Implementation of Internet of Thing Technology for Infrared Therapy Device Design

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Abstract. This study aims to develop an infrared therapy device by embedding the internet of things technology in the research area of therapy devices, especially infrared therapy. Low back pain is a disease that attacks the back muscles that can cause disability and discomfort in activities. This system was developed with an automatic system located in the automation of the lights off and the LM35 temperature sensor, which records the temperature if you feel hot and the timer setting that appears on the LCD and the android interface. This system is based on the internet of things to be monitored from anywhere, anytime. This study consists of an LED lamp, cloud system, and ATmega 328 microcontroller. The study and literature review are carried out following the device development method that embeds the internet of things technology systems in infrared. This study’s result is a prototype design of an infrared therapy device with the internet of things technology that can be used to treat people with low back pain.

1. Introduction

Low back pain is an extreme symptom that generally affects people of all ages [1], [2]. This disease often occurs in low-income, middle-income, and high-income countries. In 2015, the global prevalence of low back pain activity was 7.3%, indicating that 540 million people were affected at any one time. Low back pain is currently the number one cause of disability globally [3].

Diseases such as low back pain can affect the stability of the body and cause fatigue. The fatigue level says that the conditions are different for each individual but leads to a loss of efficiency and decreased work capacity and endurance levels. One of the solutions for recovery from disease is medical therapy. Infrared therapy is a step in treating various diseases, such as low back pain and pain [3].

Independence in creating the design of an appropriate infrared therapy device requires initiation in making it happen. So far, infrared therapy tools are still focused on dose regulation [4], long exposure intensity [5], and frequency [6].

Based on the above, in the realm of technological independence of medical therapy tools, the development of infrared therapy devices is carried out by embedding the internet of things technology.
2. Method

2.1. Literature Review
Fatigue in activities can be the first cause of a disease that can interfere with various activities. In general, the symptoms caused are pain. There are various types of pain, such as acute pain, which is the first reason a sufferer seeks medical help [7]. One solution to dealing with pain is therapy. Physical therapy is a part of medical rehabilitation that can help treat chronic or acute pain. One of the modalities of physiotherapy that is often used to reduce pain relief is infrared rays. Infrared radiation has a wavelength of 750 nm - 100 μm with a frequency range of 400 THz - 3 THz, and a photon energy range of 12.4 meV - 1.7 eV [8]. Based on the ISO 20473 standard, infrared is divided into Far IR (FIR) with a wavelength of 50 - 1000, Mid IR (MIR) with a wavelength of 3.0 - 50, and Near IR (NIR) with a wavelength of 0.78 - 3 μm [4].

In general, the use of FIR is more often implemented in health therapy tools. The infrared emitted will exert a healing effect on the exposed skin directly. The design concept of using the internet of things technology can improve infrared therapy treatment. The internet of things technology makes it easier to monitor patients by looking at the notification on the gadget screen connected to the program settings shown on the LCD.

2.2. IoT Infrastructure of Infrared Therapy Device Design
Infrared Therapy Device uses internet of things technology, an innovative breakthrough that is being developed. Several aspects need to be developed by implementing the internet of things technology in technological architecture. The infrastructure of technological architecture is the first key to infrared therapy devices with IoT. If this infrastructure has been developed adequately, infrared therapy devices’ effectiveness can be accessed via gadgets. Some parameters of the adapted infrared therapy device with IoT, namely:

Figure 1. IoT Architecture Design
2.3. Proposed Work

2.3.1 Flowchart Research Framework

![Flowchart Research Framework](image)

**Figure 2. Flowchart Research**

2.3.2 Infrared Therapy Device Design Architecture

This study uses the internet of things technology with an Arduino Uno ATmega 328 microcontroller (datasheet). In Figure 3, you can see the architecture of the system to be developed.
2.3.2.1 Temperature Sensor LM35
A temperature sensor, the LM35 is specifically made to measure an object’s cold or hot temperature. It is an accurate temperature sensor with the result proportional to the measurement of the temperature in degrees Celsius. It can be measured more accurately than with a thermistor. This temperature sensor also has low self-heating and will not cause more than 0.1 °C of temperature rise in the air. The operating temperature ranges from -55 °C to 150 °C. The LM35’s low output impedance makes the control circuit’s interface incredibly easy to use [9].

2.3.2.2 Arduino Uno
The Arduino Uno is designed to sense the environment by receiving input signals through sensors and communicating with the environment via actuators. Since the Arduino hardware and software is open-source, it has many clones of Arduino hardware available with many outstanding advantages [10]. Arduino Uno board is used in the design of safety equipment in this study.

2.3.2.3 Liquid Crystal Display (LCDs)
LCD has two lines and can display 16 characters on each line. Arduino IDE only allows users to use 4-bit LCD mode. This type of communication allows the user to down-pin the Arduino, in contrast to the other Arduino set to communicate in 4-bit mode. The LCD’s 4-bit mode can be used in a circuit [11].

2.3.2.4 Buzzer
The buzzer is an electronic component that can convert electrical signals into sound vibrations. The type of buzzer that is often used or found is the Piezoelectric type. This is because it has the advantage of being easier to attach to the circuit and lighter. Buzzer belongs to the transducer family known as the Beeper. The electric voltage applied to Piezoelectric materials can cause mechanical movement. The movement is converted into sound for the user to hear [12].
2.3.2.5 MySQL Technology [13]
MySQL is a system that organizes databases. The structure of data collection, to be more, process or access data stored in the database. MySQL can be used in specific jobs and supports applications to use databases and manage large amounts of data. MySQL serves as a database management system and database.

2.3.2.6 Java Technology [14]
Java technology is intended for programming purposes in an Object-oriented style and is designed for application developers “Develop only once but can work anywhere.” This means that developers can group Java code run on each platform that supports the Java language.

2.3.2.7 Android Technology [15]
Android is intended to be a fundamental field of study in which human-robot and human-human communication principles are studied. Includes network providers and developers where Android is also an operating system that integrates developers who write many applications under Java.

2.3.3 Design Software
Software is used to interface between the system and the user. The system interface design is shown in the following figure.
2.3.4 Tool Component Test
Testing of this study test will be carried out on a prototype visualizing on a box diagram. This study test is carried out to determine all the prototype systems, whether they are adequate with the initial plan in designing an infrared therapy device. This test, carried out by experts in the field of electro-medical engineering technology.

![Figure 6. Tool Component Test](image)

3. Results and Discussions
This study is a design that embeds the internet of things technology in infrared therapy tools. A similar study only focuses on determining the effect of heat emitted from infrared by adjusting the intensity of the radiation using Pulse width modulation (PWM) as a controlled dose. Apart from time and distance, the intensity of infrared radiation also affects the temperature generated during therapy [4].

Another study focuses on designing a stimulator therapy device integrated with infrared into one unit with the ATMega 32 microcontroller. This integration system makes stimulators more efficient, which makes it easier for therapists to handle patients. The stimulator’s result is a faradic electric current with a choice of frequencies, 10 Hz, 30 Hz, and 70 Hz [6].

A study from [5] also focuses on the design of ATMega 8-based infrared therapy. The design tool is built to focus more on the therapy process’s timing to reduce the level of negligence risk when monitoring the length of therapy time displayed on the LCD screen measurements.

In the study on the enhancement of infrared devices above, no one has applied the Internet of Things Technology to make it more comfortable to monitor the patient. The design offers the enhancement of infrared devices with the internet of things so that nurses can easily monitor patients’ condition online through notifications from gadgets. Embedding internet of things technology is a contemporary approach in the issue of the infrared therapy device.

4. Conclusions
Internet of things technology can be increased in all fields, one of which is enhanced in an infrared therapy device. This device is a new design with challenges from the new technology era intended to help the patient with low back pain. This device system’s design has made a scheme for implementing the internet of things technology in medical devices. This study describes the research of designs that can help treat low back pain. This study’s result is designing an infrared device with the internet of things technology system as the case study.
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