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Transforming the African Traditional Heating Therapy for Malaria Treatment and Body Spa (CICI*) Into Machine-Based Therapy

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ABSTRACT

For ages, different African societies have been effectively applying heating therapy to solve/address various types of illnesses/issues. Two of such are the curing of malaria and a traditional body spa called "Gyaran Jiki" in the Hausa language. On one hand, the African traditional method of treating malaria via heating therapy entails the collection of specific herbs which are boiled and the patient is covered up in the steam of the boiled herbs. On the other hand, the use of heating therapy for a body spa involves the burning of a particular type of wood in a flameless fire or live coal and the subject is covered in the heat and smoke for a specified period to allow for proper penetration into her skin. These processes and similar ones for achieving other purposes are called "cici" in the Kanuri language. However, these processes have not changed since they have been in use despite the advancement in technology, the need to ensure energy efficiency, and the want for a more scientific approach to achieve better performance. Therefore, the machine-based heating therapy addressed the lack of advancement in this process by initiating and producing a machine to replicate those processes with additional value as virus disinfectant and energy efficiency.

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INTRODUCTION

Heating therapy is an age-long healing and therapeutic method in traditional African medicine. This include herb steaming, post-natal steam bath, treatment of wound using heated palm oil, treatment of convulsion using heated Afzelia Africana (Cakcawu) wood, et cetera.

Though the effectiveness of these types of therapy, especially herb steaming, had been confirmed by generations of people from different communities in Africa where it is commonly practice, but it wider use by the global communities as an effective alternative therapy is impaired because of lack of clinical confirmation of its efficacy largely owing to its method of application/administration, which still remained in its crudest form as shown in figure 1.

This prototype design, which is Bi-Modal, took cognisance of the uses of steaming and hot-dry-air for treatment like herb steaming for curing malaria, and internal beautification like traditional body spa. The heating/steaming chamber as shown in figure 2 was innovated to transform the crude form of herb heating therapy into a machine-based system. In the traditional heating therapy system for treating malaria as shown in figure 1, boiled herb is poured into a container, the patient and hot herb container are together covered up with a thick clothing material to steam the patient for a limited time span, and at the same time, the patient also inhales part of the steam emanating from the boiled herb. However, in the machine-based system, the heated herb is directly piped into the heating chamber where the patient is. Both body steaming and inhalation of the steam from the boiled herb is accomplished. The heating chamber could also be used to apply hot-dry-air onto the patient using the hot-dry-air inlets alone at which stage the heating chamber acts as virus disinfectant, and when used with specific types of wood, it acts as a body spa device.

Ergonomic is of high consideration in the design of the heating/steaming chamber, and the chamber is further equipped with

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temperature and humidity sensors to enhance measurement taking, and its clinical applicability. It is called a Bi-Modal system owing to its ability to generate steam as well as hot-dry-air, and its capability to function on either electricity or charcoal. The device could be used to research into the effectiveness of the African traditional heating therapy and other applications including virus disinfection.

HEATING THERAPY DEVICE DESIGNS IN AFRICAN TRADITIONAL MEDICINE

The apparatus for Herb steaming may vary depending on the location, however the common ones are; Herb container, seat, and a thick wide cloth. The hot boiling herb is turned into container which is moved closer to the patient who is seated on a medium height seat, and the thick wide cloth is used in covering the patient together with the herb container. In this way, the patient body is steamed with the highly humidified hot air coming out of the herb container. More so, the steam is also inhaled by the patient in addition to steaming the body. These provides for simultaneous heating of both internal and external organs of the patient. Additionally, the herb is a boiled combination of different plants (mostly leaves but sometimes roots and sometimes bark of a tree) combined in different quantity.

a b c d

Figure 1: Illustration of African Traditional Therapy for Malaria Treatment. (a) The Patient, (b) Boiled Herb, (c) Thick Cloth for covering, and (d) Patient and Boiled Herb covered with the cloth.

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HEATING THERAPY AS A METHOD OF HEALING IN AFRICAN TRADITIONAL MEDICINE

Traditional African societies have always had ways of solving problems or addressing issues within their traditional settings. Problems or issues like; dispute settlement, debt settlement, inheritance sharing, general knowledge and historical education via oral transmission, methods of healing ailments, etc.

Herb Steaming

Malaria is prevalent in Africa. One of the symptoms of Malaria is fever occasioned by body mechanism to kill malaria bacteria with temperature higher than it can be sustained in. A very common African traditional way of curing Malaria is through the use of herbs. Varied but specific plant leaf/leaves, either alone or in combination with the tree bark or roots are combined and boiled in order to extract their compositions/contents and then administered at high temperature to patient mostly as oral therapy and sometime to replace water in bathing, and sometimes use in form of steaming the patient.

Post-Natal Steam Bath

In African tradition, one of the popular post-natal treatment is bathing the subject with hot water after which a more hotter water is used to steam her body including the virginal in a process roughly translated as either cleaning/remoulding her body. The process involves exposing the virginal to steam from very hot water, pressing her stomach with a mopper immersed in hot water, and pressing the whole body with steaming mopper. These force out blood clots from her body and refresh the body back to its former state before the bath.

Wound Treatment using Hot Palm Oil

When as a result of an accident, someone sustains an injury involving sharp object piercing through the muscle region, a clean metallic object with sharp end is heated to high temperature at which point a few drop of palm oil is applied on the heated metallic object, and the resulting hot palm oil is dropped on the wound. This could be very painful but effective.

Treatment of Convulsion using Heated Shesheu Tree

Get a stick from 'Shesheu' tree, divide symmetrically into two along the vertical line. Arrange the two in form of an inverted T and roll the vertical one in clockwise and anticlockwise directions as fast as possible while maintaining the point of contact until the point of contact becomes red hot. The red hot point of the vertical stick is then placed on the forehead of the patient suffering from convulsion. This is popular and had been proven to be effective for treatment of convulsion by the Kanuri ethnic group in West and Central Africa.

Traditional Body Spa

In Kanuri traditional settings, the use of heating therapy for body spa is popular and gradually penetrating other Northern Nigeria culture. This involves burning of a particular type of wood in flameless fire or live coal and the subject is covered in the heat and smoke for a specified period of time to allow for proper penetration into her skin. These processes and similar ones for achieving other purposes are called "cici" in Kanuri language.

DESIGN METHODOLOGY

The process leading to the implementation of the work started with the conceptualization of the idea, studying the processes of African traditional heating therapy, designing the machine-based alternative, purchase of material, production or fabrication of the device, and testing of the final product.

Material

The materials used in the work includes: Plastic glass, metal plate, angle iron, aluminium, rollers, aluminium void, nylon, gum stay, cables, electric motor, electric fans, switches, battery, micro-controller, LCD, and gear pipe.

Process

Using the materials, the process took a bottom-up approach which involves first, the building of the base using the metal plate, and later, the construction of the cuboid with a open-able top using the plastic glass. These were followed by the construction of the heating system made up of electric heater, coal stove, electric fans, herb/water-pot, and hot-dry-air

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plate. Then, the mounting of the electric motor together with the electronic control circuitry consisting of temperature and humidity sensors were made. Some of the parts were wedded, and the rest were fastened together.

DESIGN

The engineering process involved in this work is divided into nine sections starting with the ergonomics of the design as explained in the following sections and device is depicted in figures 2.

The Ergonomics Design

The human being is modelled in the form of a cuboid (Height-by-Width-by-Depth) of dimensions of 1.74m-by-0.47m-by-0.26m [1] with an average surface area of 1.9 meter square [2], skin thickness of 6mm, and thermal conductivity of 0.187W/(m.k) [3]. Taking these into consideration, the researchers adopt a two-compartment heating chamber space of dimensions (1.6m/1.1m)-by-0.75m-by-0.75m. The entrance stands at 1.32m when the height is 1.6m. The length and breadth of 0.75m was adopted to allow for minimum movement within the chamber, and accommodate virtually everyone irrespective of the body size. The height of 1.6m is chosen as against the standard height of 1.83m because the patient would have to be in sitting position during the treatment which make him/her to be comported and at which point the chamber height is reduced up to a minimum of 1.1m depending on the height of the patient at sitting posture. The variation in height varies the volume of the chamber for optimal heating. The ability to vary the height is as a result of the two-compartment chamber approach adopted. The chamber is designed with an open-able roof in case of need for a quick and temporal diffusion the chamber temperature.

The Heating Section

This is the part of the design where fluid heating takes place. The fluid, which could be ordinary water, or water with herbal leafs/barks/roots, are heated to boiling point and maintained at that temperature to puff out steam. The fluid could also be air pushing through heated electric heaters or charcoal for hot dry air treatment.

Electric heating

The heating system comprise of four (4) pieces of 1000W electric heating elements for fast fluid heating.

Coal heating

The coal heating is provided as an alternative heating system because of the peculiarity of the Nigerian environment (unstable electricity supply).

The Fanning Section

This section is provided for two reasons namely: to provide blowing of air to the charcoal compartment, and two; to provide a push of hot air through the heating section when the need for hot dry air arises. Two 0.5Hp DC fans are provided to ensure adequate air blow/push.

The DC Electric Motor

The device is provided with a 2Kw 12v DC electric motor. The function of the electric motor is to provide vertical movement of the upper part of the chamber. The chamber design takes into consideration two things which are; ergonomics, and energy conservation. In terms of ergonomics, when the upper part of the chamber goes to maximum height (1.6m), it allows entrance into the chamber in near full height of the patient, however as soon as the patient sits in the chamber, the upper section is adjusted downward until it is closer to the patient head or reaches its minimum downward position (1.1m). This implies reduction in the size (volume) of the chamber therefore, ensuring conservation of heat energy.

The Battery Compartment

There is a 12v 60AH battery to operate the 2Kw 12v DC motor, the two (2) 12v DC fans, and the electronics circuit for controlling activities. The battery is also expected to energize the circuits of the temperature sensors and the timer that will be situated inside the chamber.

The Chamber

The chamber is a 0.75m by 0.75m by (1.6m/1.1m) cuboid designed to accommodate an average person when standing. This is possible because of the adjustablility of the upper part of the chamber. Furthermore, the

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supply into the chamber could be in two ways as described below:

Steam

This refers to hot wet air coming from a specially designed steaming pot which could be ordinary water or boiled herb heated by the four (4) electric heater or burning charcoal.

Hot-dry-air

The hot dry air or dry hot air emanating from the four (4) electric heater or burning charcoal and drove into the chamber by the two (2) 12v DC electric fans.

Stoves and Pot Designs

The electric and coal stoves, and the pot were designed to perfectly fit into each other for effective heating and prevention of heat loss which invariably reduces heating cost.

The Microcontroller

Microcontroller is employed in the design to make possible the measurement of temperature and humidity of the inner part of the heating chamber during operation.

Temperature and Humidity sensors

The Microcontroller is connected with four sensors namely DHT 11 and LM 35. Each of the sensors are in pair and situated at opposite ends of each other to occupy the four sides of the inner chamber. The DHT 11 is a digital sensor and functions as both temperature and humidity sensors while LM 35 is an analogue temperature sensor only. The sensors are physically connected to the appropriate ports of the Microcontroller, and are then programmed to function as expected.

The temperature sensor and thermocouple unit measures and display the chamber temperature to enable the user and other observers know the temperature of the chamber at any particular instant. The timer is incorporated to measure the duration of time in which a set temperature has been attained. This aspect is meant for clinical examination of heating treatment.

Switching and Control section

The switching and control unit provides for switching of the electrical devices like the DC electric motor, the DC fans, and the AC electric heaters. Also there is provision for energizing the microcontroller which energizes the temperature and humidity sensors and the timing programme in the microcontroller. The control unit is be made up of a micro-controller that allows for the control of temperature in order to attain a time duration desired for steam healing/curing or virus disinfection to be effective.

IMPLEMENTATION

As shown in figures 2. This section is about the construction of the device which followed the process explained in section 2 above.

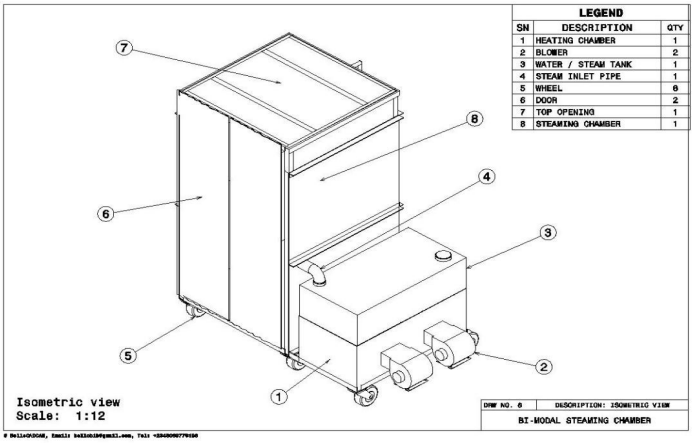

Figure 2: Implementation of Bi-Modal Heating Therapy Device with a clear view of the entrance. (a) Isometric view showing electric motor and battery compartment, (b) Isometric view showing heating section.

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CONCLUSION

This design seems like the combination of Steam rooms and Sauna in one unit, but it is far more than that in that the Steam rooms and the Sauna are primarily about the heat generated while the transformed heating method presented in this paper, comes with medicinal substances like herbs in the steamed herb, and the use of specific type of wood which when heated releases a smoke that helps in the body spa. Additionally, like the Steam rooms and Sauna, either of the two modes could find use as virus disinfectant, improve blood circulation, lower blood pressure, reduction of stress, clear congestion, promote skin health, loosen stiff joints, burn calories, boost immunity, and remove toxins, and the motivation for this innovation is its capability to cure many diseases or promote general well-being if clinical investigated when the heating system is combined with medicinal plants as it is done in the traditional African heating therapy.

RECOMMENDATIONS

Based on evaluation of the functionality of the prototype design, the following areas are suggested for future design improvement:

a) The electric heating and Charcoal heating should be made in a way that the two can be accommodated together as against the present design in which they are made to replace one another.
b) In like manner, the generation of both steam or hot-dry-air should be done in the same compartment rather than having to replace some components as it is in the prototype design in order to compact the design and prevent heat losses.
c) There is need to look into the materials used in different sections of the prototype design for efficient heat transfer and prevent heat escape from the steaming chamber
d) The electric motor used in the “Up and Down” movement of the upper section of the steaming chamber and the lifter should be improved upon to achieve a noise free design with and faster lifting capability.
e) The design should be made to allow for the patient/subject inside the steaming chamber to control the temperature of the steaming chamber for better comfort

ABOUT THE AUTHOR

Abdulfattah Adelani Aboaba is the innovator of this device. He is a Professor of Intelligent Systems as it relate to Biomedical Computation and Embedded Systems in the department of Computer Engineering at the University of Maiduguri, and a registered engineer. He hold a PhD in Biomedical Engineering (Computational) from the International Islamic University, Malaysia and has been working on lots of medical related researches such as “Intelligent hospital queuing system”, “Transforming the African traditional heat treatment methods into machine based method”, “Microcontroller-Based Remote Control for Giving-Set V-track Controller”, et cetera apart from his other researches in computer, communication, electronics, and electrical engineering. He is currently the coordinator of research in the department of Computer Engineering of University of Maiduguri.

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