Towards a Pharmaceutical Ontology for African Traditional Herbs

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Abstract—In recent times, traditional herbal medicine found its way to modern medicine. It is used in many societies and common to all cultures due to its affordability. Hence, there is a need for the development of herbal database systems that contain the taxonomy hierarchy, structured knowledge of herbs that could be prescribe in a rapid and convenient fashion. This need serves as the major motivation for the work.

In this work, we design and develop a database system that can be used for alternative therapy, to meet the needs of those who could not afford the prices of orthodox medicine or those who do not even believe in the use of orthodox medicine. The system is user-friendly enough for indigenous and those literate in the local language, Yoruba, only.

Index Terms— African traditional medicine, affordable healthcare, complementary medicine, herbal ontology

I. INTRODUCTION

MOST of the western world regard African "traditional medicine is a mystery" [1]. Unlike the western medicine which is based on scientifically proven evidences, Africa traditional medical practices are based on mystical concept often not understandable to the scientific world. It is however reported in [1] that "the Yorubas in Nigeria offer fresh outlooks on the concept of health and unique healing treatment to the world medical community." The Yoruba methods of medical treatment if carefully studied objectively, scientifically advanced, and unified with western medical procedures can "provide the best medical service possible" [1].

Having quality health care without wasting time in care centers or hospitals; having one's health status monitored without going to the health care centers or hospital; having quality health care service at an affordable rate. All of these are desirable to us as human beings. Introducing traditional herbal web service into our health care system will make this possible. It allows electronic communication between physicians or medical practitioners and patients and to quickly access electronic herbal consultation [2].

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The goal of this research is to formulate and implement a robust herbal drugs/medicine database ontology framework for Yoruba traditional medical services from which Physicians can have knowledge of herbal medicines (Drugs) and can infer knowledge about traditional drug prescription and cure for ailments and diseases.

In order to achieve this goal, the research focused on the following objectives:

Formulation and Implementation of an ontology framework for African Traditional Medicine prescription using herbal drugs showing their Family, Generic, Specie, Common and Local (Yoruba) names for primary and related diseases; Collecting some traditional drugs data, listing them according to their generic name and prescribing them for different disease(s); Finding "out what changes and new opportunities the modern information technology brings for different aspects of" African Traditional Medicine (Yoruba traditional medicine as a case study), thereby creating a path for future research and utilization of African Traditional Medicine [15]

II. LITERATURE REVIEW

A. Ontology

In [3] ontology is described as "the shared understanding of some domain of interest," or "a unifying framework to solve the problems caused by ambiguous terms". The Semantic web today, rely on ontologies as a key technology. Fields of study lacking in "data standards, agreed semantics, and common vocabularies" such as biomedical science, rely heavily on Ontological frameworks to "define the semantics of data" in order to support the "connection of heterogeneous data sources." Ontologies are used in data mining to integrate existing data and knowledge, annotate experimental data, aiding information retrieval, and driving information mining [4].

The word "ontology" is derived from two Greek words: "ontos" and "logos." "Ontos" means "being" and "logos" means "language" or "reason" Therefore Ontology is defined in philosophy as the science of being [5]. According to Tom Gruber at Stanford University, ontology in the context of computer science is "a description of the concepts and relationships that can exist for an agent or a community of agents; it is generally written as a set of definitions of formal vocabulary." It is an explicit and formal conceptualization of a domain of interests [6]. "Representation of entities, ideas and events, along with their properties and relations, according to a system of categories" are common in Ontology in both philosophy and

computer science. There are extensive work on "ontological relativity" in both fields [7].

B. Worldwide ontology on traditional medicine

There is increased worldwide attention on alternative (herbal) medicines as a result of "increased side effects and lack of curative treatment for several chronic diseases, as well as high cost of new drugs, microbial resistance, and emerging diseases" [8]. There are opportunities and challenges associated with the global phenomenal "growing market of herbal products and treatments." Traditional Chinese medicine (TCM) for instance is acknowledged as an "effective complementary and alternative medicine modality" by the National Institutes of Health in United Sates [9]. Currently TCM is widely used by consumers and its popularity is on the increase. For example in Australia there are an estimated 3 million TCM consultations annually [10].

The emphasis of western medicine on preventive as opposed to curative has further paved way for herbal medicine which most often dwells on supplementary diet and natural remedy for preventive purposes [11], [12]. This development has engendered scientific research in traditional medicine including ontologies in traditional medicine [13]. The internet has supported the growth of this herbal medical databases based on ontological design. The World Health Organization (WHO), has recognized traditional medicine as alternative therapy and many governments are adopting policies on traditional medicine. For instance, the federal government of Nigeria on 17 August 2006 approved a policy supporting the practice and regulation of traditional medicine in Nigeria. Yoruba traditional medicine, which is mainly practiced in Nigeria has received a boost as a result of this policy [1]. This has further broadened the scope of research in ontology of traditional medicine in Africa. The approach in this work is to design an ontology for African traditional medicine with Yoruba traditional medicine as a specific case study.

C. Importance of Yoruba Traditional Medicine (YTM)

Most of the herbal drugs in YTM are either single leaf, root, bark of trees or shrubs, mixture of leaves, roots, barks etc with some of the herbal drugs grinded or choped into desired sizes which may be applied to the affected part based on experience and arduous training e.g., wounds (*egbo*) or most times ingested or drank e.g., in case of malaria (*iba*) or typhoid (*iba'ponju*).

The importance of YTM cannot be over emphasized, herbal medicines makes us to really appreciates our nature and what it offers in terms of maintaining our health and finances such as:

Be self-independent in health care delivery exploring the nature for cure of sickness and diseases.

Reducing financial burden placed on individual seeking modern curative medicine for different kinds of ailments, thereby reducing cost.

Saving lives through the use of local herbal products.

The biggest asset we can have in life therefore is health. Health care help to keep people fit for whatever they want to do either farm, go to work because health is wealth which is the main objective and alternatives YTM offers by maintaining the health status of individual that is not even sick to keep such a person from illness of different kind.

III. METHODOLOGY

This study was carried out through the study of local herbal materials and some other web material on ontology and database development, survey of traditional health care delivery in western part of Nigeria and the world at large through internet and personal interview of Traditional medical practitioners. The Traditional herbal ontology is developed using NetBeans 7.0 Java SE (Standard Enterprise), MySQL as the Database engine.

A. Data Collection

The data were collected through series of oral consultation and interview with some traditional herbal practitioners in Ogbomoso, Wikipedia, and also consulting different texts such as Systematic Biology by Adeyemi L.A, etc, from where I got the individual herbs Biological taxonomy and diseases they work for. The Yoruba translation of individual herbs was gotten from the some educated herbal practitioners, personal research and knowledge (Table I).

B. Ontology Taxonomy for Selected Yoruba Traditional Herbs

Fig 1 shows the taxonomy of a number of Yoruba Traditional Herbs.

C. Building the Database

Building a Relational Database: Using the NetBeans Java tool to create ontology of the herbal medicine to relate together herbal cures working for the same diseases by

TABLE I.
SELECTED HERBS IN YORUBA TRADITIONAL MEDICINE (YTM)

FAMILIES	Sapotaceae	Verbenceae	Lamiaceae	santalaceae
GENERA	Chrysophyllum	Lantana	Ocimum	Viscum
SPECIES	Albidum	Camara	Gratissimum	Album
COMMON NAMES	Cherry leaves (white star)	Wild sage (Spanish Flag)	Basil	Mistletoe
YORUBA NAMES	Ewe Agbalumo	Ewon agogo	Efirin	Afomo onisana
ILLNESS/ *AISAN*	Stomach disorder (Inu Kikun), Vomiting(Eebi)	Convulsion(Giri), Epilepsy(warapa), Hypertension(Eje riru)	Diabetes(Ito Suga), Dysentery(Inu gbuuru), Convulsion(Giri)	Asthma(Iko egbe), Epilepsy(Warapa), Cancer(Jejere)

outputting it, according to its Botanical hierarchical order. Also, Careful observation of the project reveals that in order to have a successful working web application, the database is well built and the table well related, joined and linked to one another in such a concept that gives would be user options or varieties of herbs user(s)/patient(s) can use to cure an ailment or a disease. MySQL was used to build the database use for the collection of entries, which can add, delete, edit, sort data and also scalable using phpMyAdmin as the interface. Five tables were created which are Family tables, Genus table, Specie table, Herbs table (Common Name) and Illness table. These Tables were joined together multi-join via indexes like primary key, foreign key etc, and a dedicated tracking ID. Fig. 2 shows the database table with the primary and secondary keys. Fig. 3 shows how the herbal medicines were structured or programmed in the database. Fig. 4 shows selected example of ontological representation of herbal medicine in the database.

D. Flowchart of the Graphical User Interface (GUI)

The GUI consists of options interfaces such as the Search, Data Entries, View chart, Super Task and Admin. The overall system flowchart is shown in Fig. 5. Data entry interface for the collected herbal data into the database, with its individual botanical hierarchy names or botanical taxonomy such as the Family, Genera/Genus, Specie(s), and Common Name, Yoruba Name, the herbal cures and all other requirements. This is shown in Fig. 6. View chart is an interface that allows the user to access the output result of the herbal chart working for the entered or selected ailments. Embedded in the chart is the hierarchical and ontological taxonomy of the herbal cures for the selected ailments. The flowchart for this task is shown in Fig. 7.
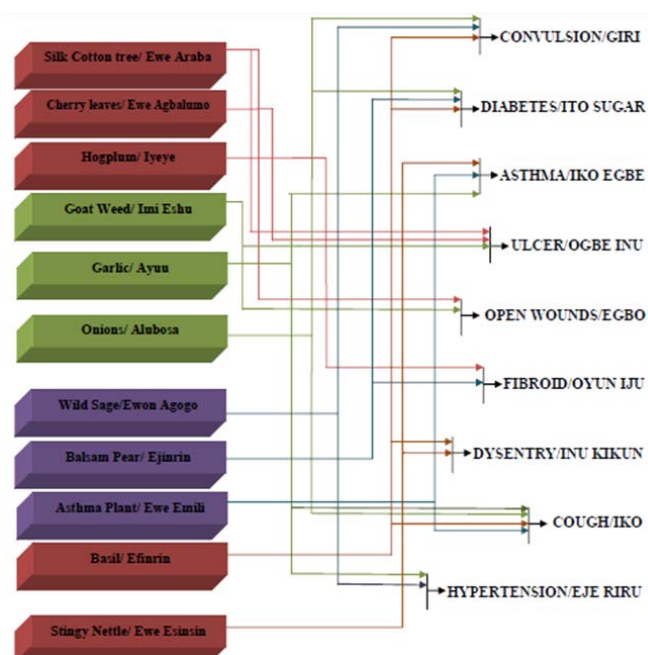
A Super task otherwise called managed entry enables the user to carry out debugging operations such as Deletion of erroneous data entry due to modification or outdated information about particular herbs working for an ailment or Addition of more information about a particular herbs orailment in the database. Flowchart of a super task is shown in Fig. 8.
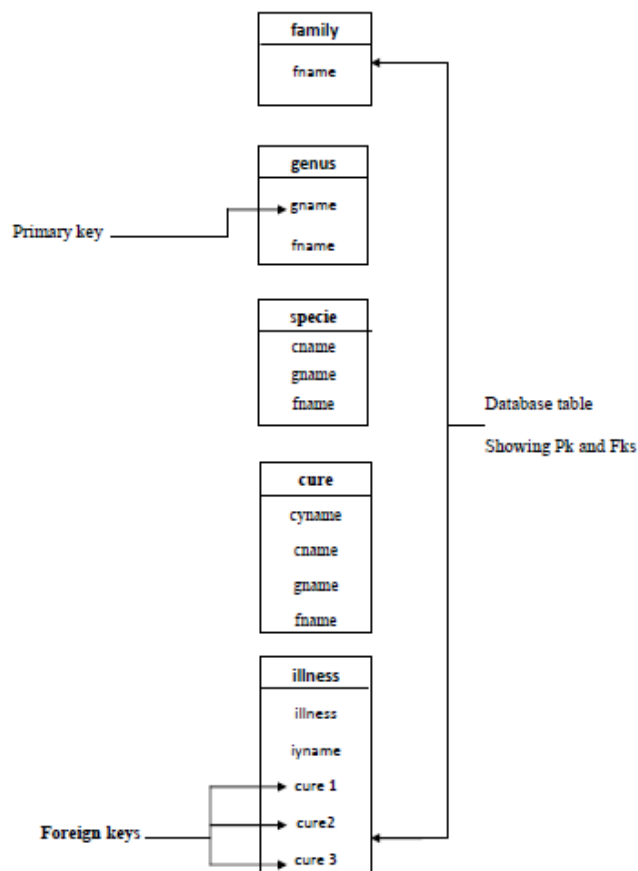

Fig. 2: Database Tables with Primary and Secondary Keys

Fig. 1. Ontological Taxonomy of Selected Yoruba Traditional Herbs
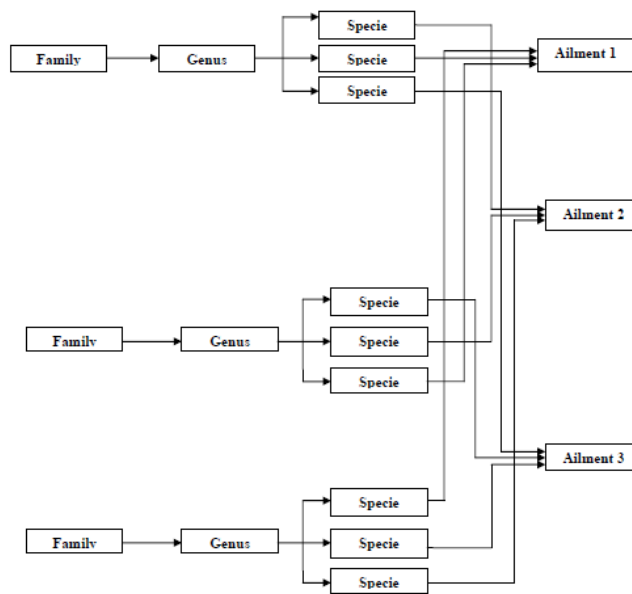

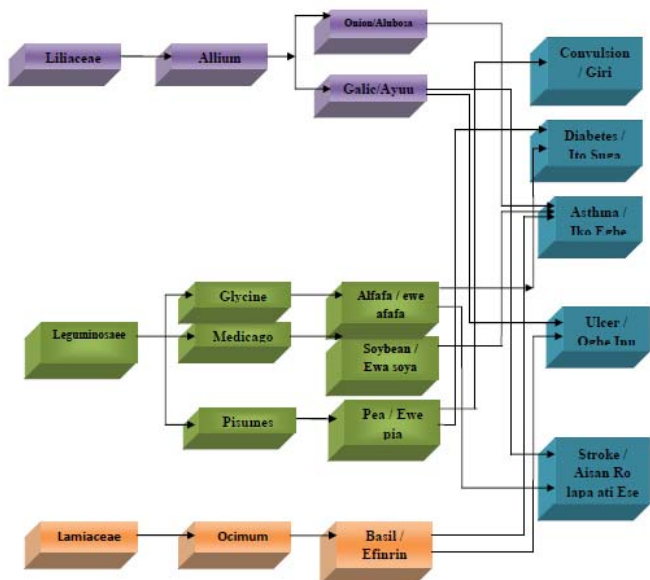Fig. 3: Herbal Medicine Structure in the Database

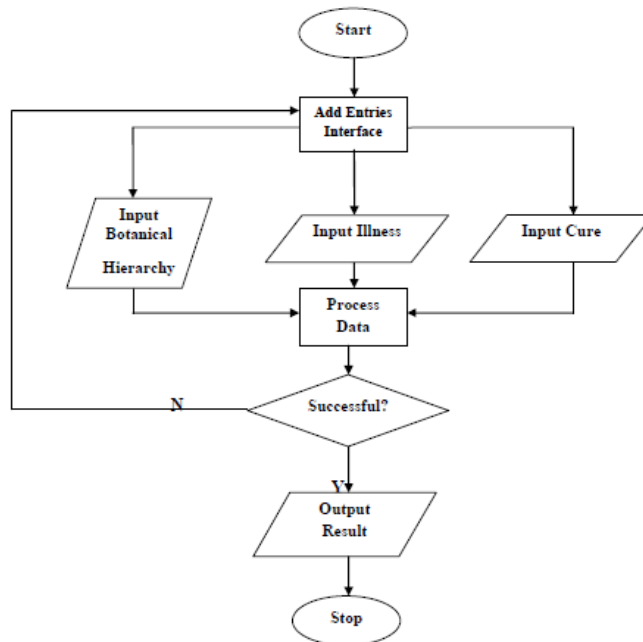Fig. 4: Sample Representation of Herbal Medicine in the Database

Fig. 6: Data Entry Flowchart
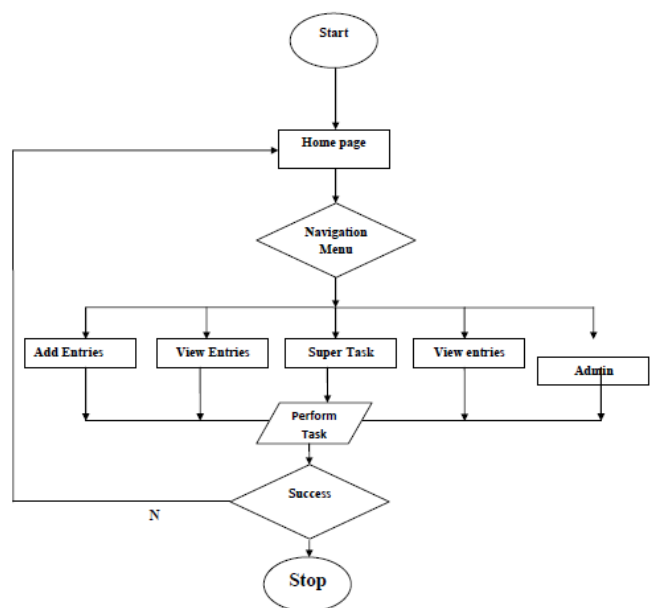

Fig. 5: Overall System Flowchart

(a)   Stroke/ *Aisan Rolapa Rolese*
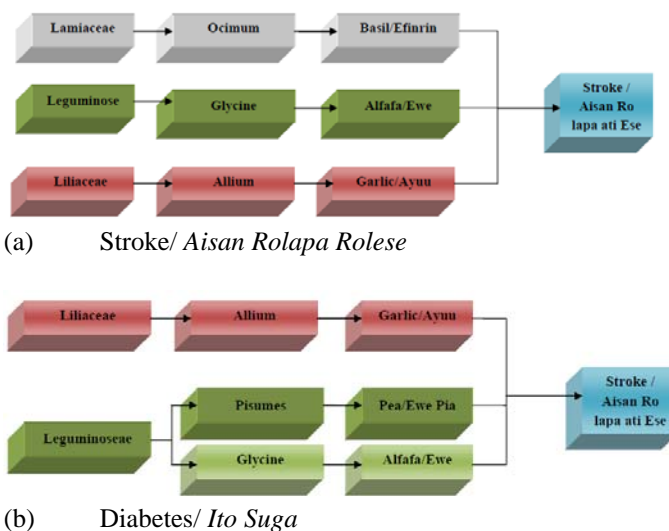

(b)   Diabetes/ *Ito Suga*
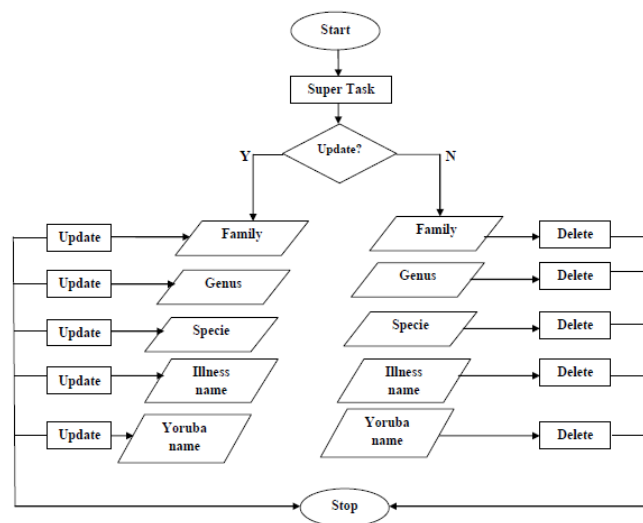
Fig. 7: View Chart Flowchart

Fig. 8: Super Task Flowchart
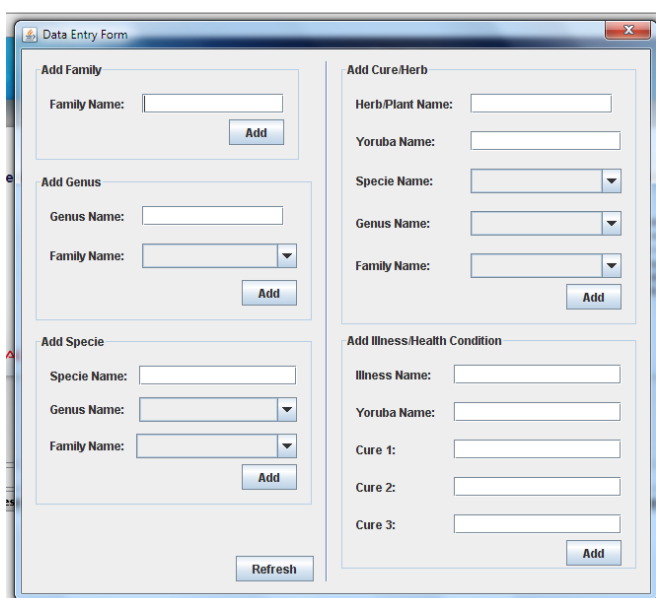
Fig. 9: The Home Page
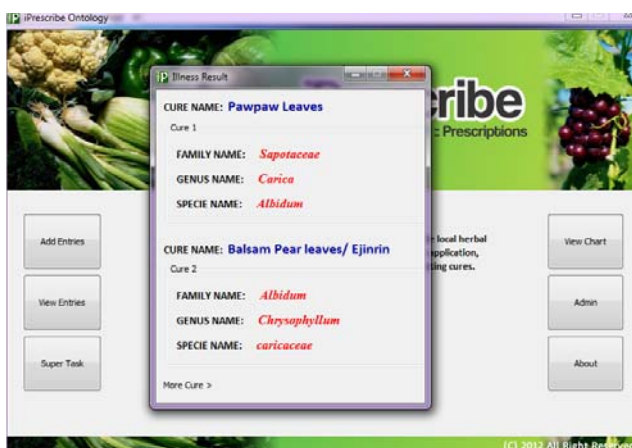

Fig. 10: Data Entry Interface

Fig. 11: Two Alternative Herbal Cures for Cough with Yoruba Name for the Herb

IV. RESULTS AND DISCUSSION

In demonstration of how the ontological framework functions, a number of screen shots were taken from the application developed and the functionality is discussed in this section. The home page interface comprise of other graphical user interfaces GUI which is an interface between the user and the database. It is where the user can query the database for the desire information about herbs working for an ailment (Fig. 9).

One of the important buttons in the home page is the data entry button. When selected it invokes the Data entry interface for the herbal data in the database, with its individual botanical hierarchy names or botanical taxonomy such as the Family, Genera/Genus, Specie(s), and Common Name, Yoruba Name, the herbal cures and all other necessary information (See Fig. 10). The system can extract herbal remedy for a specific illness. An example of this is shown in Fig. 11 which shows two alternative herbal remedy for "cough". The Yoruba name for the herb is shown for the herb in order to make it easy for the indigenous user to apply knowledge from the ontology to care giving. This solution thus provides a formal platform for the local (Yoruba) user to provide primary and secondary healthcare from a knowledge-based system. This is the main trust of this work

V. COMPARISON WITH EXISTING WORK

A. Figures and Tables

This work is comparable with the Korean Ontology for Medicinal Materials Based on Traditional Korean Medicine developed in [14]. The work in [14] constructed ontology for traditional Korean medicine (TKM), such that the ontology includes various data (herbs), such as their scientific names, parts of materials used, effectiveness, and the disease they cure. But this work does not cover symptoms in relation with the patient disease and treatments.

Computational methods for Traditional Chinese Medcine in [15] describes how ontologies and semantic tools can be utilized when collecting existing knowledge and combining different databases, with different computational methods and TCM expert systems that were introduced.

The current work is different from the existing work just described in that it applies ontology to a completely structurally different traditional medicine domain. Also, Protégée was the tool used for both existing work while Java is the tool of design of the current work.

VI. CONCLUSION

As pervasive technologies become a more integral part of everyday life, attention is now being paid to how these ubiquitous computing systems can be used to monitor and contribute to traditional herbal healthcare services. This work shows herbs with their botanical hierarchy i.e. Family, Generic, Specie, Common and Yoruba names for particular and related diseases. It Developed herbal ontology database

for Yoruba traditional medical services from which more than one herbal prescription can be made to cure diseases.

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