities are not considered. These and other errors contribute to diagnoses that are wrong or delayed, causing substantial harm to the patients affected. Systems that help clinicians explore a more complete range of diagnostic possibilities could conceivably reduce these types of errors. Many different CDSSs have been developed over the years, and these typically matched the manually entered features of the case in question to a database of key findings abstracted from experts or the clinical literature. The sensitivity of these systems was in the range of 50%–60%, and the time needed to access and query the database was often several minutes. More recently, the possibility of using Google to search for clinical diagnoses has been suggested. However, a formal evaluation of this approach on a subset of the same "Case Records" cases used in our study found a sensitivity of 58%, in the range of the first-generation CDSSs and unacceptably low for clinical use. The findings of our study indicate that CDSS products have evolved substantially [5-7]. Using the Isabel CDSS, we found that data entry takes under 1 minute, and the sensitivity in a series of high histories using copy/paste functionality allowed even faster data entry but reduced sensitivity. The loss of sensitivity seemed primarily related to negative findings included in the pasted history and physical (e.g., "the patient denies chest pain"), which are treated as positive findings (chest pain) by the search algorithm [8]. There are several relevant limitations of this study that make it difficult to predict how Isabel might perform as a diagnostic aid in clinical practice. First, the results obtained here reflect the theoretical upper limit of performance, given that an investigator who was aware of the correct diagnosis entered the key findings. Further, clinicians in real life seldom have the wealth of reliable and organized information that is presented in the Case Records or the time needed touse a CDSS in every case [9]. To the extent that Isabel functions as a 'learned intermediary', successin using the program will also clearly depend on the clinical expertise of the user and their facility in working with Isabel. A serious existential concern is whether presenting a clinician with dozens of diagnostic suggestions might be a distraction or lead to unnecessary testing. We have previously identified these trade-offs as an unavoidable cost of improving patient safety: The price of improving the odds of reaching a correct diagnosis is the extra time and resources consumed in using the CDSS and considering alternative diagnoses that might turn out to be irrelevant. In summary, the Isabel CDSS performed quickly and accurately in suggesting correct diagnoses for complex adult medicine cases [2, 7]. However, the test setting was artificial, and the CDSS should be evaluated in more natural environments for its potential to support clinical diagnosis and reduce the rate of diagnostic error in medicine. Therefore, this chapter discussed the literature review of the proposed system. The views and opinions of other researchers regarding the concept. The performances of such systems are clearly shown as well as their challenges.

METHODOLOGY

Study Population

The target group included: Doctors, pharmacists, nurses and field-related medics that regardedthe topic or research/study.

Sampling Selection

This involved the categories of persons who participated in the collection of data, that is key informants or personalities and users who intended to interact very closely with the system. These included staff and administrators of Naguru Teenage Information and Health Centre.

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Data collection tools

Interviews, observation and questionnaires were used to collect data. The samples selected were interviewed following some already set questions. Questionnaires were given to the selected sample. Time was set for them to fill in easy and straightforward questions. Formal meetings were arranged for the analyst (researcher) to obtain required informationbasically by asking questions. to get data on ideas, verify understanding of the system and build user confidence in the new system. This method was employed so that the researcher(s) acknowledges the flow of activities at the centre i.e. for instance how manual diagnosis is performed with its related demerits and constraints.

Design tools

PHP and my SQL

In developing the web application, the researcher(s) used a WAMP server. All the PHP scripts developed at this stage were uploaded to the local testing server for the purpose of seeing how they work [10]. The database was also created using My SQL and the connection between the database and the web app was done using PHP.

System Testing Techniques

The researchers used a reliable testing technique to make sure the application is working as itwas intended to. The White box testing technique was the one used to perform the task.

White box Testing

According to [11], White box testing is a method of testing software that tests the internal structures or workings of an application, as opposed to its functionality (i.e. black-box testing). In white-box testing, an internal perspective of the system, as well as programming skills, are used to design test cases. The tester chooses inputsto exercise paths through the code and determines the appropriate outputs. The researchers used white-box testing at the unit, integration and system levels of the softwaretesting process. Through this method of testing, the researcher uncovered many errors or problems. The only thing that this testing technique cannot do is it might not detect unimplementedparts of the specification or missing requirements [12].

Development Methodology

The approach to be adopted in this research is the widely used methodology for system development. That is the System Development Life cycle (SDLC). The following steps were used to develop the system under study.

Preliminary investigation

This phase was conducted for the purpose of determining the cost of operation on the old systems and the cost expected for the new system. The problems with the old system were identified through interviews and questionnaires. Finally, a suggestion to develop thecomputerized system was made and a report was submitted to management.

Data Analysis

The data gathered from the above phase was arranged and prioritized. From the findings of the study, a system's specification was made stating what the system would do to meet the health centre's goals.

Systems design

Involved Definition of the architecture, components, modules, interfaces, and data for thesystem to satisfy specified requirements for the proposed system.

Logical design

This takes an abstract representation of the system's data flows, inputs and outputs of the system.

Physical design

Shows the actual input and output processes relating to the system proposed.

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Research design

The research design depended on the workers and patients from whom data was collected by useof observations and then samples taken.

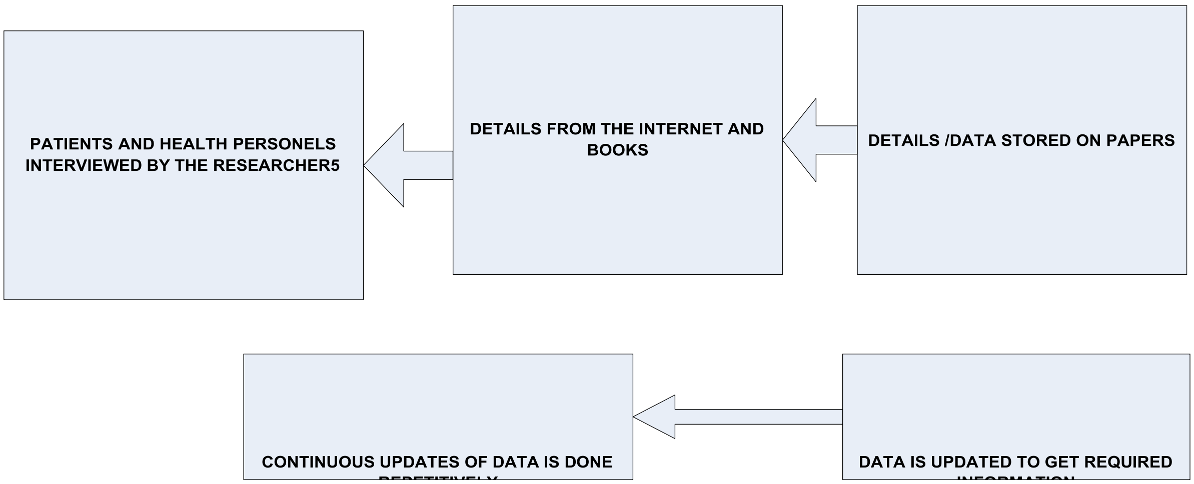

Figure 1: Data collection verses systems role

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Therefore, this chapter the methodology or the techniques that the researcher used in the processof carrying out research. The system that was developed was structured on a constructive well-defined systemmethodology and reliable fact-finding techniques. The researcher(s) explained the way different activities were carried out during the entire methodology development phase from requirement elicitation, system design, system building and system testing.

RESULTS

Data analysis

This section shows the outcomes of the study that we carried out. In the study, we usedinterviews, orals questions as well as questionnaires. These are the sample questions that we asked when interviewing one of the health workers at NTIHC.

Data Collection Results

Question	Respondent answers		
Please may you tell us your names	Yes	No	Open
Have you ever taken part in the diagnosis of any healthproblem?	Yes		
How many times?			Daily
Do you encounter any challenges?	Yes		
What are some of the challenges?			Speed
How did you overcome the challenge?			Open
Do you think a computerized system could be moreeffective in the diagnosis process?	Yes		
What new ways do you think diagnosis can be improvedupon?			Open
Would like to support this research project research?			
Any more comments		No	

Table 1: Questionnaire showing the response of the potential system users

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Possible users of the developed system

Possible system users	Percentage
Doctors	80%
Pharmacists	60%
Clinicians	70%
Nurses	50%
Midwives	40%
Other users	50%

Table 2: shows the percentage of possible users of the new system

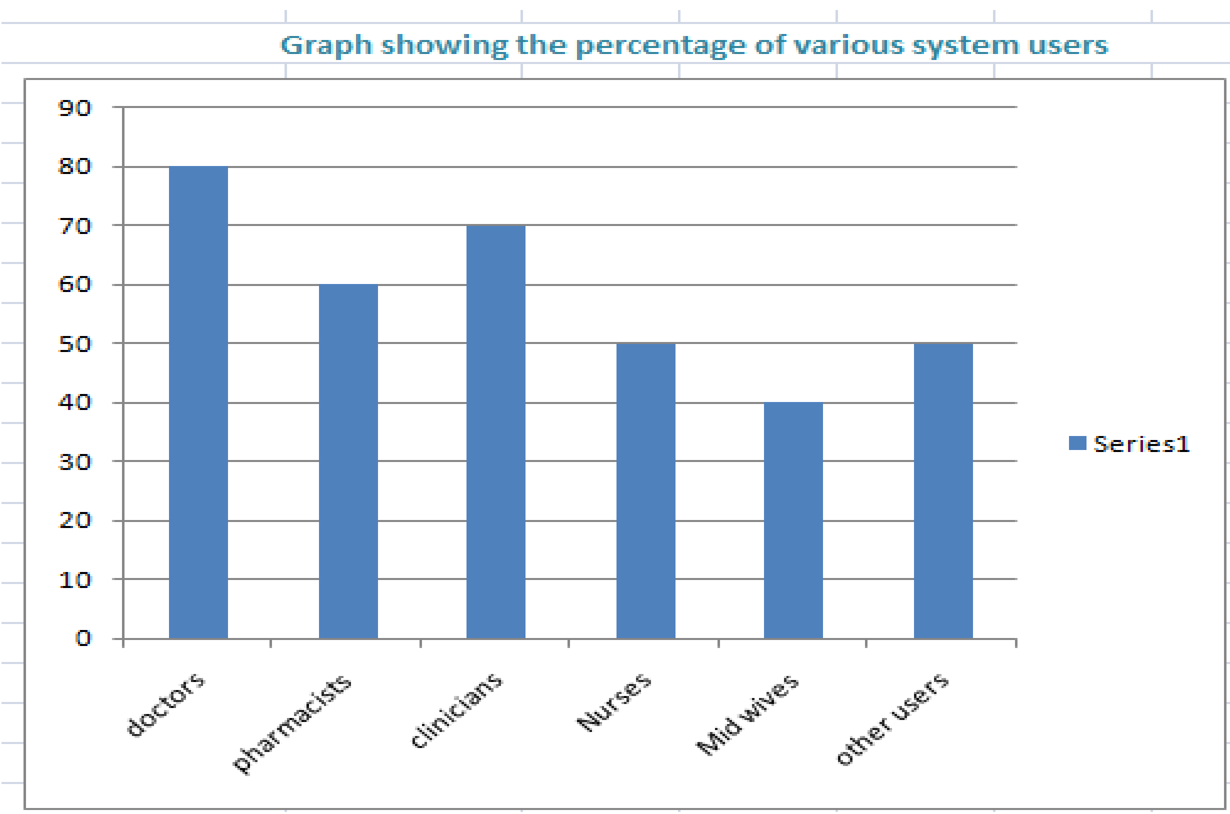

Figure 1: showing a bar chart of the percentage of various system users.

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Interpretation of the bar Graph

From the bar graph above, we can observe that the highest portions of the possible system users are doctors. (With a percentage of 80%). for reasons being that most medical diagnosis procedures are mainly carried out by doctors and the new system can quicken this activity. Clinicians follow doctors in percentage (70%). Clinicians also diagnose patients although much of their work is selling medical drugs and services. They can be assisted by the system during thediagnosis. Pharmacists are the third highest possible users of the EPDMS, pharmacists prescribe and offer medications [13-15]. They as well as diagnose several health conditions of their clients/patients. Nurses are the second last possible users of the system. The nursing work does not involve much of diagnosis but they can still use the system to discover more information about different health problems. They take a percentage of 14% from the pie chart. The least possible users of the system are mid wives. The nature of their work is basically manual, not computer based. Making the potential to use the EPDMS so reduced. They take the least percentage from the pie chart above.

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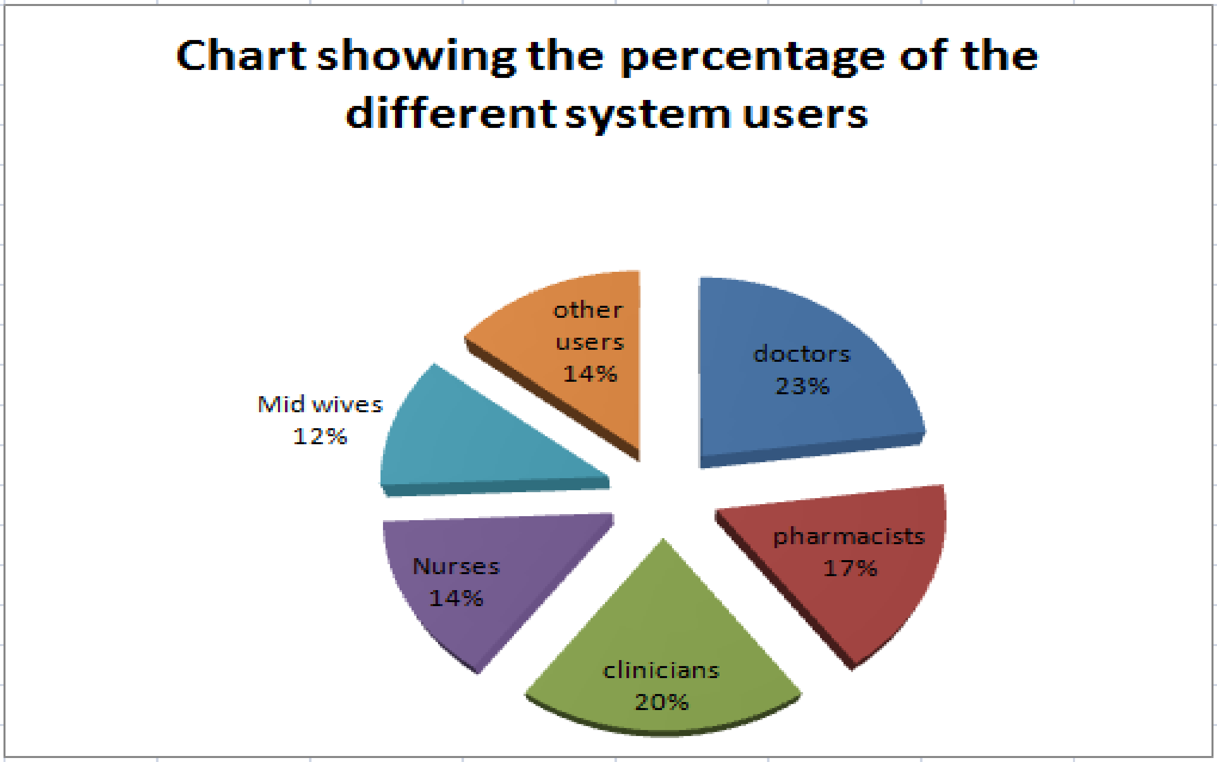

Figure 3: Showing a pie-chart of the different users

Interpretation of the pie chart

Of all the possible users of the new system, it is evident that doctors take the greatest percentage (23%), for reasons being that most medical diagnosis procedures are mainly carried out by doctors. They examine patients one on one and this gives them thorough information enough to write prescriptions for the patients. Second to the doctors are clinicians. Second to the doctors in percentage are clinicians. They also perform diagnosis although they prescribe and sell medication drugs. They take a percentage of 20% from the chart above. Pharmacists follow clinicians in percentage. This is because they do not perform diagnosis so frequently, instead they mostly do Drug prescriptions. Nurses are the second last possible users of the system. The nursing work does not involve much of diagnosis but they can still use the system to discover more information about different health problems. They take a percentage of 14% from the pie chart. The least possible users of the system are mid wives. The nature of their work is basically manual, not computer based, making the potential to use the EPDMS so reduced. They take the least percentage from the pie chart above.

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Financial costs incurred during the research process

Data collection and analysis involved several costs and expenses. It constituted much paper work. Printing of questionnaires, record note books and other stationary. We also encountered travel costs, each time we had to go to the health center. However, above all that challenge we acquired data collection experience and techniques. Our interview skills improved and this process added great value to our research. Finally, this chapter covered data analysis, presentation and interpretation. Data analysis involved interview and questionnaire questions. Data analyzed were presented in form of charts that is bar graphs and pie charts. The data presented were interpreted immediately after the respective presentation illustrations (after the graphs and charts).

DISCUSSION

Systems requirements and analysis specification

This section looked at what the research intended to collect on the existing system and the areas to be investigated and these included;

User requirements for the new system

These were the requirements which the system should avail for smooth running of the tasks by the users. These were as follow;

- The system was developed with different compatibilities so as to work or run on differentprocessors of different computer types.
- Diagnosing a given health problem especially an infectious disease.
- It was developed to allow its user to learn more about certain health problems
- It was developed to be relatively fast and reliable when diagnosing health problems.
- It was developed to ease the process of inputting, storing, updating and outputting ofdata.
- It was developed to combat some errors that the different system users might be prone tomaking.

Functional requirements

These were requirements that the system was developed for to perform the required tasks orservices. They include the following;

I. To have a system that will allow users to diagnose a given health problem, especiallyinfectious diseases.
II. To have a system that will allow the user to learn or have more information aboutdifferent health problems and diseases.
III. The system was developed to allow data input from the forms and storage in the intendeddatabases.
IV. The system was developed to allow the different users to view the required information.
V. The system was developed to work securely as well as store data.
VI. The system was developed to allow easy access of data required by its respective users authorized/non-authorized users.
VII. The system was developed to allow the automatic Detection of errors.
VIII. The system was developed to allow easy access, retrieval and update of data

Nonfunctional requirement

These were requirements that constrained the system functionalities and include;

- Ability to notify the user in case of anything (Success / Failure / unexpected situation)
- Ease of Navigation from screen to screen.
- User Friendliness
- The system building was to be completed within the stipulated time.
- The system building was to be completed with the use of stated requirements.

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- The system users were to require less training to operate the system.

Systems requirements

The building of the system required the following;

- Webpage designs.
- Form design.
- Database design.
- Coding.
- Testing.

Software requirements

- Windows operating system.
- Database Management System (wamp server, MYSQL).
- Dream weaver (dream weaver cs6) for PHP coding.
- Web browser.

Hardware requirements

- Processor.
- RAM disk.
- Pentium IV or dual core.
- Hard disk 60 or higher.

System design

The system was designed to complement the existing manual one which was associated with numerous challenges in the running of the duties at the health information centre, for example reduced speed. The new system is modernized with friendly graphical user interface and database system that makes patient diagnosis easier. The system is designed to run on a web browser for quick accessibility by the authorized users. The system was automated to allow a user learn more about certain health problems anddiseases.

Description of the system

The system was designed to have login interface, database, forms, to allow easy access, storage retrievals, updates, and user interaction as well as easy data manipulation. The system has forms which act user interface to allow user interaction, database to allow storage of data in a very much secure way to allow easy access of information. The system is associated with a login form which requires password and a username to access the system to prevent unauthorized users. The database tables were built with level of integrity, accuracy and consistency.

System development life cycle

The section dealt with how activities of building the system were packaged or broken to allow quick construction. The user interface for interaction, the databases for storage of data and the reports to output the data required.

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System Prototype

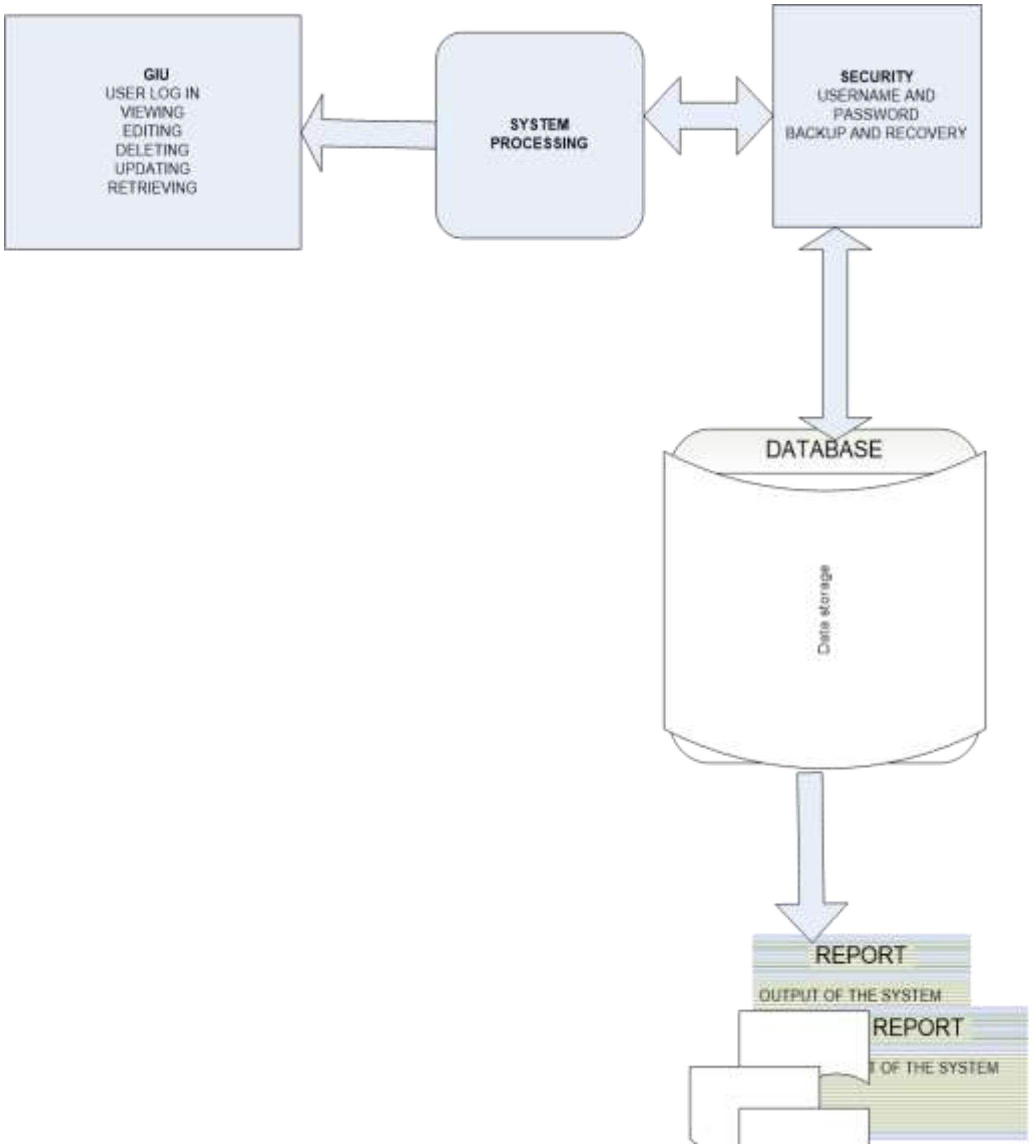

Figure 4: System prototype

System testing and verification

The process of testing and verification of the system was carried out throughout the system development and different pieces of the system were combined together to determine how well they can perform their tasks. The top down approach of integration was used to identify defaults.

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Through this, the system meets the required objectives [16, 17].

Specification requirements.

This shows full explanation of the behaviors of the proposed system as bellow;

- Accuracy

The constructed system provided proper, order, organize and collect services expected to beperformed by the users in the process of operations.

- Consistency

The system minimizes data redundancy in the performance of its tasks. This helps to allowconsistency to be achieved in the operations performed by the users.

- Reliability

The proposed system provides a reliable storage task to the information inputted through thegraphical user interface.

- Ease of operation

The proposed system cheapens the tasks performed without delay and wastage of time.

Safe storage

The proposed system provided proper secured storage of data.

- Immediate retrieval

The proposed system allows quick search and update of the data.

Entities and attributes

The information to be captured by the system was mostly about the following entities as below;Health professionals/Medics.
Patients.
Interested. users.
Non. health staff.

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The Entity Relationship Table

Entity	Relationship	Entity
Health professional	Treats	Patients
Non health staff	Directs	Patients
Health professional	Trains	Health trainees

Table 3: Showing relationships between entities

The Entity Relationship Diagram

The relationship and the entities were used to draw the case diagrams, data flow charts and entityrelationship models for conceptual design. The logical and physical designs were used in the database of development phase of the project. The design of the new system took the following symbols;

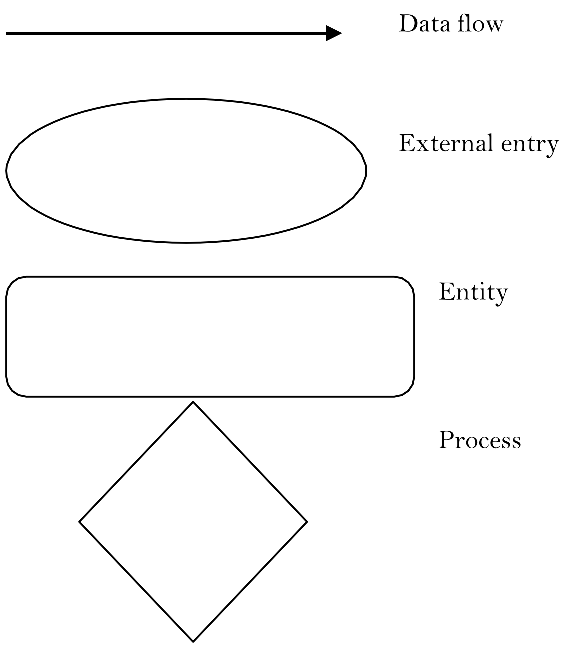

Figure 5: System symbols

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Simple Data Modal

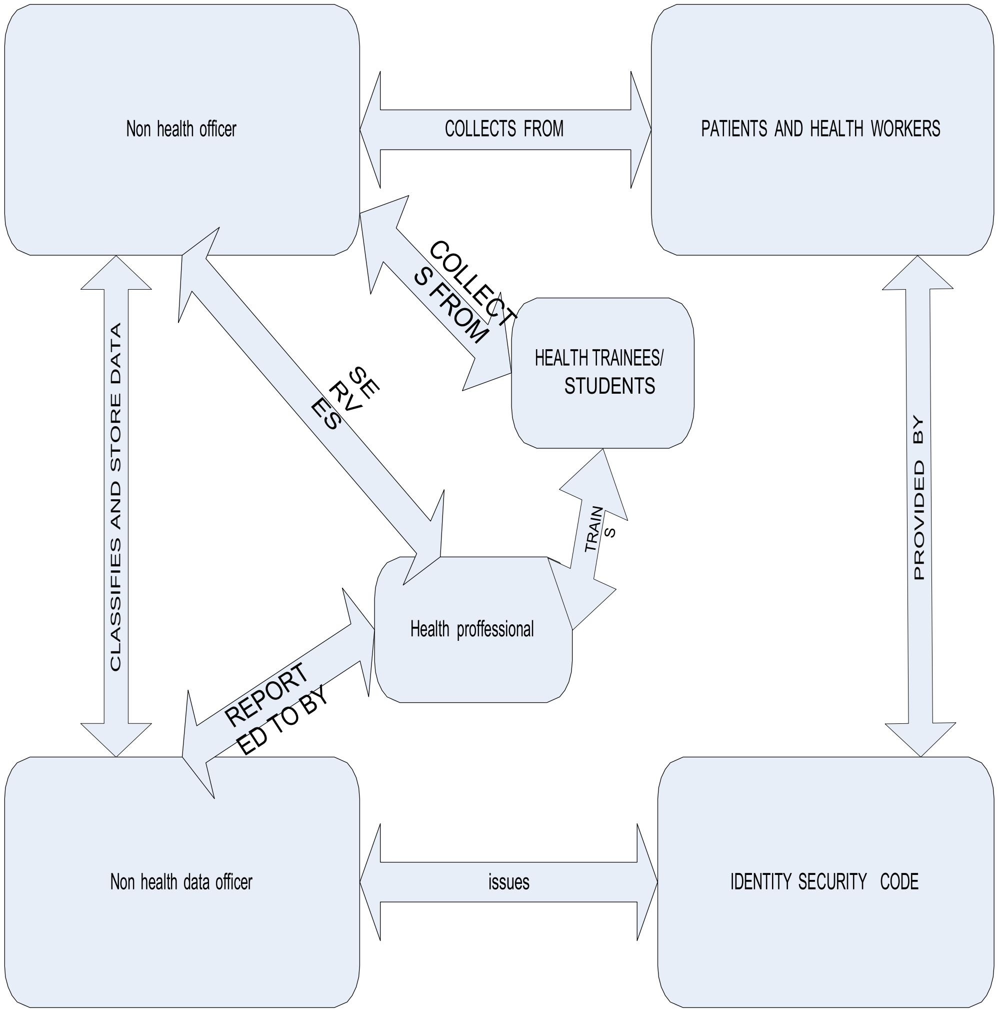

Fig 6: Showing a simple data model of the system

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Activity Diagram

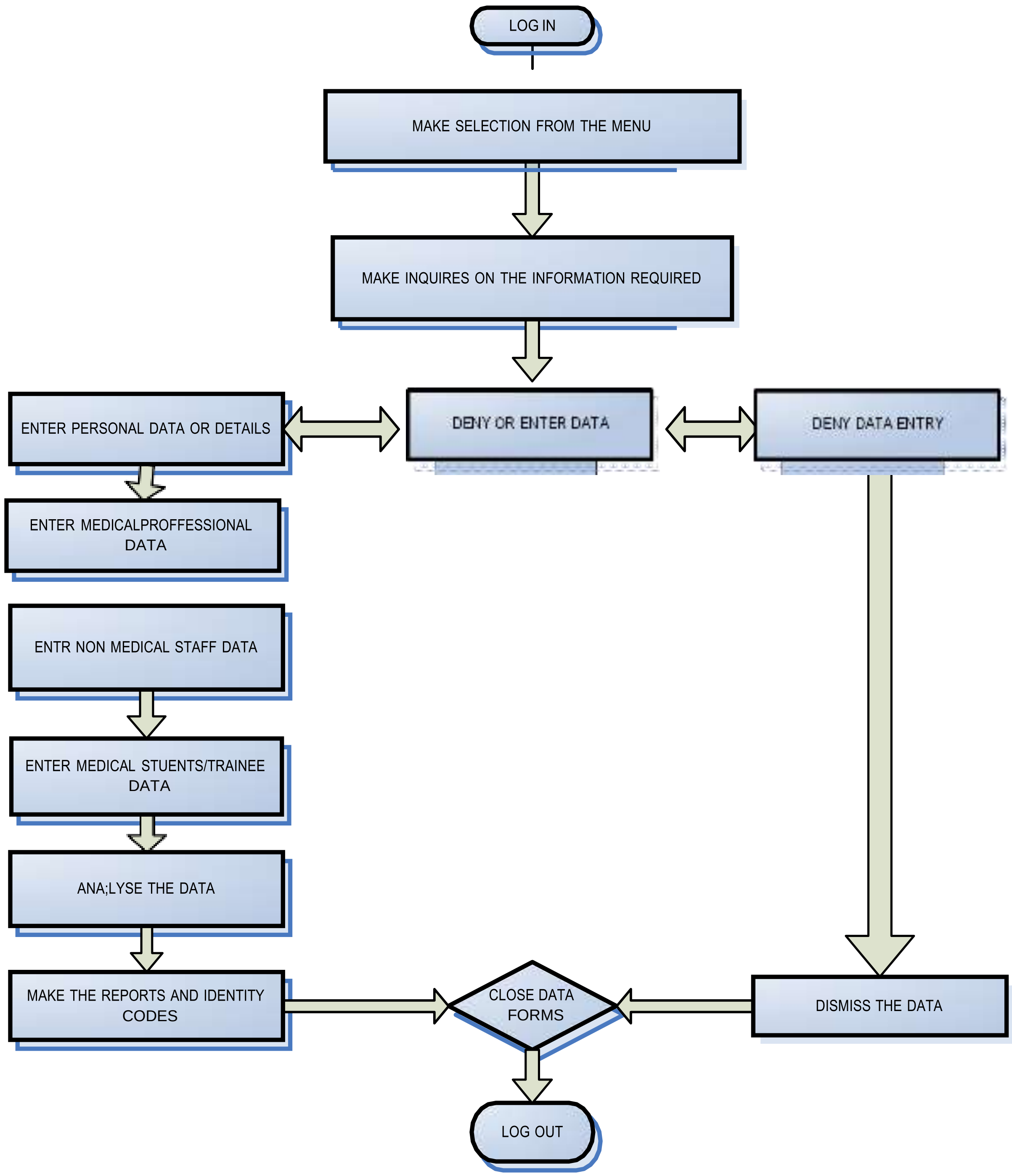

Figure 7: showing the activity diagram of the system

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System features

The system features include the system user interfaces, which were developed as unit components of the system. These were later merged and integrated into one system. The systemwas developed using PHP AND MYSQL platforms.

System graphical user interface forms

The system graphical user interfaces were constructed using PHP for quick and easy interaction. The user interfaces were developed in an interactive way with quick and speedy response to the tasks as it's expected to perform.

System log in interface form

The log in interface was constructed on index page and provides the directions of how to log in the system. It was developed with security features which require the user to have system username and password to be authorized to user use or open the system. The username and password are private and secret and should be availed to only authorized person. When, the password and username are entered correctly, the user is availed with the services interface were the selection is supposed to be made on the required tasks. The snap shot is below;

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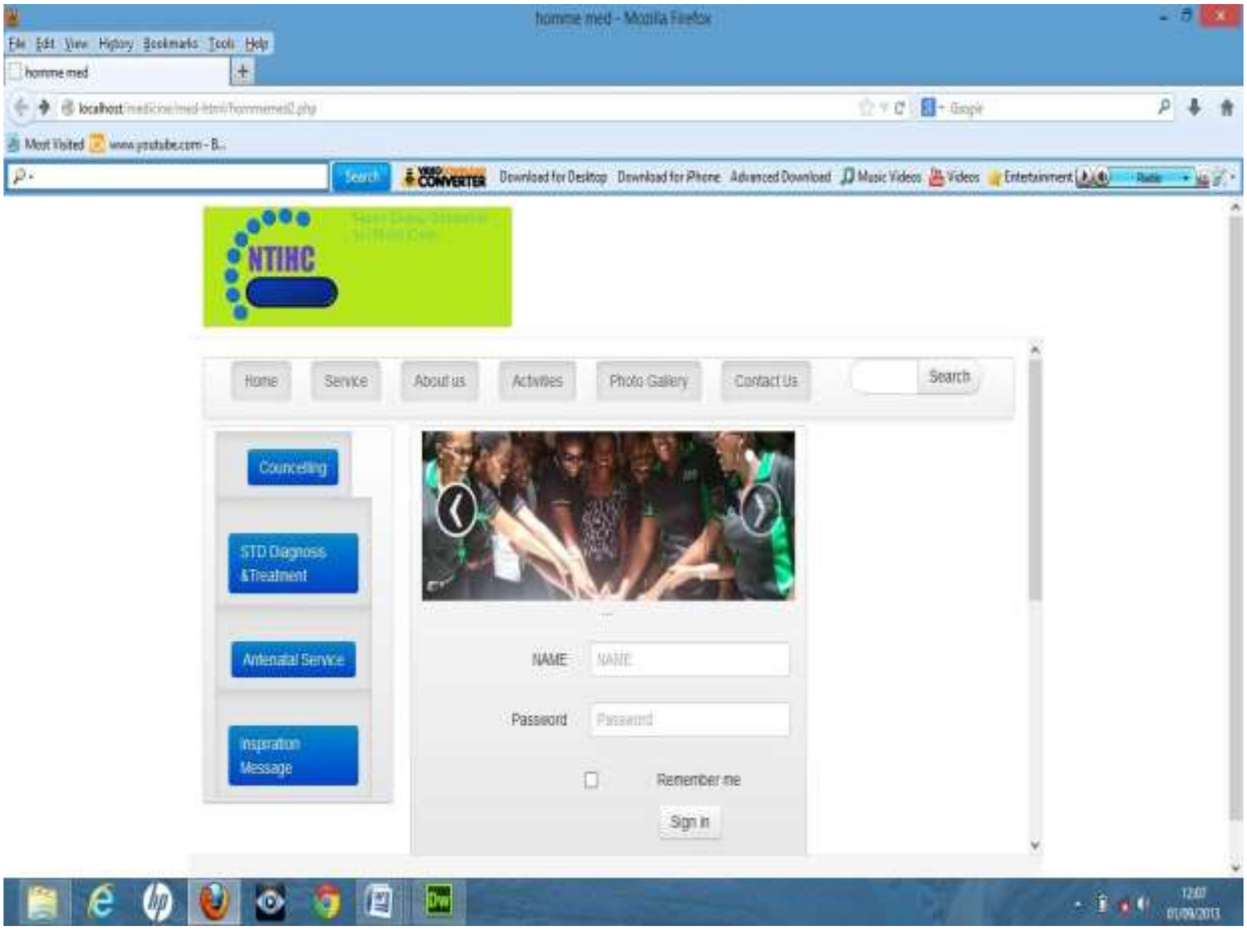

Figure 8: Showing the system's log in interface

The services interface/page

This is where the different services offered by the system are got. A user is able to diagnose the disease or health problem based on the information provided by the system, about that disease or health problem. One is also able to learn more about better ways of treating certain health problem. For example, different ways of first Aid management. The snap shot is shown below:

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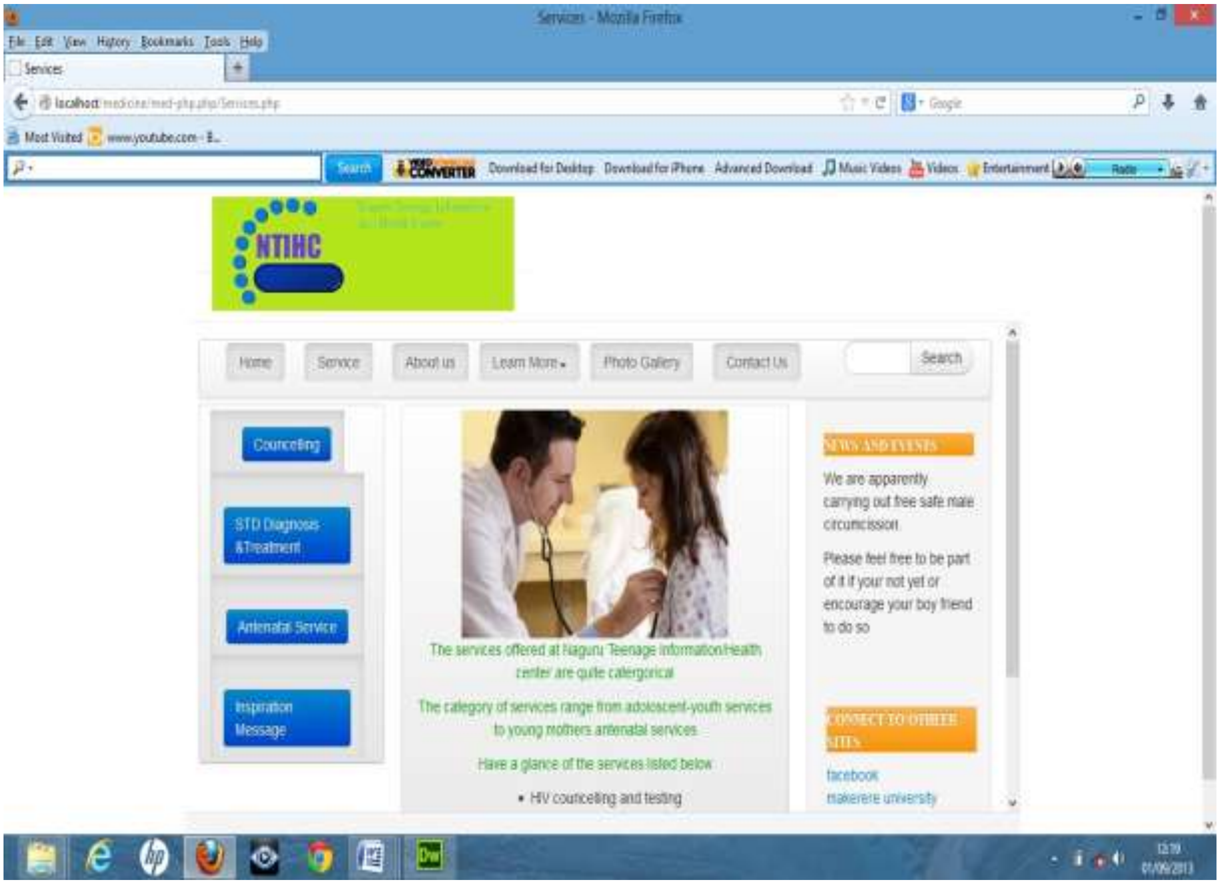

Figure 9: Snapshot of the system's log in interface

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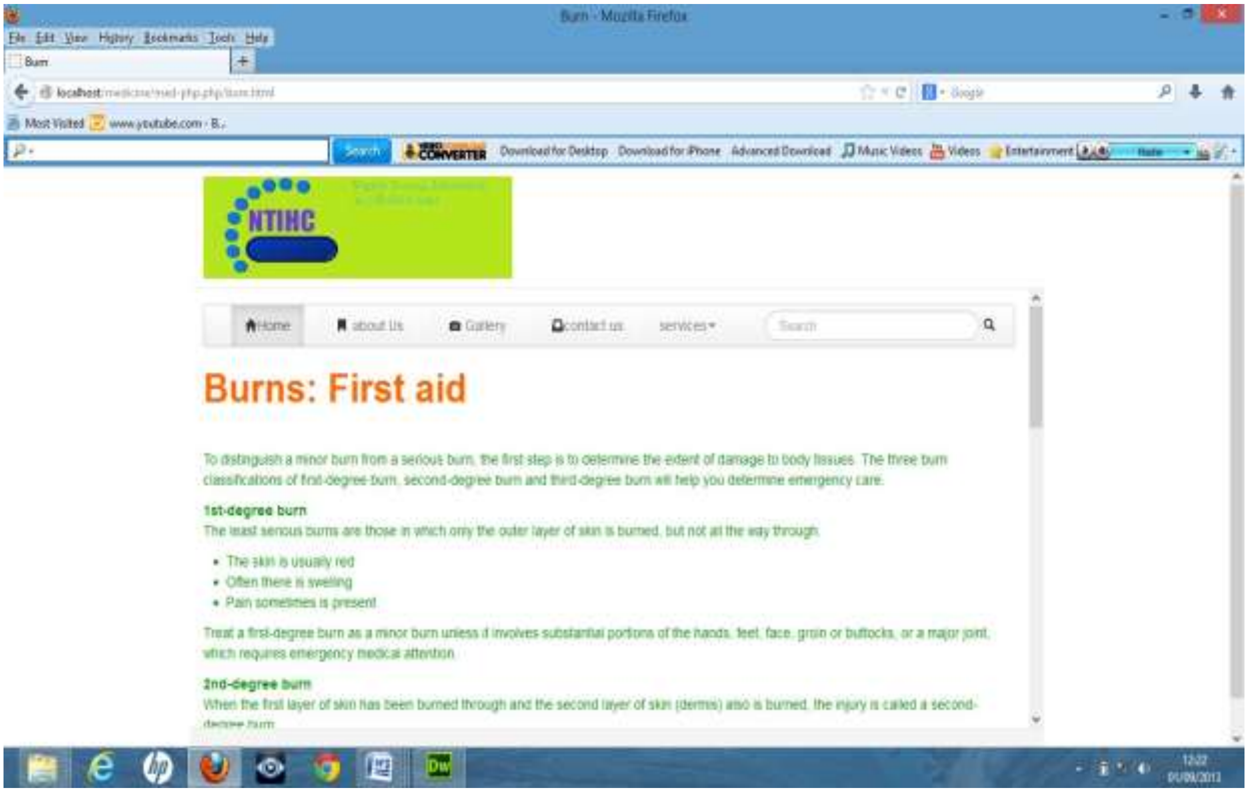

Figure 10: Snapshot of one of the system's outputs

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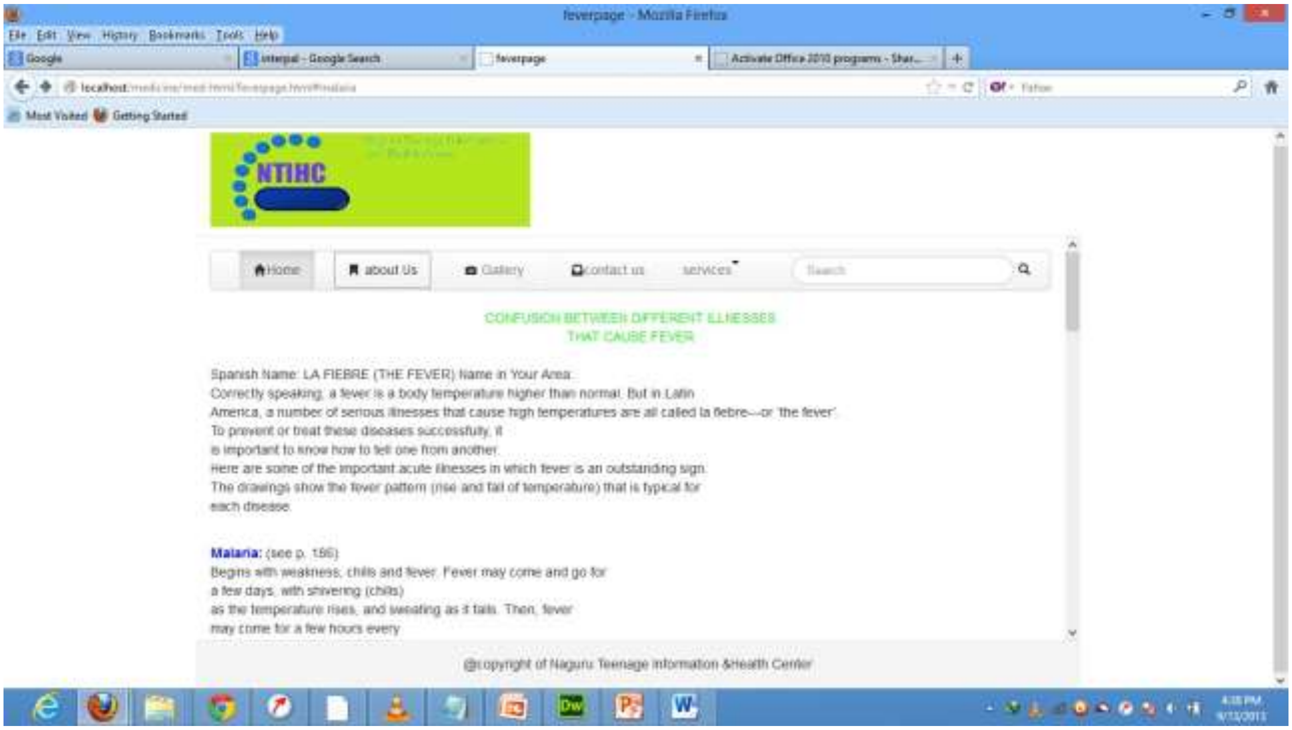

Figure 11: Snapshot showing output page on medical treatment

Testing, verification and integration

The process of testing and verification of the system was carried out throughout the system development after which the different pieces of the system were put together to determine how well they can perform their tasks complementarily. Unit testing was done on each of the components of the system to verify its effectiveness and proper functionality. After unit testing, the components were combined/ integrated together for general testing to eliminate systemfailure. The top down approach of integration was used to identify defaults. Through this, the system meets the required objectives. This section was involved with construction and delivery of the system and it therefore brought the real system in the production and performance of the tasks. The implemented system was embedded with many components which are useful and important to the system users therefore much more user friendly. The constructed system was developed as an electronic patient diagnosis management system with great advanced features of interaction and easy use. The new system was embedded withlog form with security features like password and username for logging on the system for the purpose of preventing authorized users from accessing the information. Also the system was embedded with databases for data and information storage. Lastly, the system was developed with a feature for generating reports as most important output of the system.

CONCLUSION

The system is designed to enable Naguru Teenage information health center in its general process of medical diagnosis. The system's functionality to operate online also allows any interested user to diagnose his or herhealth problem especially an infectious disease. One is able to get more information about a particular disease or health problem he/she could probably be suffering from Simple medical remedies such as first aid treatments are also offered by the system.

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