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The Use of Artificial Intelligence in Predictive Medical System to Analyze and Predict the New Registration Parameters

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Abstract

This thesis "The use of Artificial Intelligence in Predictive Medical System to Analyze and Predict the New Registration Parameters" was motivated by the high rate of fetal loss in Nigeria which mostly occurs as a result of wrong medical predictive system. To solve this problem, software that will identify the fetal parameters that predicts the gestational age was developed. The new model will be a hybrid model. It will combine the Nägele's Rule and Mittendorf Rule to predict the foetal parameter. A platform for solving complication problems due to low and excessive birth weights at delivery by accurately estimating fetal parameters (Fetal Weight, Fetal Age, Conception Date, and Delivery Date) was implemented. This was implemented using externally generated data by combining the independent information about fetal size obtained from the three different approaches (i.e, clinical examination, quantitative assessment of maternal characteristics, ultrasonographic fetal biometry). Expert system methodology and Object-Oriented Analysis and Design Methodology (OOADM) were adopted in the design of the predictive system. The new system allows the patients to access their antenatal visit records from any internet access point and the software developed helps physicians to accurately estimate the gestational age of the fetus and hence provide a support tool for estimating Gestation Age and to establish accuracy indicators that will provide tolerances for its later use in growth and health evaluation.

Keywords: Artificial Intelligence, Medical System, System Analysis, New Registration

Introduction

To improve the healthcare system for expectant mothers, accurate determination of gestational age (GA) is essential for the provision of appropriate obstetric and neonatal care, including treatment of infections during pregnancy with drugs that may be contraindicated in the first trimester, detection of growth restriction and post term pregnancies (42 weeks gestation), provision of antenatal corticosteroids during pre term labour, and decisions regarding whether to administer or withhold intensive care to extremely premature infants (Rijken, 2012). Where ultrasound is available, late attendees to antenatal care or birth centres present dating issues in all settings because ultrasound biometry is less accurate and less precise when measured later during pregnancy (Haddrill, 2014) [10]. Therefore, estimating gestational age in the absence of CRL biometry is a problem of global significance.

Accurate GA assessment is of particular significance in malaria endemic areas as the adverse maternal and fetal effects of exposure to malaria or anti-malarial drugs used for treatment maybe modified by gestation (White, 2008). Additionally, although all methods of estimating GA will have a margin of error, large and systematic measurement error will lead to misclassification of adverse birth outcomes such as preterm birth, small for gestational age, intrauterine growth restriction, spontaneous abortion and stillbirth; misclassification will bias associations between exposure to malaria and anti-malarial drugs during pregnancy and adverse birth outcomes.

Methodology

Methodology is the study of how to perform scientific research. It is the part of any analysis or research that is used to find out what type of data is maintained, what fact to find and look for, how to find them and how to record them for usage. Many methodologies include a diagramming notation for documenting the results of the procedure; approach for carrying out the procedure; and an objective (ideally quantified) set of criteria for determining whether the results of the procedure are of acceptable quality. The system was implemented using Php-Mysql programming language and Java Script. This is because the

programming language has the advantage of easy development, flexibility and it has the ability of providing the developer with possible hints and it produces a graphical user interface.

Expert system methodology was adopted in the design of the predictive system for comparative analysis of foetal parameters. Expert systems are interactive computer programs that mimic and automate the decision making and reasoning processes of human experts in solving a specific domain problem, through delivering expert advice, answering questions, and justifying their conclusions. The expert system is a rule-based expert system; it consists of three main phases as shown in Fig 1.

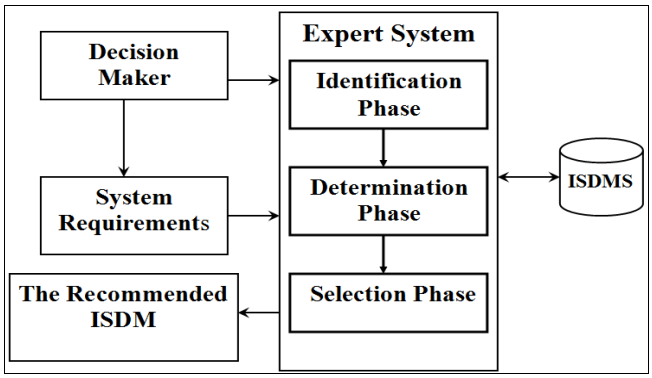

Fig 1: Expert System Framework

System Analysis

Analysis of the Proposed System

The development of an artificial intelligence predictive medical system for analysis and prediction of foetal parameters is design to be used by healthcare centers and maternity homes to monitor the foetal development.

The new model will be an expert system and a hybrid model. It will combine the Nägele's Rule and Mittendorf Rule to predict the foetal parameter. The new model will take the average of the two models as the predicted date of delivery. In this new system, it is noteworthy to name some ways of determining gestational age based on Last Menstrual Period (LMP).

Nägele's Rule: To calculate Expected Date of Delivery, one should add 7 days, and then subtract 3 months from LMP.

Expected Date of Delivery = ((LMP + 7 days) - 3 months)

Example: ((the LMP on 1st April + 7 days) - 3 months) = January 8

Mittendorf Rule: To calculate "Mittendorf's Rule", one should add 15 days for first time Caucasian women.

Expected Date of Delivery = ((LMP + 15 days) - 3 months)

Example: (LMP on 1st April + 15 days) - 3 months) = January 16

Therefore, the proposed model will be a combination of the two-model taking average of the number of days to be added to the LMP. This will give us the following formula.

Expected Date of Delivery = ((LMP + ((15 days + 7days) / (2-3 months).

Results

System Specifications

Database Development Tool

A relational database design was used to design the database. Relationships between the tables were defined by creating special columns (keys), which contain the same set of values in each table. Creation of a database involves determining the name of the database, and the tables used to store data in that database.

Database Design and Structure

This tables, data types, and data sizes were used in the design of the databases using MySql database.

Table 1: Antenatal Registration Table Structure (tblantenatalreg)

Field	Type	Size	Key	Description
CardNo	varchar	15	PRI	Antenatal card number
Surname	varchar	20		Surname of the patient
Firstname	varchar	20		First name of the patient
Consultant	varchar	25		Doctor consulted
Dateofreg	date	8		Date of registration
LMD	date	8		Last menstruation date
EDD	date	8		Expected delivery date
Address	varchar	70		Address of the patient
Age	int	3		Age of the patient
Tribe	varchar	40		Tribe of origin
occupation	varchar	40		Patient occupation
Education	varchar	30		Educational qualification
Language	varchar	30		Languages spoken
State of origin	varchar	30		State of origin
Medical history	varchar	2000		Medical allergies
Heart disease	varchar	20		Heart diseases
Chest disease	varchar	20		Chest disease
Kidney disease	varchar	20		Kidney disease
No of children	int	3		Number of children given birth to
No alive	int	3		Total number of children alive
Husband	varchar	30		Name of husband
Husb occupation	varchar	150		Husband occupation
Employer	varchar	150		Name of employer
Phone	varchar	11		Phone number of patient
Email	varchar	30		Email address of patient
Hospital	varchar	50		Hospital registered
Snum	int	5		Serial number
Pic	varchar	100		Patient picture

Table 1 shows the structure with data types and size of the antenatal registration table. The variable names used and their meanings are contained in the table.

Program Modules Specification

Below are some of the modules designed in the medical predictive system for foetal parameters and their specifications.

Birth Registration Module

Hospitals register child birth on the platform using this module. Unified medical identification number is generated during the registration for the every child birth recorded. All other information must be completed on the form before submission.

Input / Output Format

The input specification as designed in the medical predictive system for the comparative analysis of foetal parameters is as shown bellow.

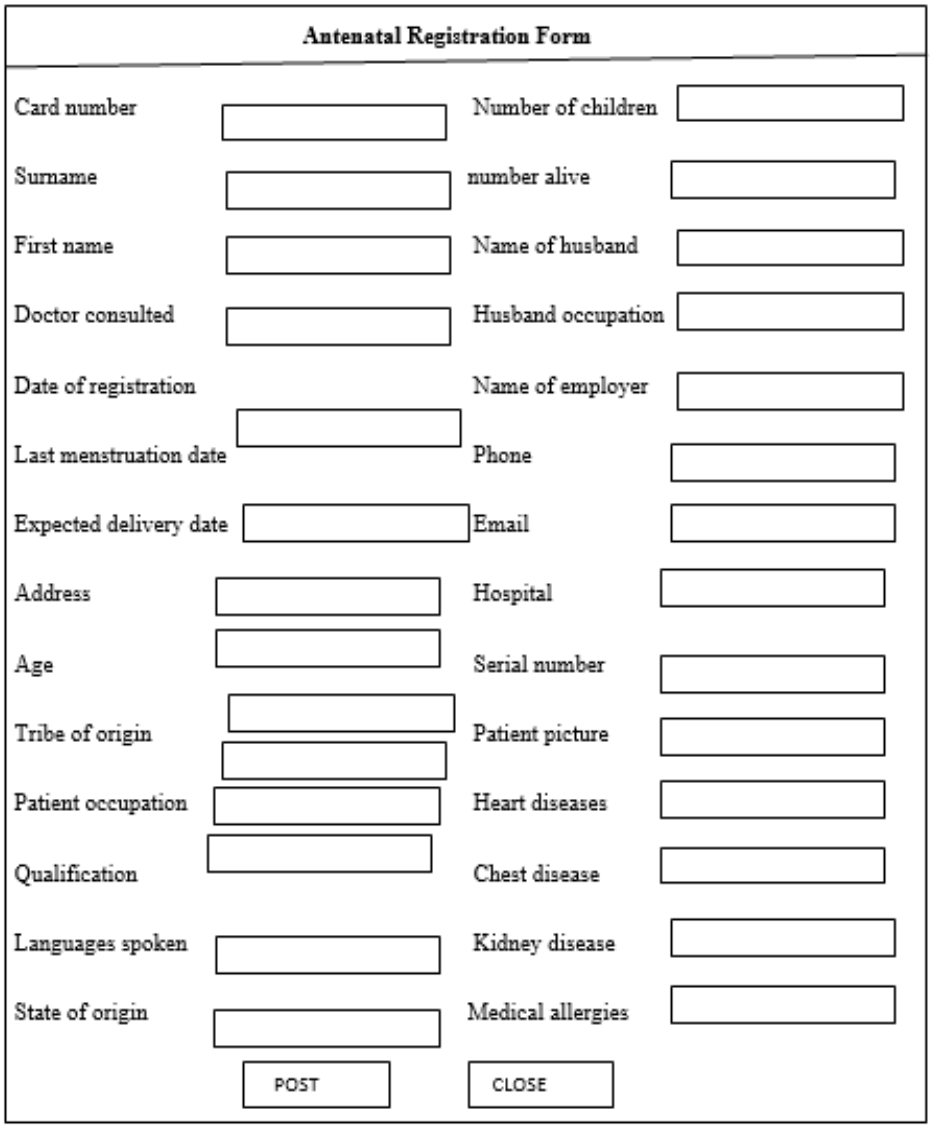

Fig 2: Antenatal Registration Form

This form is used to register pregnant mother for antenatal in a hospital. The patient's medical details are captured with the form.

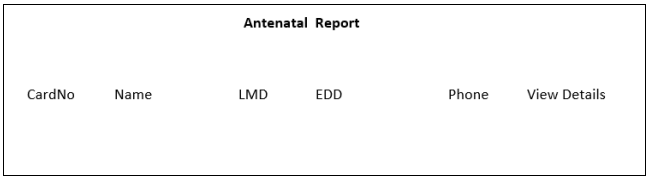

Fig 3: Antenatal Register

Fig 3 shows the list all the names on the antenatal register. A click on the view details will display the detail report of the selected patient.

Test Plan

We have three basic testing method that shall be adopted viz.

1. Module Testing
2. Intergrated Testing and
3. System Testing

Component and System Testing

This approach aims at testing elementary units of an interactive system. Individual components that make up the system are tested to ensure that the system is completely free from errors System testing can be described as a series of tests administered on a complete system to ascertain the system's alignment with decided objectives.

Database Testing

A database is a collection of logically related data. Also, these data are dynamic information required by the system. Each table in the database holds closely linked fields that are guided by a set of rules and constraints limiting the type of data stored in them. The Database Management System (DMBS) avoids abuse and misuse by ensuring that these checks aren't violated. The model database is made up of 7 tables and each table contains the name of the fields, data types, sizes and other constraints that define the table. Below are few screenshots of some of the tables along with a brief explanation.

Fig 4 shows the antenatal registration database table and this contains the pregnant mothers registration details.

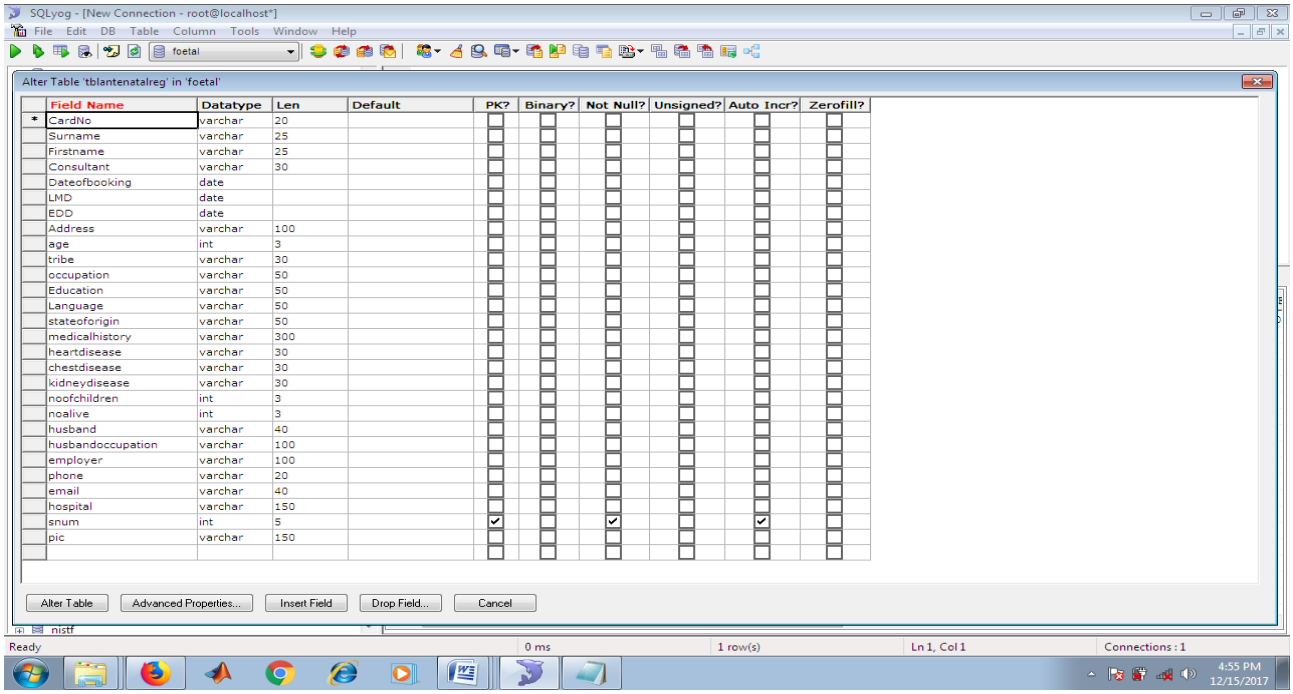

Fig 4: Antenatal Registration table

Table 2: Test Result

Module	Expected Test Result	Actual Test Result
Log In Form	Expected to see the Log In form so that one can log in.	When clicked on log in, a form appeared where you can enter your username and password.
Home Page Form	The expected result was the screen from where you can decide to call up any of the sub systems	The home page enables user to have access to other sub systems
Signup Form	Is expected to be used by pregnant mother for antenatal registration	When clicked on the sign-up button, it displayed a form where the user can fill the pregnant mother record for starting antenatal clinic and the system generated a registration number automatically for each person that registers.
Hospital button	Expected to be used by hospital admin to login to the new system	This button displays the hospital admin login form where the user's name and password is verified before gaining access to the restricted area
Patients button	Expected to allow registered antenatal mothers to access their data	The button displayed a form when you are required to enter registration no and phone number. Once validated, the person can view her details and all the antenatal clinic visits.
Statistical report button	It is expected to display all the registered antenatal records across various hospitals	The button when clicked on displayed all the registered antenatal records with their respective health centers and total.
Report	In this module, it is expected to be used to view report	When you go to this module, antenatal register, antenatal visit report, child birth report, and foetal parameters prediction report can be viewed
Delete button	To be used to delete record from the database	When clicked on delete button, the selected record was deleted from the table in the database
Help and support form	Expected to be used to submit help requests online	The form allows users to send request for attention or direction on antenatal issues.

Conclusions

This thesis have attempted to discuss a particular possibility of an ES to solve problems of complications primarily due to low and excessive birth weights at delivery by accurately estimating foetal parameters (Foetal Weight, Foetal Age Conception Date, And Delivery Date) using Ultrasonographic Foetal Biometric Data. The primary goal of expert system research is to make expertise available to decision makers and technicians who need answers quickly. There is never enough expertise to go around - certainly it is not always available at the right place and the right time. But computers loaded with in-depth knowledge of specific subjects can bring decades worth of knowledge and solution to a problem. If we must investigate and solve those ultrasonographic foetal biometry method of estimation that has been described over the decades as complicated, labour-intensive, limited by suboptimal visualization of foetal structures, costly and specially requiring trained personnel, we will have to build into the estimation the use of a Computer Wizard (An Expert System).

The perception of the clinician as the final arbiter and a system's ability for clinician override has been described as crucial in clinical decision support system integration. The issues relating to the requirements for clinician control indicate that close co-operation with medical staff is crucialin the development of our system to ensure that it can be successfully implemented. Full disclosure of the assumptions involved in the design of the system is also vital. Once again this requires a close relationship between the knowledge engineer and the expert medical staff during development to ensure that clinical guidelines are understood and are being implemented correctly.

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