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RESEARCH ARTICLE

Advanced Automation of Janu Dhara and Janu Basti Process in Ayurveda

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ABSTRACT

The research aims to design a standalone automated janu dhara and janu basti system using an automatic temperature controller, pumping mechanism and sensor array. The paper consists of two parts: The mechanical design of the machine, which includes mechanical drawing, measurements, welding and fabrication, while the electrical part consists of electrical connections, heater, temperature controller and pumps. The prototype was successfully tested in an Ayurvedic clinic. The results were better accuracy in maintaining oil temperature throughout the process and reduced manual efforts of temperature monitoring and reheating oil by 50% compared to the manual procedure.

Keywords: Janu dhara, Janu basti, Automatic temperature controller, Recirculation.

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INTRODUCTION

Automation is a concept that has been around for a long time in the field of medical science, but it has recently gained popularity in Ayurveda. Automation leads to reduced manual efforts and time along with better accuracy in maintaining critical parameters such as temperature, pressure etc. and improved delivery mechanisms of therapy. In the medical field, automation has become a crucial tool for both patients and doctors. This is due to the fact that automation has made it possible to perform procedures that were once very time-consuming and laborious. This is especially true in the field of Ayurveda.

Ayurveda is a holistic system of medicine that uses herbs, diet, physical exercise, and meditation to cure patients. It is an approach to health that emphasizes prevention rather than treatment. For example, in Ayurveda, joint and muscle pain treatment is done using a warm oil massage. The warm oil stimulates the body's natural healing response, which helps relieve pain and restores mobility to the affected area.[1]

According to Ayurveda, "The weakening of joints is caused due to the accumulation of ama (toxins)". The prolonged aggregation of toxins over time leads to joint inflammation and loss of strength. Similar is the case with the knee joint.[2] Knee joint pain is the most common health issue that we encounter nowadays and out of all the remedies that are available to relieve the pain, Janu Dhara and Janu Vasti (Janu Basti) are the most opted ayurvedic therapies for patients with osteoarthritis. The therapy involves placing medicated oil over the knee joint to relieve pain and improve mobility. Janu Dhara (Janu means knee joint and dhara means to pour) is an ayurvedic procedure where lukewarm medicated oil is poured over the knee joint for a period of 40 to 45 minutes. Similarly, the word 'Janu Basti' has 2 terms: Janu means knee joint and Basti means to hold (compartment which holds). Thus Janu Basti means a treatment in which medicated oil is poured and pooled for a fixed duration of time in a compartment or a cabin constructed around the knee joint/joints using wet flour of black gram.[3]

The traditional procedure[4] followed for the treatment of knee joint pain is well documented in the Ayurvedic literature as follows:

1. The patient is made to lie on the abhyanga table so that the area of the knee joint is exposed and then subjected to basic abhyanga procedure.
2. The medicated oil bowl is heated gently over hot water (water bath). The lukewarm taila (having bearable warmth to the patient) is poured into the dhara pot and made to flow on the Janu-Sandhi (knee joint) in a regular, circular steady stream motion. Mild massage should be done with the left hand continuously, along with the flowing oil.
3. The medicated oil is then continuously taken and reheated in order to maintain the temperature throughout the procedure.

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4. After the taila dhara, light abhyanga is done over the Janu-Sandhi for about 5 minutes.

The presently used manual procedure has challenges in dealing with a) Collection and Recirculation of oil b) Temperature monitoring of oil c) reheating of oil. The proposed automated system provides better oil collection and recirculation, less oil wastage, and ease of conduction of therapy. Table 1 describe the issues with traditional procedures and solutions updated in a proposed system.

The paper presents the design of an automated machine for oil-based therapy for knee joint pain. The automation of the following process is included 1) Heating of oil, 2) Temperature regulation of oil, 3) Pumping of oil, 4) Design of oil applicator. The following objectives are formulated in this research: a) To verify the readiness of nursing staff to use automated machines over a manual procedure. b) To identify technology required to automate the process c) To draw electrical drawings d) To develop the prototype of the proposed design d) To compare the effectiveness of oil therapy using automated machines over a manual procedure.

METHODOLOGY

The flow diagram of the approach toward automation of knee and the joint oiling system is depicted in Figure 1. The overall prototype was developed in 3 stages: Fabrication of mechanical assembly, designing and testing of electrical circuits and integration of electrical and mechanical assembly.

Mechanical Assembly

The 3D design of the machine was developed using SolidWorks, CAD software.[6] The mechanical assembly of the machine includes two sections: section 1 for oil storage and heating and section 2 for pump and electrical assembly (shown in Figure 2A). The machine is 15 inches in length, 15 inches in width and 20 inches in height. As shown in Figure 2 (A), a cylindrical oil container of diameter 8 inches and height 7.5 inches with 2L capacity is placed at the center of the design. A sieve is attached at the top of the oil container in order to filter the oil. At the diagonal end of the top surface, a round opening for pipe of 0.7 inches in diameter with an attached

Table 1: Comparison between traditional procedure and proposed automated system

Traditional procedure	*Proposed automated procedure*
Need to reheat the medicated oil in order to maintain the desired temperature.	The desired temperature is monitored and reheated with the help of a temperature controller and heater.
Collection and recirculation of oil is difficult, leading to more wastage of treated oil.	Very less manual effort required. Collection and recirculation of oil is automated using a collection tank and pumping mechanism
A lot of manual effort is required.	Reduced manual efforts
Difficulty in continuous execution of procedure.	Ease of conduction of procedure without break in continuity.

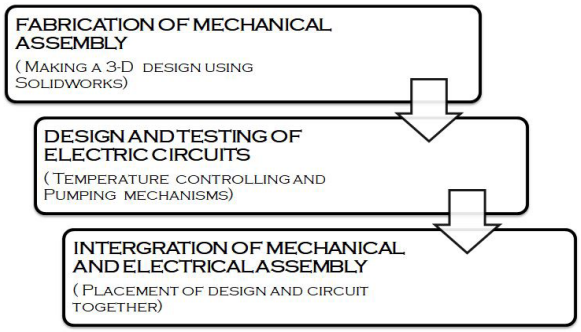

Figure 1: Flow diagram of approach towards automation

height adjustment knob to alter the height of the pipe as per requirement. A solid sectional layer divides the machine into two sections 1 and 2. The side walls of section 2, include a ventilation window for air flow-based cooling. The user interface module includes an LED for temperature display and temperature setting knobs. Figure 2B depicts the cross-sectional 3D view of the machine. A hole of 0.15748 inches in diameter is present at the bottom center of the oil container for insertion of the temperature sensor. Section 2 is used for pump and electrical wire placement. The pump is screwed to the container along with an anti-vibration pad in order to reduce vibrations.

Electrical Assembly

The electrical circuit consists of oil heating element, temperature sensor and controller circuit, and pumping mechanism for oil recirculation. The oil used for janu dhara and janu basti is medicated oil such as mahanarayan tel.[6] The oil temperature maintained during the process is 40 to 45°C, which is found to be well tolerated by the patient. The mica band heater is installed around the cylindrical storage tank for heating the oil. The temperature sensor used is an NTC waterproof thermistor with an operating range of -50 to 110°C. The digital thermostat temperature controller switch module is used to regulate the operation of heating elements. A booster pump with operating voltage range of 24V DC is used for oil recirculation. It has a suction height of 2 meters and works at a pressure of 110 PSI. The electrical drawing of the machine is shown in Figure 3.

Electrical power is given to the device by a single phase (1Φ) supply i.e., 230V 50Hz. The main supply divides internally where a 24V DC pump runs for pumping the oil continuously and the mica heater turns ON. The oil container is surrounded by a mica heater and at the bottom center of the oil container, there is an opening for the placement of a temperature sensor i.e., NTC thermistor for temperature sensing. The system is a closed loop system where the temperature controller module regulates the switching of AC mica heater by the electromagnetic switching circuit. Thereby maintaining the temperature value in the desired range. For safety purposes, 10A and 15A fuse are used with heater and main supply, respectively. The 15A/250VAC DPST 6 pin switch used as a power switch because of screwless fitting, marked ON/OFF

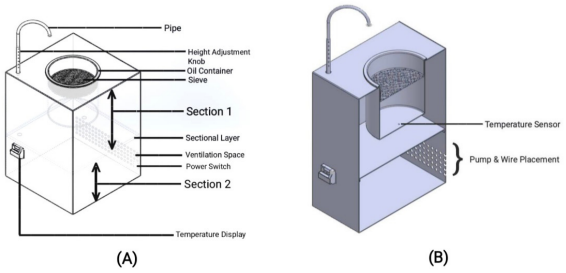

Figure 2: A Construction details of automated machines for Janu dhara; B: Cross-sectional 3-D view of the machine.

with light indication, provides an upfront layer of safety. Electrical earthing of the device is done and the temperature module is shielded using PLA+ material.

Integration of Mechanical Assembly

The abhyanga table is a rectangular table which is 71 inches in length and 32 inches in height from the ground. The table has a comfortable bed and has a middle section cut-out of 17 inches attached with a flap opening where the part to be treated is placed i.e., the knee part of the leg is to be placed. At the bottom corner of the middle cut-out section is an outlet for oil recirculation. plastic tubing connects. The machine oil inlet to the table oil outlet. (as shown in Figure 4). As plastic tubing acts as an insulator, the patient is completely isolated from the machine. The experimental prototype is shown in Figure 5.

RESULTS

The experimental prototype developed is shown in Figure 5. The overall process of operation of the machine is demonstrated using a flow chart (Figure 5) and the steps are discussed below:
Step 1: Start. Turn on the power supply, the mica heater, pump and temperature sensor gets powered on.
Step 2: As the heating starts, the medicated oil in the container attains temperature in about 10 minutes.
Step 3: The temperature sensor starts sensing the temperature of the medicated oil in the container.
Step 4: The pump starts oil circulation in order to maintain a constant temperature of the medicated oil in the container.
Step 5: When the temperature goes above 45°C, the heater automatically turns off and when the temperature goes below 45°C, the heater turns on again.

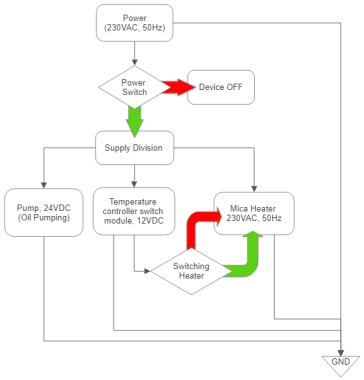

Figure 3: Electrical drawing of automated machine

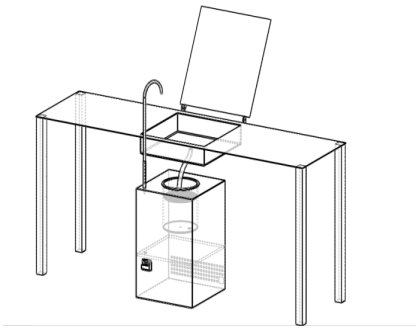

Figure 4: The complete mechanical assembly of the proposed system

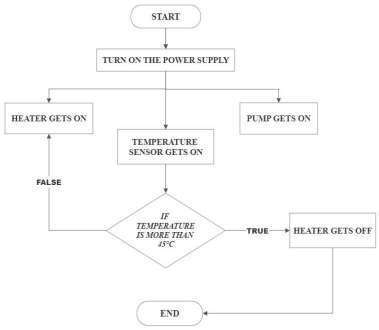

Figure 5: Flowchart of process of operation of the machine

Figure 6: Experimental prototype

CONCLUSION

This paper presents the automation of janu dhara and janu basti therapy of Ayurveda. The manpower required in manual procedure is 2 per patient. The designed prototype reduced the manpower requirement by 50%. We are working on a fully automated system in the future, thereby completely removing human intervention. The oil requirement for 5 days of therapy is reduced by 200 mL as compared to manual oil refilling and reheating. The prototype developed was successfully tested in an ayurvedic hospital and thereby found to reduce manual efforts, with less oil wastage and better efficiency in process execution. A standalone system is proposed by integrating the design with sensor assembly for key parameter monitoring. Further, by adopting technology such as the Internet of things (IoT), the doctor would monitor several such systems centrally. Thereby, ayurvedic therapy stations with multiple such units would also be installed in remote areas.

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