Volume: 08 Issue: 04 Pages: 3124-3143 (2017) ISSN: 0975-0290

An Integrated Framework for Telediagnosis and Prescriptions in Herbal Medicine

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ABSTRACT

Herbal medicine has been an age long tradition for the treatment and curing of diseases globally. Previous studies on telediagnostic and prescription of orthodox medicine have been examined using the application of modern technology device to improve health care services. In spite of this, there is yet an exhaustive study on the integration of technological framework for telediagnosis and prescription in herbal medicine. Therefore, this research focused on development of collaborative teleconsultation and telediagnosis in sharing of information on herbal medication for patients in remote areas to improve healthcare delivery. WAVA based collaborative framework was designed for telediagnosis and prescription in herbal medicine, it has multimedia features for videoconferencing, and ability to record, capture and replay consultations with the capacity for edit, data compression and short messages (sms) between the teleconsultants. The framework study the propagation time, link media delay, packet loss, processing delay between all (tele-herbal consultant 1, 2, 3…n) connected to the system. Each herbal tele-consultant was aloted with peer IP address in order to join the telediagnosis videoconference from their remote areas. The framework displays paradigms for data acquisition on herbal medications, video-recording, and imagery of patients. The integration of this collaborative framework enhanced telediagnosis of patients with better prescriptions on effective herbal drugs for speedy recovery.

Keywords - **Collaboration, WAVA, Telediagnosis, Prescription, Transmission, Packet loss, Herbal Practitioners**

Date of Submission: Feb 15, 2017 Date of Acceptance: Feb 23, 2017

I. INTRODUCTION

Healthcare refers to the organized provision of medical care to individuals or community. Healthcare consists of the management, practice, prescription, diagnosis and consultation for the purpose of curing and treatment of diseases. It is broadly divided into two categories. It includes the herbal (traditional) medicine and orthodox medicine [1]. Herbal medicine is an age long tradition used for the curing of and treatment of diseases. It is cheaper, accessible and close-to nature [2].

In recent times, Herbal medicine has found its way as an alternative to orthodox medicine; it is the oldest and the most alternative system of medicine in the world today. Its medicine is made exclusively from plant. It is used in all societies and is common to all cultures due to its affordability. Herbal medicine is increasingly being validated by scientific investigation which seeks to understand the active chemistry of the plant; many modern pharmaceuticals have been modeled after, or derived from chemicals found in plants. The alternative to orthodox medicine is herbal medicine, otherwise referred to as traditional medicine. Traditional medicine is practiced in every part of the globe, both developing and developed nations. One of the most important components of alternative Medicine is herbal medicine [3].

The link between herbs and modern pharmacology is so close that as many as 40% of the prescribed medicines dispensed in the US contain at least one active ingredient derived from herbs [4]. The vast majorities of these drugs are either made from plant extracts or synthesized to mimic a natural plant compound [2] . Due to advancement in medical technology, patient can have herbal medication through telephony and web with aid of internet [5]. The use of telephone systems in healthcare settings serve as a viable tool for improving the quality of service provided to patients, decreasing the cost, and improving the patient satisfaction [6] .

Collaborative telediagnosis in telemedicine is to provide a media to facilitate the consulting procedure between physicians. With this, bed-site physician in rural or less-developed areas can consult more specialized or experienced physicians located at the remote site. Remote physician can therefore examine the patient's medical images; medical documents, real time data from the device connected to the patient, and provide comments and findings to the bed-site physician [7]. Though, telemedicine with respect to herbal medicine is arguably one of the most important applications that information technology supports. Although it is not

Volume: 08 Issue: 04 Pages: 3124-3143 (2017) ISSN: 0975-0290

necessarily true that telemedicine is widely used in herbal Medicine, its origin certainly forms the basis of remote support for modern medical science some 5,000 years of ancient telemedicine history [8].

In the modern world, telemedicine allows information about herbal materials to be gathered from remote forests for analysis of substances that can serve as remedy for some diseases, and their study for contraindications and any possible side effects. The compositions of plants contain many photochemical substances including vitamins and minerals; one important aspect of technology is to ensure that the amount of intake of any component does not exceed certain toxic level that may result in health damage rather than healing. According to the Natural Resources Conservation Service of the US Department of Agriculture (NRCS), as many as hundreds of thousands of plant species exist. Identification and subsequent isolation of active ingredients would entail thorough studies of individual plants. The vast numbers of plant species mean only a small number have been studied for their healing properties. Further to active ingredients, synergistic interactions between different components within the plant also need to be studied in order to grasp a comprehensive understanding of its medical value. Botanical study will continue to play a significant role in pharmaceutical research in the foreseeable future [9].

Telediagnosis is the determination of the nature of a disease at a site remote from the patient on the basis of telehealth methods of transmitted data. Telehealth is a method of health treatment by using telecommunication technology such as telephones, cell phones, PDA's, the Internet and videoconferencing [10]. Telehealth care systems are becoming more popular due to its mobility.

However, since telemedicine has been successfully applied to orthodox medicine, it is imperative for research to be carried out on the application of telemedicine on herbal medicine and hence the need for this study. Therefore, this research study herbal-based telediagnostic system is proposed to manage the information and the challenges of existing telediagnostic framework of orthodox medicine. This collaborative telediagnosis framework in herbal medicine will provide tools for distance prescription for an online diagnosis of patients by tele-herbal consultants [11].

Therefore, adaptation of collaborative framework for telediagnosis and prescription in herbal medicine will help herbal practitioner bring about collaborative health care delivery to the society in the distributed operating centres.

2. REVIEW OF RELATED LITERATURE

Telediagnosis refers to diagnosis that is made at a remote location and is based on evaluation of data transmitted from instrument that monitors the patient and a transfer link to a diagnostic centre. In other words, it is the determination of the nature of a disease at a site remote from the patient on the basis of telehealth methods of transmitted data. This is done through telecommunication technology such as telephone, internet and videoconferencing [10]. To have a good telediagnosis, ICT play a commendable role for an effective diagnosis of patients on a real-time interaction and consultation via online communication such as videoconferencing [12]. Telediagnosis have been used by nurses, physicians and consultants to diagnose many common conditions in order to reduce cost, ease appointments and visits and minimize patient visit. Among the methods used in telediagnosis involves the use of telephone, internet usage and computer telephony [6].

Telephones have been found very useful for teldiagnosis in modern medicine. Correspondences with patients through telephone have provided useful information on affective symptoms, health related quality of life, disability and medication compliance in patient to medical care [13] .

In addition, computer telephony (web telephony) is basically an integrated system linking telephone with computers to receive, transmit and process information [14]. In orthodox medicine, the doctor uses a stethoscope to examine the patient for signals from the heart tissues or for signals in the brain waves while the herbal medical practitioner uses his experience and observes the patient for any abnormality in posture or breathing to determine the sign of the ailment during diagnosis. According to [5], in herbal medicine, diagnoses are classified into several aspects as follows:-

i. Observation of the Patient

This involves watching the patient's attitude (especially in early mental cases) and gestures can be clearly extended to include his relations, to find out whether the disease being observed is a family trait. Hereditary diseases in orthodox medicine e.g. (asthma or sickle cell anemia) are similarly investigated but this is a common component of an herbal Practitioners method of diagnosis. Whereas the herbal traditional Practitioner sometimes listens to tones of patients, using the opportunity to observe the patient and later enquire into the health of the patient relations, the modern doctor gives the impression of having no time for his patient at all due to queue of patient in the hospital.

ii. Visual Examination

The eyes, skin, urine and faces are examined in traditional medicine, especially in the cases of yellow fever or rashes.

iii. Biological Examination

The herbal practitioner uses his own sensory organs to carry out biological examinations because of the lack of knowledge of the scientific system of medicine, as well as lack of training in the performance and interpretation of test. Examples include testing urine for confirming the presence of sugar in diabetics, smelling sores for putrefaction needing potent antimicrobial agent, or observing the colour of vomited food in diabetics. If a diabetic patient urinates and later finds out that the site is infested with ants, this is an indication that the sugar is in his urine.

Herbal medical practitioner is a person recognized by the community in which he lives as competent to provide health care by using vegetables, animals, mineral substances and other natural resources. These methods are based on social, cultural and religious background as well as on the knowledge, attitude and beliefs that are prevalent in the community regarding physical, mental and social well-being and the causes of diseases and disability [15]. In India, however, traditional health practitioners are called 'indigenous healers' [16]. In China they are called "bare-foot doctors", not because they go bare-footed (they wear shoes most of the time, and especially when performing their medical tasks) but to emphasis the fact that these personnel are also farm workers. Indeed, every culture has a vernacular name to describe herbal medical practitioners, emphasizing their close association with the community in which they live and practice [17].

Telemedicine can best described as an integrated system of health-care delivery that employs telecommunications and computer technology as a substitute for face-to-face contact between health service provider and the client [18]. This is the delivery of health care and the exchange of health-care information across distances and not a technology or a separate or new branch of medicine. It involves the interaction between the client and the expert (real-time or prerecorded), and the type of information being transmitted (text, audio, image or video) [19]. It is a system that provides healthcare and shares medical knowledge over distance using telecommunication means to have telemonitoring, teletreatment and teleconsulting [20].

Telemedicine and e-Health offer a way for improving the standard of healthcare deliveries particularly in the developing world. The developing countries such as Nigeria, where large portion of population has access to ICT can exploit this to give better healthcare services. Healthcare systems present great opportunities for improvement by providing better, reliable and secured services to the patients, physicians, staff and other stake holders within the boundaries of a hospital and also to distant patients where no physical healthcare infrastructure is available [21].

Consider for instance elderly people that can press an alarm button when they are in trouble, the alarm system can then contact the practitioner for consultation. Another example is the sharing of patient data between caregivers, which enhances collaboration efforts. Additionally, several social-economic developments such as teleconsultation, telediagnosis etc. that stimulate and justify the need for ICT in healthcare are identified [22].

The Telemedicine Unit of the National Airspace Research and Development Agency(NASRDA, Nigeria) uses NigCom SAT1 to perform tele-surgery at designated hospitals across the country making use of experts from various University college hospitals such as Ibadan, Jos, Abuja, Port-Harcort, Zaria and Maiduguri for the six geographical zones in Nigeria[18].

This web service for the intended adaptation is called Web Service for Automatic Video Adaptation (WAVA). This allows the teleconsultants to have access to changes made to the exchanged data within a given environment, taking into account its constraints. The WAVA adaptation determines marks in the function of properties used by specific devices. Most telemedicine centres or institute adapt the services of WAVA for the quick information flow [23],

[24] developed a frame work to protect patient diagnostic medical imagery for secure telediagnosis. The hyper chaotic chen system and tent map were harnessed for the design. The framework showed significant improvement on the security of encrypted contents. However, because HCCS does not consider the physical appearance of patient but stored and forward telemedicine and the developed system is less applicable in practice. [23] Presented a tool for telediagnosis of cardiovascular Diseases in a Collaborative and Adaptive approach using WAVA principle. In the study they proposed combining the semi-automatic detection tool with a collaborative adaptive platform thus allowing practitioners to share data and to co-author their remote diagnosis. The first results show that practitioners benefit from a very high level of information availability, and performance results validate this use. The phase of clinical trials is now in progress. The WAVA adaptation determines marks in the function of properties used by specific devices. Their research does not consider physical teleconsultation of patient rather the system applicable on Imagery.

[25] Video conferences Systematization and Experiments in Telemedicine. The paper described one of the different modalities of telemedicine, allowing real-time interaction. The present study is aimed at describing videoconference systems in a simplified way, focusing on their application in telemedicine. Videoconference involves the necessity of equipment for audio and video capture and reproduction, besides a communication link for connection with similar equipment through ISDN (integrated services digital network) or IP (internet protocol). Video and audio quality is essential for the success of a videoconference. Experiments using videoconferencing equipment in radiology and other fields of medicine are a reality at international level. In Brazil, reports account for some isolated initiatives in this field, most of them involving universities networks. Besides its remarkable impact on costs of medical care delivery for the population, videoconference represents an invaluable tool for physicians in their education and knowledge updating. However, the paper has a setback hence no telediagnosis of patient condition and appearance.

[10] developed a framework, Mobile telemedicine system application for telediagnosis using multimedia messaging service technology, the research model a multimedia to send messages to patient in remote areas

who could not have access to medication to enhance the capability of MMS technology in message delivery. The proposed techniques were on the client and server sides ensure that the quality of data is preserved which is critical for accomplishing the diagnosis process. The experimental results show that the proposed framework can be used to develop a practical mobile telemedicine system. Nevertheless the research suffers the ability of see the patient's status of health in appearance.

[26] presented a concept for a web-based telemedical system for use in rural areas with limited communication infrastructures and a lack of medical professionals. The TeleMedSys consists of a patient management system and a medical device system that are available to the doctor and the patient-side assistant during treatment via an Internet browser. The combination of local and remote web applications enables a seamless integration of the medical devices required at the patient's location into the doctor's remote station based on browser technology. In rural and isolated areas where there is a geographical limitation, the uses for telemedical stations that take into account satellite connectivity, power supply such as solar panels, and ready to use teleconsultation equipment are very highly needed and not easily available or affordable.

[27] presented a platform concept, Scars Collaborative telediagnosis platform using adaptive image flow which allows to remotely share images of scars and to adapt these images that can be communicated across different client platforms to monitor scar excision to ascertain if the cancer cells has been removed. The research ultimate goal of a collaborative system is to be able to adapt to changing initial needs, to emerging needs and to changes in contexts and technologies was chosen to reflect the fact that collaborative systems must evolve continuously, but not with total autonomy or self-adaptation. This research also has a setback because there is no continuous checking of the status of patient after images collected at the initial stage.

[19] propose a collaborative telemedicine for interactive multiuser segmentation of a volumetric medical images in which the interactive collaboration systems will control editing of an object among multiple users are often limited to a simple "locking" mechanism based on a conventional client/server architecture, where only one user edits the object which is located in a specific server, while all other users become viewers. Such systems fail to provide the needs of a modern day telemedicine applications that demand simultaneous editing of the medical data distributed in diverse local sites.

[5] presented a research decision support system on prescription in herbal medicine using mobile and web devices; the research is self-diagnosis and prescribing. The research has setback because it is self-prescription, no consultation from any herbal practitioners, no update to ascertain the improvement of the patient and excessive usage of herbs.

[28] presented an article Telemedicine using Mobile Telecommunication that allows collaborative activities between health professionals for the deployment of medical procedures carried out remotely by means of device using information and communication technologies. This article focuses on the teleexpertise that allows collaboration between medical professionals in order to share knowledge and expert advices used as explanation elements for decision support.

Most of the related works reviewed do not address African adaptation to herbal medicine. Also many related works are mostly interested in stored and forward telediagnosis and the challenges that face the rural and remotes areas that have no electric power source and communication network.

This integrated framework for collaborative telediagnosis and prescription in herbal medicine platform will address these challenges that will allow all the patients to have access to a real time (videoconference) telediagnosis.

3. MATERIALS AND METHOD

This study is organized within a multidisciplinary framework. It incorporates the field of survey. Medical and the application of technology for telediagnosis and prescription in herbal medicine as it were used in orthodox medicine. This research applies the systems development life cycle approach to secure a an integrated collaborative telediagnosis and prescription in herbal medicine. An improvement was introduced to meet the operation of the system in teleconsultations between herbal practitioners more easily to enhanced videoconference on a real time telediagnosis.

A. Architectural design and framework for telediagnosis and prescription model

This paper gives the general overview of the architectural framework for the establishment of prescription of herbal medicine on the web presented in Figure 1. The framework highlights the structure of the developed system together with the way they interactions with each other. The architecture of the system shows constraints imposed by the user requirements and the available technology.

A diagrammatical model approach was used to accomplish the main objective of this research work. To achieve this objective an architectural framework was designed. This framework is used for both the real time (videoconferencing) and medical diagnosis of stored–and-forward telediagnosis as shown in Figures 1. This approach was used to realize the main goal of the research.

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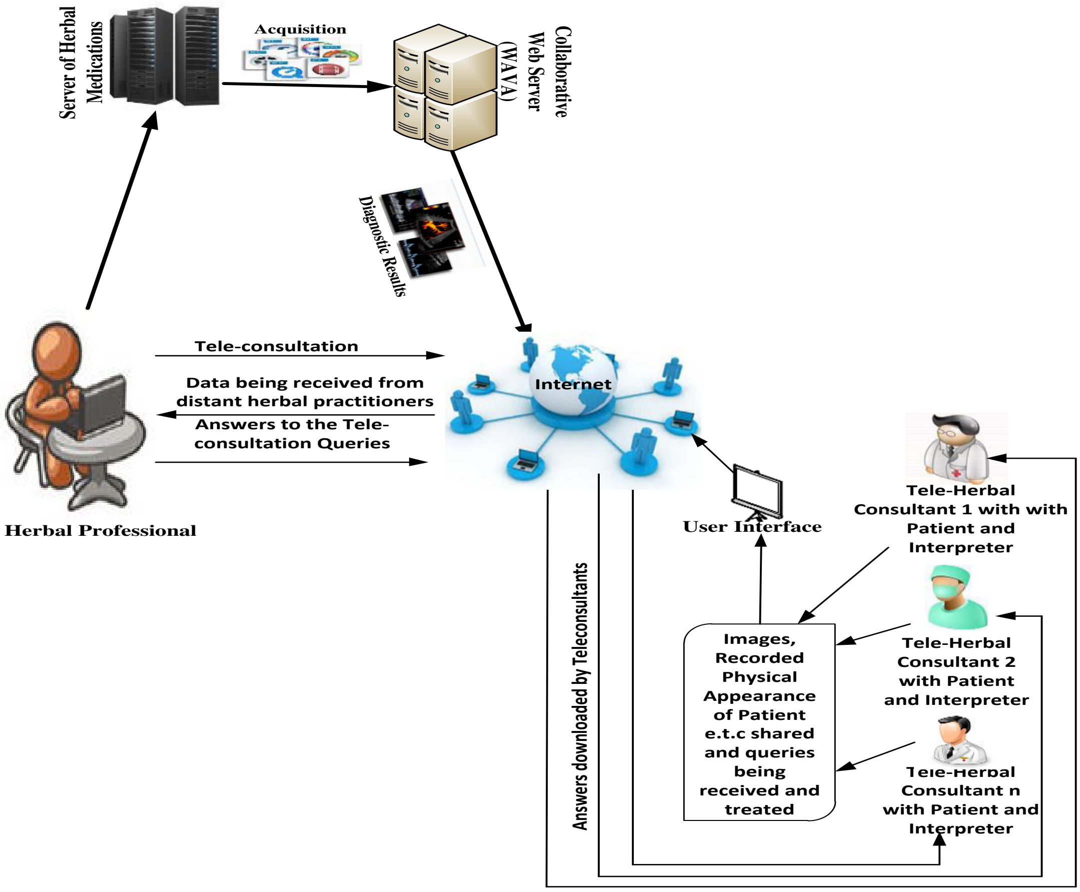

Figure 1: Collaborative WAVA-based Herbal Telediagnosis

It is assumed that the practitioners (tele-herbal consultant) could have different types of connections to the system (for example Internet, Wi-Fi, 3G,), and as well different terminals with different capabilities. Hence they cannot receive the same data, therefore switch to the adapted solution by adding the Web service for Automatic Video data flow Adaptation (WAVA), which adapts the web service then distributes recorded videoconference to all practitioners who are involved in the telediagnosis (tele-herbal consultant 1, 2, 3…n) connect to WAVA to register themselves, transmitting their capabilities as in Figure 3.3, WAVA will give each with priority in schedule manner. When practitioners connect to the web service searching for recorded diagnosis, the web service sends a quality request to WAVA, which sends back the adapted data. At the end, the web service sends to each practitioner the adapted data, from which each will make their own diagnosis as shown in Figure 1. For the collaborative telediagnosis to take place, the telediagnosis centre must be sited in a designated room with the hardware requirements specification. It must be a noise free environment where all the tools/components are linked together via a communication network connected with internet facilities to allow collaborative teledignosis to take place as shown in Figure 1.The research hardware requirement specification needed to realize the goal of this research work are listed below for its full implementations. It includes:

i. High-resolution video camera (polycam) or web camera: A polycam is a video conferencing tool connected to the ISDN lines.
ii. Microphone. This transmits voice to the speaker
iii. Personal Computer for the storing of information about the patients
iv. The Speaker: Enhances the interpreter's and herbal teleconsultant's voice during transmission.
v. Facsimile machines and a modem.

This web server created a client application that reads the terminal performances (CPU frequency and load, screen resolution, network bandwidth) and sends the corresponding mark data to the server. The latency generated by the calculation did not allow an efficient and satisfactory work. Furthermore in a collaborative environment, heterogeneous client can connect to the system. The best solution to resolve this problem is the use of Web Services. Because of their portability and independence from programming languages, Web Services can handle any kind of platforms. Also, the feedback is saved to calculation time of the terminal. When the client chooses a video, the collaborative system automatically detects terminals performances with the WAVA mark data and sends back adapted videos.

More so, web service receives the recorded data from the acquisition component. It makes copy available for all teleconsultant, saving them in a database as a reference when the patients come back for subsequent medication. The process is a continuous one.

The components of the designed Framework are explained as follows:-

i. **Herbal Professional:** Is the administrator that supervises the tele-herbal consultants on the type of treatment to be given to the patients.
ii. **Collaborative Web Server (WAVA):** Is server that allows collaboration to take place to send/receive information through internet devices to computing devices of each tele-herbal consultant.
iii. **Herbal Medication server:** This houses the recorded information about patients, images and results of video conference consultations among the tele-herbal consultants.
iv. **Interpreters:** They are the herbal health workers who interpret the language spoken by patients so as to avoid any form of language barrier.
v. **Patients:** These are people seeking for herbal diagnosis and prescription their various ailments.
vi. **Tele-Herbal consultants:** They are specialized herbal practitioners that provide herbal medication for patients.
vii. **User Interface:** this serves as an intermediary between the patients and the herbal consultants.
viii. **Diagnostic Results and records:** These are the information about patient diagnosis which can be requested for by any herbal tele-consultant.
ix. **Internet connectivity:** This provides communication link between tele-herbal consultants.
x. **Computing Devices (Terminal):** Desktops and laptop computers which are used for communication and interaction between tele-herbal consultants with their patients.
xi. Required information needed about patient for medication

B. Conceptual modeling of the Herbal Prescriptions on Website

The emphasis of logical database model is on logic, which is a readable method and useful for representing the knowledge. This can be done through the conceptual modeling Conceptual modeling is a process to model data of domain. Conceptual modeling is a well-known technique of data modeling. It represents domain entities, meaning of the data, concepts or terms used by domain experts, function or relationship between concepts. Conceptual model, also known as conceptual level schema as shown in Figure 2a through 2c show the flowchart, decision tree and transitional diagram on how the flow of the interactions and also the database design which determines information needed by the teleherbal consultants.

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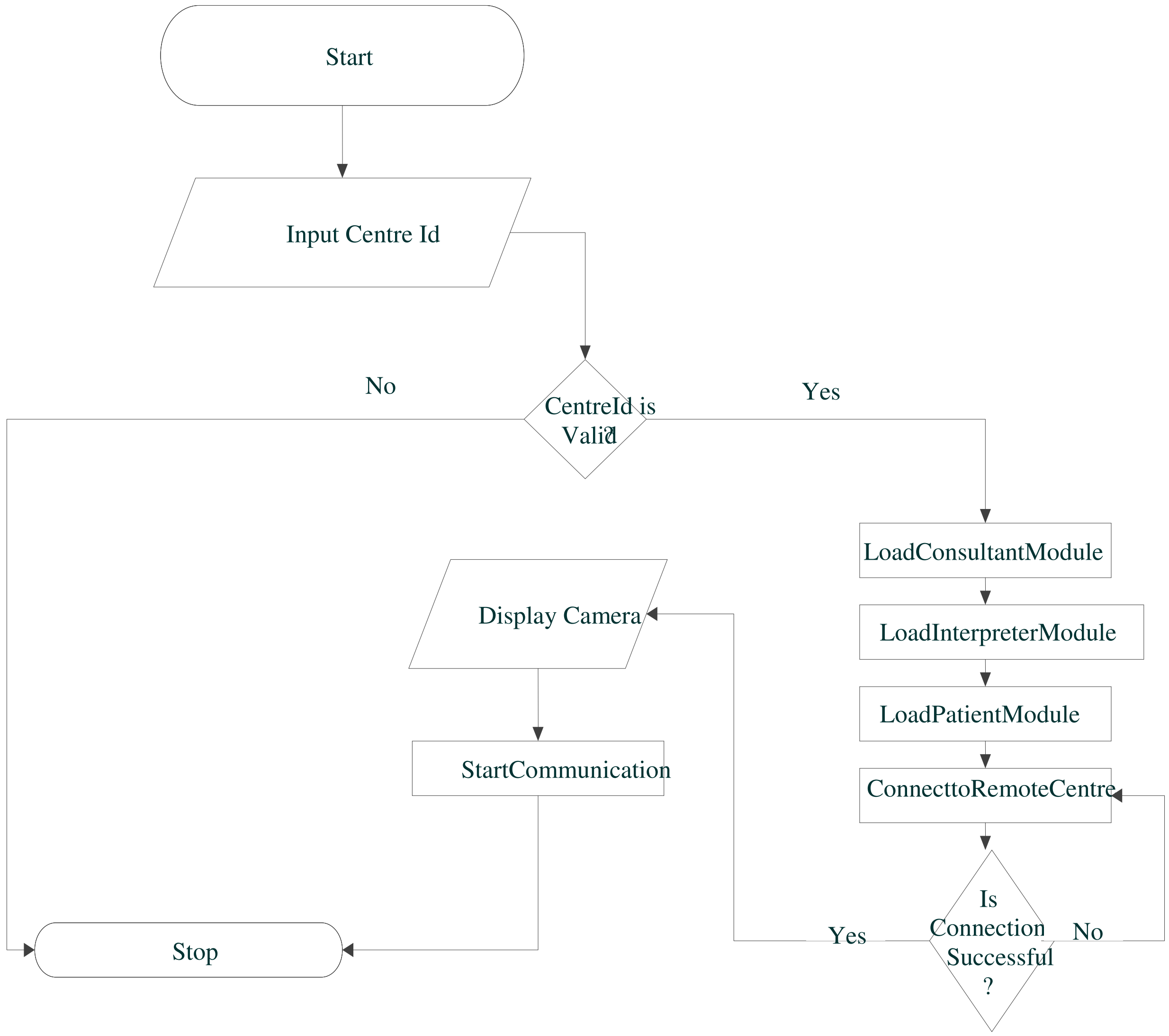

Figure 2a: Flowchart for Teleherbal teleconsultant to get connected

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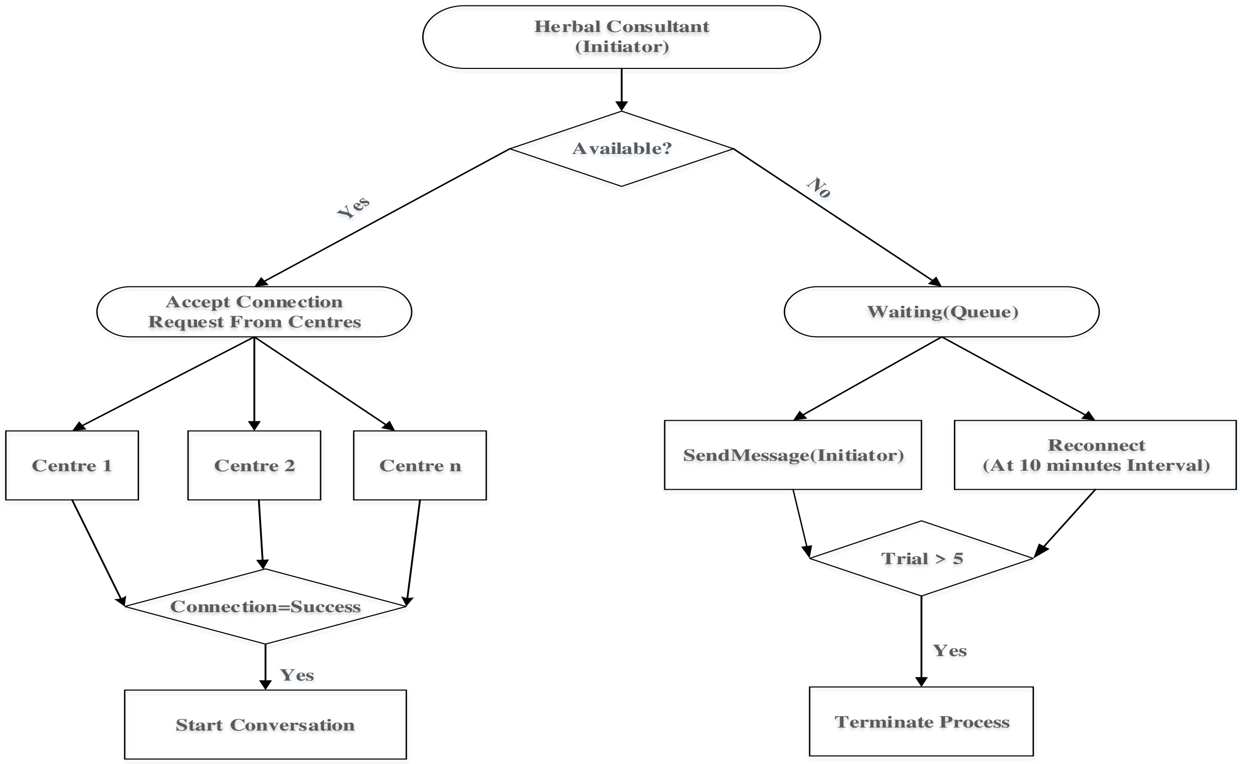

Figure 2b: Decision tree for Teleherbal Consultant having accesses to other Consultants

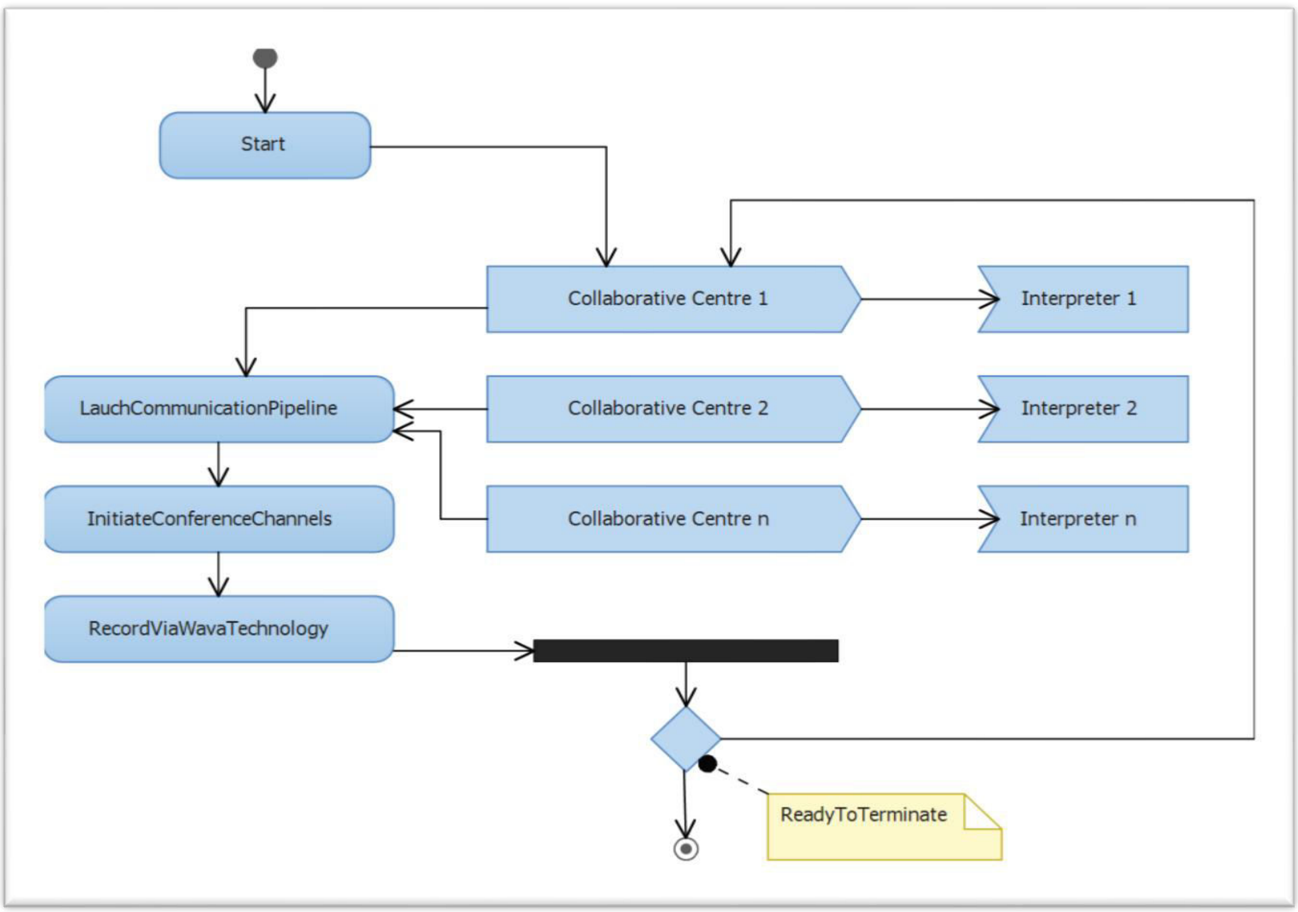

Figure 2c: Transitional Diagram of Collaborative WAVA based Herbal Telediagnosis System

C. Database design of the Herbal Prescriptions

This helps to manage or structure their data in a logical way. In addition, database design is a process to produce detailed data model of a database. The detailed data model consists of detailed value parameters, attributes, primary key, foreign key and relationship between entities. Figure 3 show the structure knowledge the database and the relational of the structure of the system. An excellent database development is important to get an optimal performance and high productivity. In order to achieve the quality of system, the structure of database has to be properly presented which representing information in the database design to ensure the database works properly.

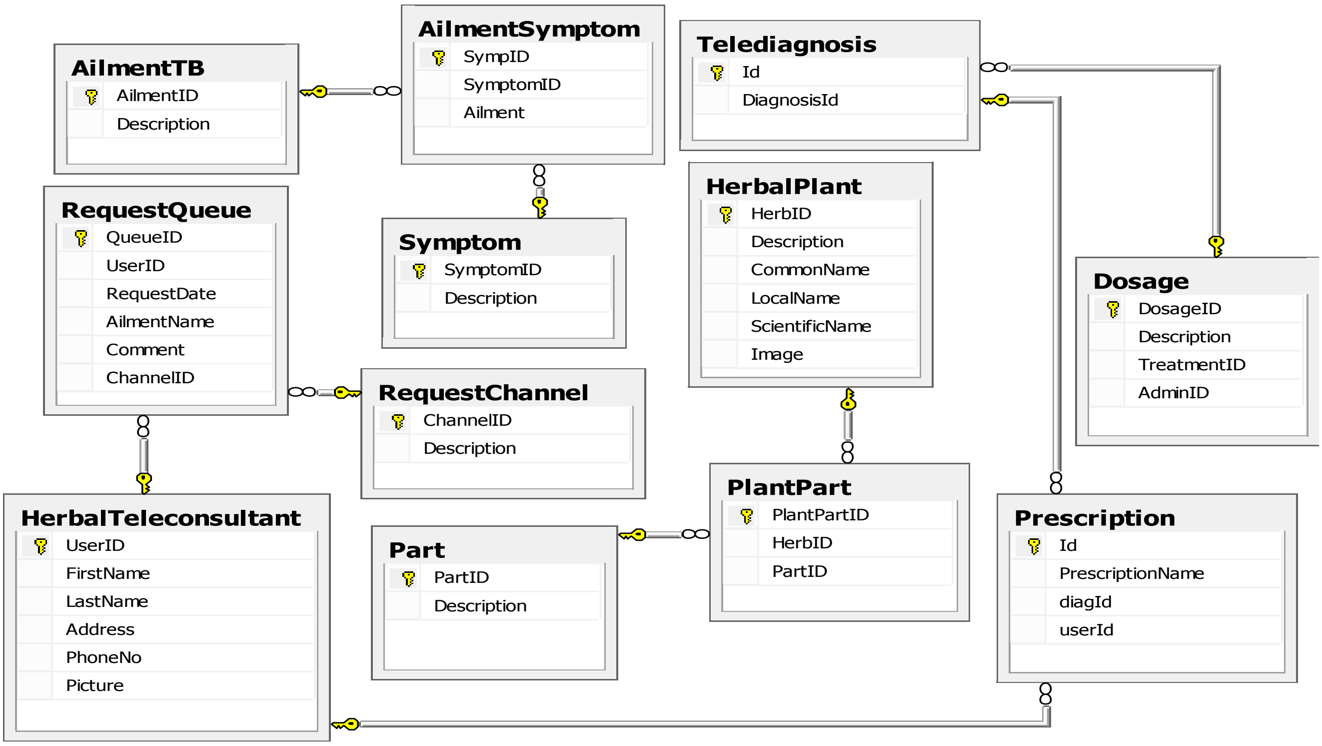

Figure 3: Structure knowledge of Collaborative WAVA based Herbal Telediagnosis database

E. Implementation Tools

The system was achieved and implemented with the usage of C# for the development of the application. The database was created to house the information collected during the survey to test the developed application. The database contains the herbs, diseases, medications, prescriptions, images and recorded video during telediagnosis of the herbal teleconsultants. The Figures below show how the application can be access by herbal teleconsultants. Home page shows all the navigation links. This shows how teleconsultants can interact with other herbal teleconsultant. Figure 4b show how telediagnosis can be initiated so that teleconsultants can join interactive session for joint telediagnosis. The Figures 4c to 4e were the images taken during collaborative session among the teleconsultants to give their own recommendation on which medication should be given to the patient.

Figure 4a: Home page showing the available navigation

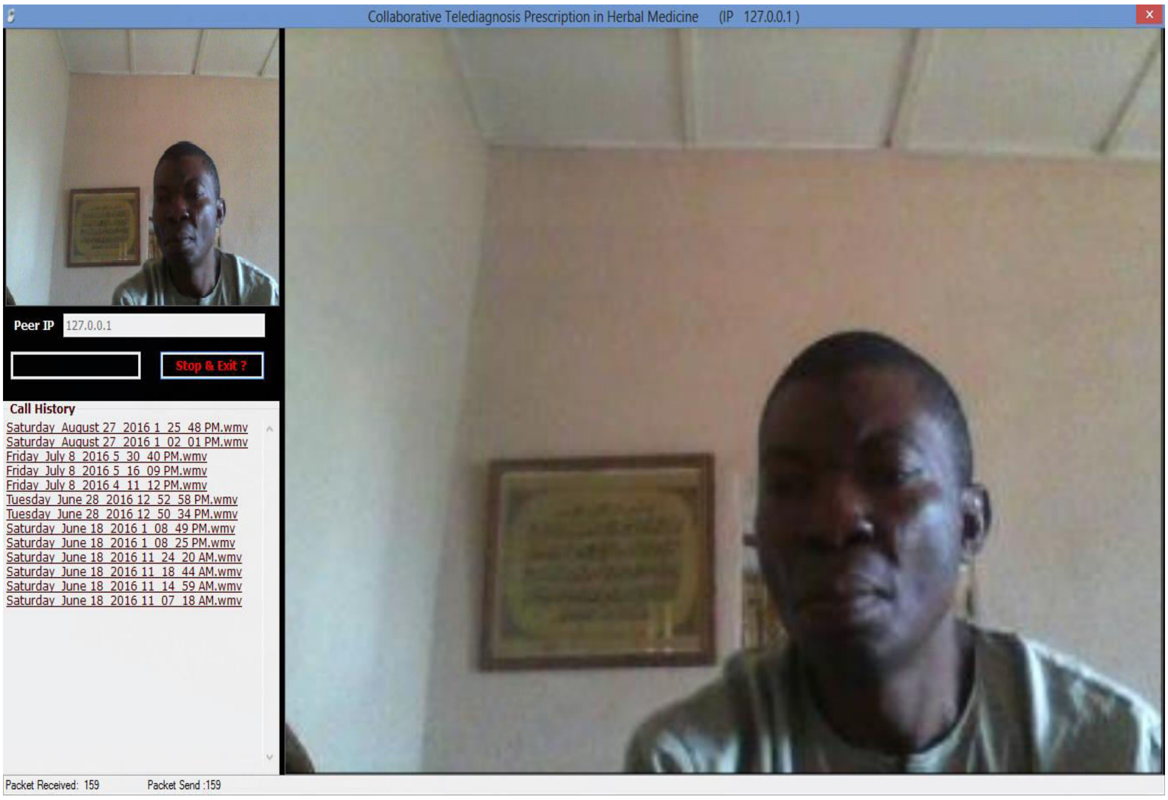

Figure 4b: Telediagnosis session

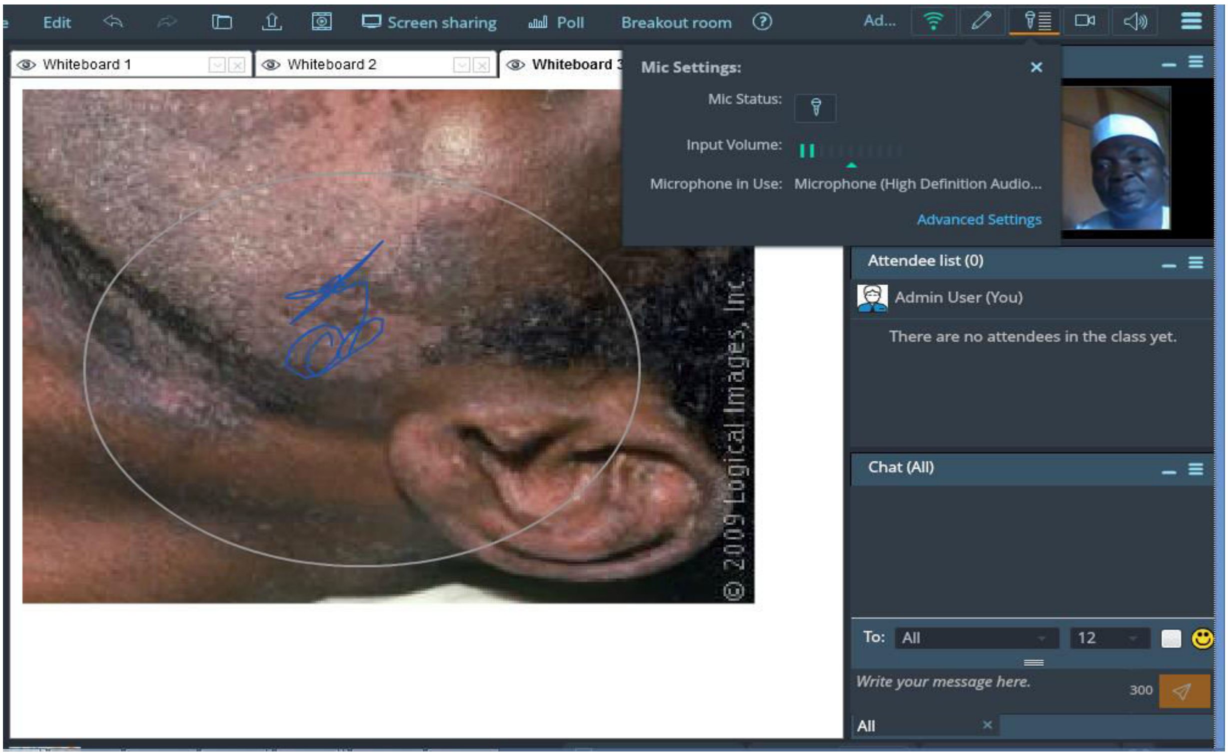

Figure 4c: Scar skin disease during telediagnosis session

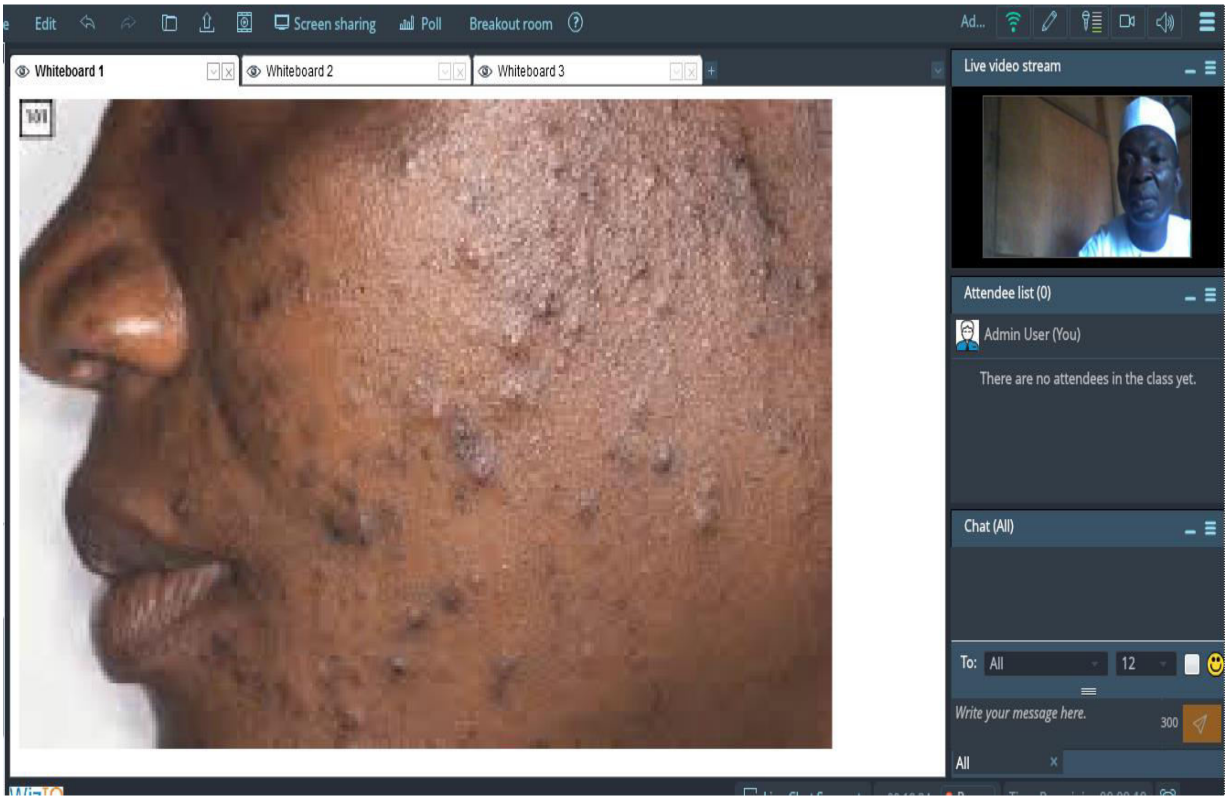

Figure 4d: HIV symptom during telediagnosis session

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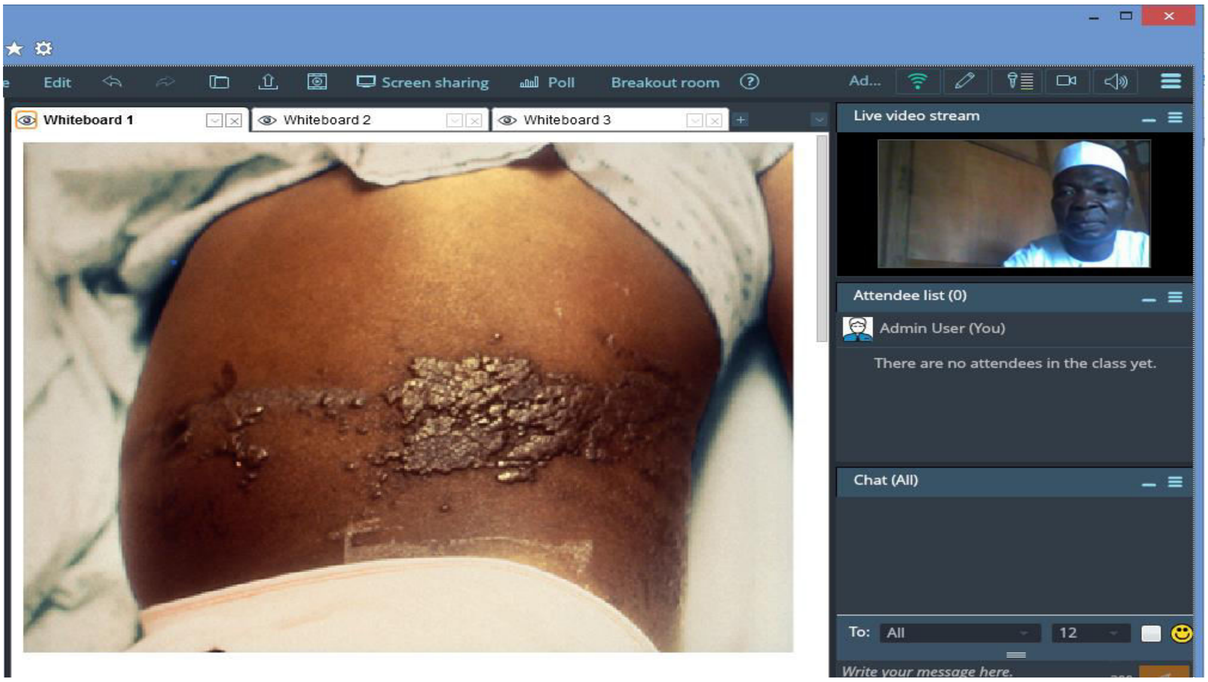

Figure 4e: Skin wart disease telediagnosis session

4. RESULTS AND DISCUSSION

The study is not aimed at enhancing the effectiveness of herbal medication, rather it is based at improving decision making of herbal telediagnosis and prescription among herbal practititioners. Therefore, the diagnosises made by the collaborative user of the system to give joint medication to patients at different centres. An experiment was conducted to quantify the effects of latency in the network it takes the tele-herbal consultant to conduct diagnosis at roundtrip bi-directional audio and video latency between them as shown in Figure 5. The experiment was conducted with reference to requirements and stream priorities on the packet loss during the transmission and propagation time. These evaluations determined the relevance of this research work to the usage of herbal consultation, telediagnosis and prescription of herbal drugs for the patient in the study areas. The amount of time required to transmit and receive audio/video signal is called latency or link media delay.

Packet delay and packet loss are two key parameters for real time applications. This was used to analyze our application over 5 nodes in 21 days, in voice communication, an over-170ms end-to-end delay is said to be harmful to the service quality, and a packet loss greater than 5% is usually unacceptable for voice application. One-way delay and round-trip delay measurement methods are used, respectively. The packet loss measurement method measures packet loss by injecting probing packets into the networks. The number of probing packets needed to get the accurate results is analyzed as follows:

$$X_n = \begin{cases} 1, \textit{packet is lost with probabilty } p \\ 0, \textit{packet is received with probability } 1-p \end{cases}$$

$$X_N = \frac{(X_1 + X_2 + \cdots X_N)}{N}$$

X_N is actually the packet loss rate for N samples

$$\frac{3.46047619 + 3.132857143 + 3.416666667 + 3.610952381 + 3.361428571}{5}$$

=3.396476% for average packet loss in Table 8.

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Table 2: Packet loss analysis for Node 1 for 21 days

Day	Total Packet Sent	Packet Delivered	Lost Packet	Loss % Percentage	Availability %
1	21242	20251	991	4.67	95.33
2	20156	19427	729	3.62	96.38
3	21641	21048	593	2.74	97.26
4	21755	21117	638	2.93	97.07
5	22295	21597	698	3.13	96.87
6	21204	20547	657	3.10	96.90
7	22904	22347	557	2.43	97.57
8	23582	22607	975	4.13	95.87
9	22620	21634	986	4.36	95.64
10	23465	22622	843	3.59	96.41
11	23198	22551	647	2.79	97.21
12	20137	19193	944	4.69	95.31
13	21627	20816	811	3.75	96.25
14	22654	21936	718	3.17	96.83
15	20245	19363	882	4.36	95.64
16	23402	22857	545	2.33	97.67
17	24989	24208	781	3.13	96.87
18	20344	19426	918	4.51	95.49
19	23923	23277	646	2.70	97.30
20	23737	22882	855	3.60	96.40
21	24986	24252	734	2.94	97.06

Table 3: Packet loss analysis for Node 2 for 21 days

Day	Total Packet Sent	Packet Delivered	Lost Packet	Loss %	Availability %
1	23006	22346	660	2.87	97.13
2	24486	23799	687	2.81	97.19
3	24454	23561	893	3.65	96.35
4	24095	23365	730	3.03	96.97
5	21632	20916	716	3.31	96.69
6	23285	22586	699	3.00	97.00
7	24093	23227	866	3.59	96.41
8	20497	19726	771	3.76	96.24
9	24050	23468	582	2.42	97.58
10	23556	22810	746	3.17	96.83
11	20766	19786	980	4.72	95.28
12	20294	19696	598	2.95	97.05
13	21024	20501	523	2.49	97.51
14	21026	20419	607	2.89	97.11
15	23759	23240	519	2.18	97.82
16	22713	22060	653	2.88	97.12
17	22553	21707	846	3.75	96.25
18	20349	19415	934	4.59	95.41

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19	21388	20840	548	2.56	97.44
20	24853	24336	517	2.08	97.92
21	22912	22204	708	3.09	96.91

Table 4: Packet loss analysis for Node 3 for 21 days

Days	**Total Packet Sent**	**Packet Delivered**	**Lost Packet**	**Loss %**	**Availability %**
1	22801	21952	849	3.72	96.28
2	21446	20792	654	3.05	96.95
3	23459	22869	590	2.52	97.48
4	21339	20520	819	3.84	96.16
5	21477	20940	537	2.50	97.50
6	23352	22646	706	3.02	96.98
7	23260	22452	808	3.47	96.53
8	23578	22639	939	3.98	96.02
9	22985	22017	968	4.21	95.79
10	20623	19815	808	3.92	96.08
11	23381	22844	537	2.30	97.70
12	23052	22209	843	3.66	96.34
13	23557	22759	798	3.39	96.61
14	24277	23593	684	2.82	97.18
15	21434	20435	999	4.66	95.34
16	22367	21739	628	2.81	97.19
17	22020	21031	989	4.49	95.51
18	22786	22162	624	2.74	97.26
19	23519	22570	949	4.04	95.96
20	22799	22010	789	3.46	96.54
21	23216	22485	731	3.15	96.85

Table 5: Packet loss analysis for Node 4 for 21 days

Day	Total Packet Sent	Packet Delivered	Lost Packet	Loss %	Availability %
1	20883	20122	761	3.64	96.36
2	20565	19621	944	4.59	95.41
3	21769	20793	976	4.48	95.52
4	23987	23425	562	2.34	97.66
5	23635	22836	799	3.38	96.62
6	23456	22730	726	3.10	96.90
7	20893	20204	689	3.30	96.70
8	23847	22901	946	3.97	96.03
9	22757	21773	984	4.32	95.68
10	23914	23163	751	3.14	96.86
11	20116	19293	823	4.09	95.91
12	20005	19087	918	4.59	95.41
13	22337	21620	717	3.21	96.79
14	24451	23667	784	3.21	96.79
15	24266	23709	557	2.30	97.70

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16	22243	21668	575	2.59	97.41
17	21248	20322	926	4.36	95.64
18	24907	24025	882	3.54	96.46
19	20521	19717	804	3.92	96.08
20	21733	20785	948	4.36	95.64
21	24027	23209	818	3.40	96.60

Table 6: Packet loss analysis for Node 5 for 21 days

Day	Total Packet Sent	Packet Delivered	Lost Packet	Loss % Percentage	Availability %
1	24622	24006	616	2.50	97.50
2	23208	22649	559	2.41	97.59
3	23951	23258	693	2.89	97.11
4	22135	21525	610	2.76	97.24
5	23222	22468	754	3.25	96.75
6	20127	19501	626	3.11	96.89
7	20234	19717	517	2.56	97.44
8	22838	22072	766	3.35	96.65
9	21181	20183	998	4.71	95.29
10	24282	23354	928	3.82	96.18
11	24497	23656	841	3.43	96.57
12	24415	23524	891	3.65	96.35
13	22698	21947	751	3.31	96.69
14	22610	21807	803	3.55	96.45
15	20567	19687	880	4.28	95.72
16	20448	19750	698	3.41	96.59
17	23066	22166	900	3.90	96.10
18	24295	23565	730	3.00	97.00
19	21011	20076	935	4.45	95.55
20	23632	22664	968	4.10	95.90
21	24910	24375	535	2.15	97.85

Table 7: Summary of Packet Loss Rate analysis for the 5 nodes in 21 days

Days	NODE 1 %	NODE 2 %	NODE 3 %	NODE 4 %	NODE 5 %
1	4.67	2.87	3.72	3.64	2.5
2	3.62	2.81	3.05	4.59	2.41
3	2.74	3.65	2.52	4.48	2.89
4	2.93	3.03	3.84	2.34	2.76
5	3.13	3.31	2.5	3.38	3.25
6	3.1	3	3.02	3.1	3.11
7	2.43	3.59	3.47	3.3	2.56
8	4.13	3.76	3.98	3.97	3.35
9	4.36	2.42	4.21	4.32	4.71
10	3.59	3.17	3.92	3.14	3.82

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11	2.79	4.72	2.3	4.09	3.43
12	4.69	2.95	3.66	4.59	3.65
13	3.75	2.49	3.39	3.21	3.31
14	3.17	2.89	2.82	3.21	3.55
15	4.36	2.18	4.66	2.3	4.28
16	2.33	2.88	2.81	2.59	3.41
17	3.13	3.75	4.49	4.36	3.9
18	4.51	4.59	2.74	3.54	3
19	2.7	2.56	4.04	3.92	4.45
20	3.6	2.08	3.46	4.36	4.1
21	2.94	3.09	3.15	3.4	2.15

Table 8: Packet Loss Rate

Nodes	Loss rate %
NODE 1	3.46047619
NODE 2	3.132857143
NODE 3	3.416666667
NODE 4	3.610952381
NODE 5	3.361428571

Table 9: Packet Transmission at each Node

No. of Transmssion	**NODE 1**	**NODE 2**	**NODE 3**	**NODE 4**	**NODE 5**
1	5120	4096	4096	1024	5120
2	3072	1024	2048	6144	2048
3	5120	3072	3072	2048	3072
4	1024	7168	6144	5120	4096
5	1024	6144	8192	3072	3072
6	2048	9216	5120	6144	1024
7	5120	4096	3072	5120	1024
8	3072	8192	6144	4096	4096
9	4096	2048	9216	7168	5120
10	5120	2048	7168	7168	3072
11	5120	8192	10240	3072	3072
12	2048	7168	7168	6144	4096
13	3072	8192	8192	3072	7168
14	1024	6144	5120	5120	7168
15	2048	2048	6144	4096	3072
16	3072	5120	1024	3072	7168
17	3072	4096	5120	3072	5120
18	2048	6144	8192	6144	6144
19	4096	3072	1024	5120	3072
20	2048	3072	7168	3072	7168

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Table 10: Average Packet Transmission at each Node

Node	Packet
NODE 1	3123.2
NODE 2	5017.6
NODE 3	5683.2
NODE 4	4454.4
NODE 5	4249.6

Propagation Time at Node1
Link Media Delay = 0.04 seconds [from LAUTECH NETWORK]
Queueing Delay = 0.0 [assume no congestion]
Node Processing Delay = 0.0 [Node 1 had nothing specified for delay]

Propagation Time at Node1 = 0.0003904+ 0.04 + 0.0 + 0.0
= 0.0403904 seconds
= 40.4 milliseconds for 3123 1KB packets to go from
Node 1through Connection Channel 1

Propagation Time at Node2

Link Media Delay = 0.04 seconds [from LAUTECH NETWORK]
Queueing Delay = 0.0 [assume no congestion]
Node Processing Delay = 0.0 [Node 2 had nothing specified for delay]

Propagation Time at Node 2 = 0.0006272 + 0.04 + 0.0 + 0.0
= 0.04006272 seconds
= 40.6 milliseconds for 5017 1KB packets to go from Node 2 through Connection Channel 2

Propagation Time at Node 3
Link Media Delay = 0.04 seconds [from LAUTECH NETWORK]
Queueing Delay = 0.0 [assume no congestion]
Node Processing Delay = 0.0 [Node 3 had nothing specified for delay]

Propagation Time at Node1 = 0.0007104+ 0.04 + 0.0 + 0.0
= 0.0407104 seconds
= 40. 7milliseconds for 5683 1KB packets to go from
Node 3 through Connection Channel 3

Propagation Time at Node 4
Link Media Delay = 0.04 seconds [from LAUTECH NETWORK]
Queueing Delay = 0.0 [assume no congestion]
Node Processing Delay = 0.0 [Node 4 had nothing specified for delay]

Propagation Time at Node 4 = 0.0005568 + 0.04 + 0.0 + 0.0
= 0.0405568 seconds
= 40.6 milliseconds for 4454 1KB packets to go from Node 4 through Connection Channel 4

Propagation Time at Node 5

Link Media Delay = 0.04 seconds [from LAUTECH NETWORK]
Queueing Delay = 0.0 [assume no congestion]
Node Processing Delay = 0.0 [Node 2 had nothing specified for delay]

Propagation Time at Node 5 = 0.0005312 + 0.04 + 0.0 + 0.0
= 0.0405312 seconds
= 40.5 milliseconds for 4249 1KB packets to go from Node 5 through Connection Channel 5

Tables 2, 3, 4, 5, and 6 show the packet loss analysis taking for the 5 NODES in 21 days. The tables indicate the total packet sent, packet delivered, packet lost, and percentage loss and availability bits after the transmission. Table 7 shows the summary table for packet loss rate analysis for the 5 NODES (centres) in 21 days. The NODES 1 to 5 has an average packet loss rate of 3.461, 3.133, 3.417, 3.611, and 3.361 % respectively as shown in Table 8. The total average packet loss rate in 21 days for the 5 NODES was 3.397 %. This confirm the claim with Sanchez *et al.,*

(2014) study the quality of the loss of precision on images during transmission. This research also confirm with study of Kassab *et al.,* (2013) that in a collaborative applications allow users to share data, but if terminals and network are heterogeneous it is hard to guarantee that no data will be lost. It shows the quality of this developed system which is able to adapt data and then provide a system with no loss. The results in table 9 show that with no adaptation the packet lost between the NODES is significantly reduced. This shows that packet loss between the NODES is minimal hence the ITU regulation that for any data transmission the packet loss rate should not more than 5% for any bits loss in any transmission. Therefore the transmission packet loss during collaborative diagnosing patient between the 5 teleconsultants is at the minimal rate. To calculate propagation time at each NODES, Table 10 was used. The table shows the average number of packet transmission at each NODES. Propagation time at NODE1 is 40.4 milliseconds for 3123 1KB packets, NODE2 is 40.6 milliseconds for 5017 1KB packets, NODE3 is 40.7 milliseconds for 5683 1KB packets, NODES4 is 40.6 milliseconds for 4454 1KB packets and NODE5 is 40.5 milliseconds for 4249 1KB packets to go from each connections.

Figures 4.1a and 4.1b through to 4.14 shows developed system how the application can be access by herbal teleconsultants in a joint diagnosing of a patient.

5. CONCLUSION

This research paper presents the background introduction of herbal medicine as alternative to orthodox medicine in healthcare delivery using the modern technology. The research discussed method used to achieve the aim of the research, the study areas, data collection and mode used to analyze the data.

This study has examined the integration of improved technological framework for telediagnosis and prescription of herbal medicine in Sub-Saharan Africa. It has explained and analyzed how herbal medicine can be utilized to complement healthcare delivery services to patients using herbal cure procedures and treatments. It has been argued in this work that the technical device has been useful to enhance accessesability to information relating to herbal drugs, its diagnosis and usage in the treatment of patients. It has also been observed from the study that information can be shared among the teleconsultants at different centres/locations about a particular patient. The framework has been designed to serve as an architectural design for teleconsultants, diagnosis and prescription of herbal medicine. This will help the intended herbal practitioners, like Yoyo Bitters, Yemkem, Oko Oloyun, Ayodele slimmer, Lambo Herbs, and AnajinonoHerbs in Nigeria to collaborative to have joint herbal medication to patient at different centres.

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