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The Application of an Artificial Intelligence Predictive Medical System to Analyze and Predict Login Parameters

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ABSTRACT

This thesis "The Application of an Artificial Intelligence Predictive Medical System to Analyze and Predict Login 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. 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). 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 be used to determine the Expected Date of Delivery in the new system designed. 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: **Information Management System, Riverine Areas, Existing System, Web-Based,** Artificial Intelligence

INTRODUCTION

For improvement of 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 preterm labour, and decisions regarding whether to administer or withhold intensive care to extremely premature infants (Rijken, 2012). Fetal crown-rump length (CRL) measured by ultrasound between $7^{+0}$and 13^{+6} weeks gestation is the recommended method for precise dating of spontaneously conceived pregnancies (Butt, 2014). Beyond 14 weeks, ultrasound up to 24 weeks is the upper recommended limited for accurate dating using other fetal biometry measurements including head circumference(HC) and bi-parietal diameter (BPD) (Mehta, 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). Therefore, estimating gestational age in the absence of CRL biometry is a problem of global significance.

Table 1.0: **Summary of Related Literatures**

Author	Techniques	Work done	Limitations
Jaehak et al. 2020	AI	Can be considered an alternative, low-cost, real-time diagnosis system that can obtain accurate stroke prediction and can potentially be used for other diseases such as heart disease	The work was limited to heart related diseases
Naeeb, 2020	machine learning	predicting health risk of the user	there is need to improve the accuracy level
Aminu, 2017	data mining techniques	The framework was trained using data acquired from hospital and tested for performance accuracy using Receiver Operating Characteristic	The system was limited to predicting malaria test result

METHODOLOGY

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. 3.1.

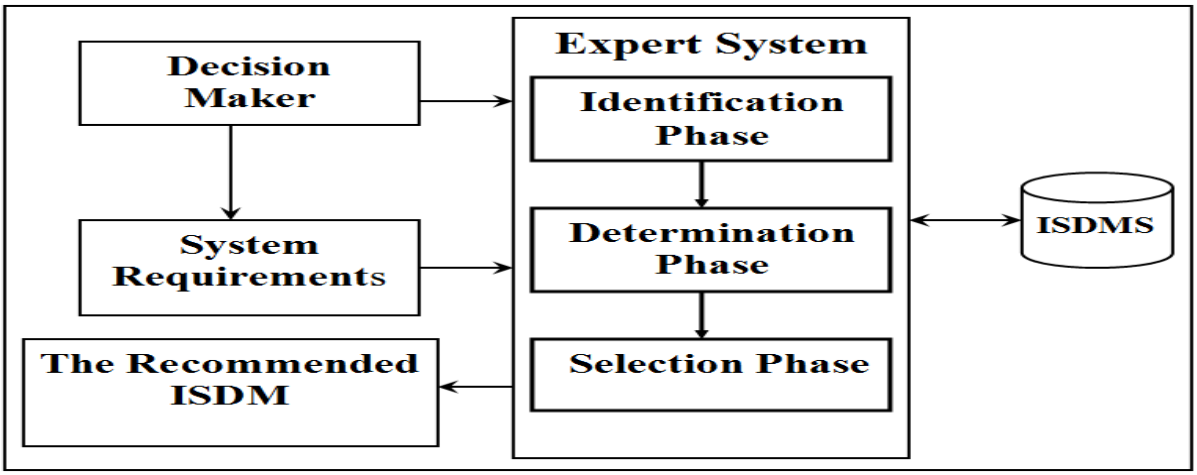

Fig 1.0: Expert System Framework

This represents an approach that is used to show the system framework that is used to structure, plan and control the system. Thus, the general knowledge acquisition processes are summarized in rough chronological order below:

1. The knowledge engineers do gather knowledge from the domain expert for solving the real-life problem.
2. Through discussions, identify the kinds of data, knowledge and procedures required to solve the problem.
3. Build scenarios with the expert that can be associated with different problem types.
4. Have the expert solve a series of problems verbally and ask the rationale behind each step.
5. Develop rules based on the interviews and solve the problems with them.
6. Have the expert review the rules and the general problem solving procedure.
7. Compare the responses of outside experts to a set of scenarios obtained from the project's expert.

Note that most of these procedures require a close working relationship between the knowledge engineer and the domain expert.

SYSTEM ANALYSIS

Analysis of the Existing System

In hospitals, medical record documentation requirements in the Prenatal and Postpartum Care measure to identify prenatal visits that occur during the first, second and third trimesters. Identify gestational age at birth from the hospital record (e.g., admission write-ups, histories and physicals, discharge summaries or labor and delivery records) or birth certificate. Gestational ageis the number of completed weeks that have elapsed between the first day of the last normal menstrual period and the date of delivery. If gestational age is not available, assume a gestational age of 280 days (40 weeks).

Methods recommended to determine gestational age are as follows.

1. Physician ascertainment using ultrasound.
2. Last menstrual period (LMP) calculation (date of LMP – date of delivery) ÷ 7. If gestational age is recorded or calculated in fractions of a week, round down to the lower whole number.

Today, there are several methods for determining gestational age. Whatever method used, if a process is ineffective, definitely the output or product will equally be ineffective. Thus, the more accurate the process used in estimation of fetal age, the more excellent results is obtained. There is the need to quickly and periodically estimate fetal age without mathematical stress on the doctors, clinicians or patients.

Fetal weight has been found to be a function of Fetal Head Circumference (HC), Femur Length (FL), Abdominal Circumference (AC), and Biparietal Diameter (BPD), and is predictable with a polynomial equation. Fetal age has also been found to be a function of fetal Weight and predictable with an equation. Modern algorithms that incorporate standard defined fetal measurements (e.g. some combination of AC. FL, and either BPD or HC) are generally comparable in terms of overall accuracy in predicting birth weight as shown in Eqn. 3.1.

$BW = -3200.40479 + 157.07186AC\ (cm) + 15.90391\ (BPD)^2\ (cm)$ Eq. 3.1

Fetal Age (T) can be estimated from weight (W) with the equation

$T = (3W + 2.730) /0.091$ Eq. 3.2

Where W = weight

Pregnancy typically lasts 40 weeks, or 9 months and at conception, the unborn child is already considered two weeks old (Egipee,2004). We submit that if gestational Age is T wks, and measured on a date DM,

Then (CD) = DM - (T - 2) wks Eq. 3.3

Where CD = Conception Date *(dd/mm/yy);*

DM = Date gestational age was measured *(dd/mm/yy);* and

T Gestational Age in weeks.

Therefore then, we estimate Delivery Date (DD), if we know the Gestational Age using the equation

DD = DM + (40 -T) wks Eq.3.4

Where DD = Delivery Date *(dd/mm/yy);*

DM = Date gestational age was measured *(dd/mm/yy);* and

T= Gestational Age in weeks

Some data operations, such as the current ultrasound measurements, are currently used by the doctor to calculate the estimated gestational age for each of the ultrasound parameters. The doctor performs a simple decision support role in that he/she will provide advice regarding the most appropriate gestation age for the fetus. It calculates both the gestation age derived from the menstrual history, ie the LMP and the mother's menstrual cycle variation, and also that due to the ultrasound estimates. The final ultrasound-derived gestation age estimate is obtained by averaging each of the four ages obtained for the measured parameters.

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)

This will be used to determine the Expected Date of Delivery in the new system designed

Data Flow Diagram (DFD) of the Proposed System

The proposed system was designed to keep track of antenatal visits of an expectant mother together with the related medical reports on the foetal development. The system modules includes: antenatal visits, Ultrasound Biometry, Foetal Parameters Prediction, foetal development analysis and other statistical reports which includes number of antenatal visits by an expectant mother before delivery, statistical report on delivery that occurred on the predicted Delivery dates, Gestational age and expected date of delivery reports, birth weight, etc.

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 2.0: **Admin Table Structure (tbladmin_login)**

Field	Type	Size	Key	Description
username	varchar	15		Admin user name
password	varchar	10		Admin password

The table structure as shown in table 2.0 is used to store the password of admin users in the database

Program Modules Specification

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

Login Module

In Login Form module presents site visitors with a form with username and password fields. If the user enters a valid username/password combination they will be granted access to then system application.

Input / Output Format

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

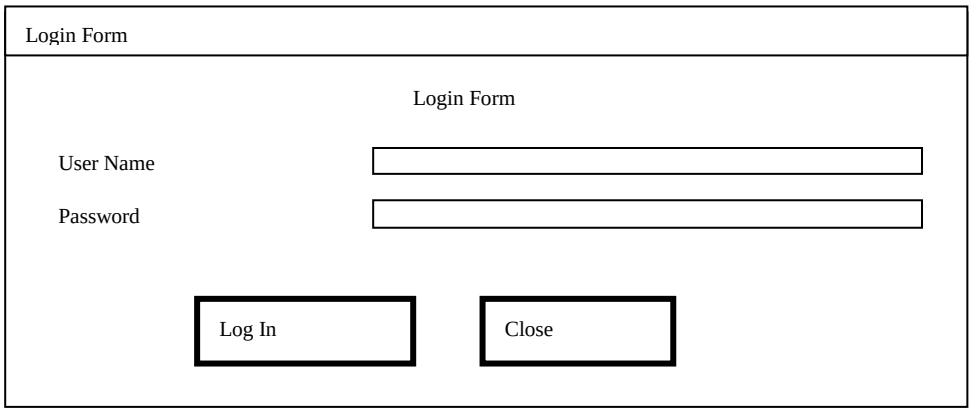

Fig. 2.0: Login Form

Figure 2.0 contains the login specification for user on the platform which includes the username and the password.

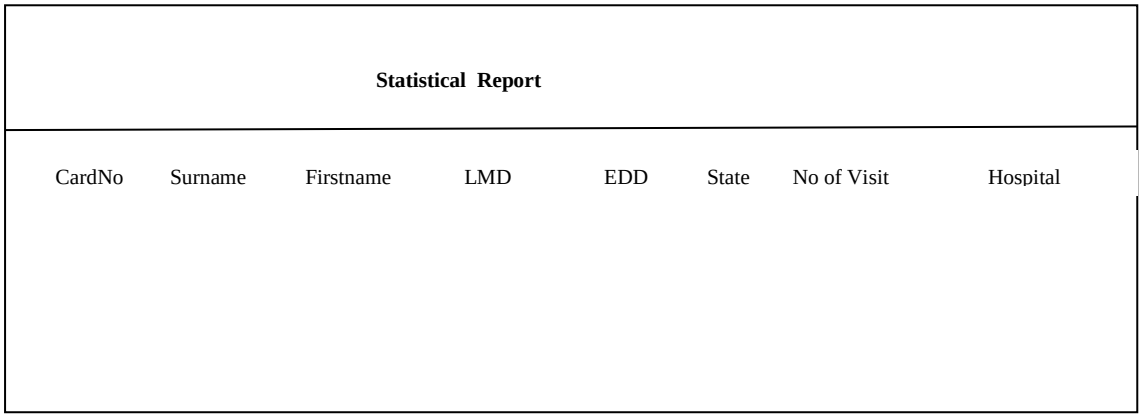

Fig. 3.0: Antenatal Statistical Report

Figure 3.0 displays the antenatal database record of selected patients totaling the no of antenatal visit attended and the health center used.

SYSTEM IMPLEMENTATION

Proposed System Requirements

The system requirement is divided into software and hardware requirement. Below is the detailed requirement for the proposed security mode.

Hardware Requirements

Table 4.7describes the hardware components and software requirements needed for effective and efficient running of the system

Table 3.0: **Hardware Requirement**

Hardware	**Minimum System requirement**
Processor	2.4 GHZ processor speed
Memory	4 GB RAM
Disk space	500 GB Hard Disk
Display	800 x 600 colors (1024 x 768 High color- 16 bit Recommended)
Internet	Wifi Internet Access

The table 3.0 above shows hardware components of the machine that allows the system to function as required for using the new system.

Software Requirements

Table 4.0: **Software Requirements**

Software	**Minimum System requirement**
Operating System	Windows 7 or later
Database Management System	MYSQL
Run-time Environment	Java Script, Wamp Server and Php
Picture Editing and Animation	Microsoft Fireworks

Test Plan

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

i. Module Testing

ii. Intergrated Testing and

iii. 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.

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 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.

Documentation

To install it on the system to run from the hard disk, follow the procedure below.

i. Install Micromedia Dreamweaver 8 on the Computer

ii. Install Wamp Server on the computer

iii. Install My-Sql

iv. Click Start Button on the desktop

v. Select program

vi. Click Windows explorer

vii. Click Drive D:

viii. Select the folder "**foetal"**

ix. Click Edit

x. Click Copy

xi. Select drive C:

xii. Select Wamp

xiii. Select www

xiv. Click paste to Copy the Folder "**foetal**" from drive D: to Drive C:

xv. The folder contains the entire sub program that makes up the software developed.

xvi. Open internet explorer

xvii. Type http://localhost/foetal /index.php

System Conversion

System conversion is a major part of the system development and involves fact-finding, data capturing, clerical procedure design, form design and even program specification. It is an often-expensive part of the systems implementation and usually means the conversion of existing manual records into a medium used by the computer. This itself, may involve the transcription of records, or part of them, onto specially designed forms before they are keyed onto the appropriate computer medium. Once the file has been created, extensive checking for accuracy is essential; otherwise considerable problems may arise when the system becomes operational.

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 utrasonographic 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 crucial in 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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