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Smart Neck Pillow Design Based on Thermal Therapy and Real-time Alarm for Public Transportation Users to Prevent Tension Neck Syndrome and Oversleeping

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ABSTRACT

The number of public transportation users in Indonesia, especially trains, has increased by 20.5% for the past 2 years. This is in line with users' satisfaction and timeliness of departure which reaches 99%. However, the available facilities are not in accordance with the ergonomic value being offered. Train passengers often feel stiff and pain in their neck, which is known as tension neck syndrome. In addition, their long trips are used by passengers as an opportunity to rest, this could lead them to miss their stop due to resting too soundly, which is definitely detrimental in terms of time, cost, and energy to return to their original destination. Therefore, there is a need for a smart neck pillow that utilizes thermal therapy, added with sound and vibration-based alarms. Thermal therapy is known to increase blood flow that carries oxygen and nutrients which will reduce pain. This therapy also increases nerve conduction to reduce muscle spasm. The alarm feature can be calibrated in real-time using a smartphone. Thus, this smart neck pillow with thermal therapy and alarm features is expected to increase the comfort and attractiveness of the public in using public transportation.

Key Words: Tension neck syndrome, thermal therapy, ergonomic, audio, vibrator.

1. INTRODUCTION

The number of train users has increased by 20.5% in the last two years (Sukmana, 2019). This is in line with the number of punctuality of departure, particularly in railway operating area (DAOP) 4 which reached 99% (Wasita, 2017). One of the factors in the highlight is that seating comfort remains less than optimal although it has the highest level of importance (Consulting, 2018). However, trains still need to improve the quality of their services. Less ergonomic seats, particularly in economy class, are quite exhausting for the body because people have to stay in a non-anatomical position for quite a long time. This can cause tension neck syndrome for its users (França et al., 2008). Another factor that worries public transportation users is missing the stop because oversleeping. Bus users may be able to get off at any place. This is different from train users who can only get off at particular stations. Currently, many kinds of neck pillows are available. However, dimensions that do not follow ergonomic principles and uncomfortable materials add to the feeling of soreness and pain for the users instead. Besides, smartphone alarms are not effective enough to wake the users up because the sounds and vibrations produced are not louder and stronger than those produced by trains.

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2. PROBLEM STATEMENT

How to design a smart neck pillow based on thermal theraphy and real-time alarm for public transportation users to prevent tension neck syndrome and oversleeping?

3. RESEARCH OBJECTIVE

Designed a smart neck pillow based on thermal theraphy and real-time alarm for public transportation users to prevent tension neck syndrome and oversleeping.

4. THE DESIGN OF THE PRODUCT

To answer this research problem, the authors designed a smart neck pillow called SNEPY! (Smart Neck Pillow Yippee!). SNEPY! is a neck pillow innovation that integrates thermal therapy and alarm. Existing features can be set directly on the device or via an application on a smartphone.

There are several buttons on the device, in the form of the power button to turn the device on and off, the heat level button to adjust the heating temperature, and last the heat duration button functions to determine the length of time the heater is on.

SNEPY! device consists of 2 main parts, that is the pillow and the electrical components of the pillow. This electrical component has 3 main elements, that is the audio element, vibrator element, and heating element. The electrical section consists of a battery charger and 3 lithium ion batteries as a power source. Then the vibrator element consists of a mini dc motor and motor driver, then the heating element consists of 2 grahene fibers, 2 temperature sensors, and 2 mosfets. While the audio element uses an MP3 player module with a micro SD socket and an audio jack. The last one to connect with our application using Arduino Nano and Bluetooth Module.

The raw material for the SNEPY! pillow is a mold memory foam. The benefits of this material are lightweight and can be compressed into smaller sizes. SNEPY! pillow consists of 2 layers of fabric. The outer layer is made of cotton so it is comfortable on the skin. This cloth is also equipped with an invisible zipper so that it can be taken from the pillow and washed. The inner fabric is made of polyester with a polyethylene terephthalate (PET) type with water repellent properties to protect the electrical components inside (Ardi et al., 2020). This design was made by considering ergonomic principles carefully and precisely so that it can be followed up to the manufacturing stage, such as using a 3D Printer or CNC (Computer Numerical Control). This design follows the ergonomic values we take from the literature and visualize them with Autodesk Inventor software

There are 3 modes that can be set in the SNEPY! application, namely basic mode, vehicle mode, and public transportation mode. Features that can be set include alarm time, alarm ringtone, alarm volume, vibration alarm, warm duration, and warm level.

The application design consists of 3 main views: the first is the SNEPY! Connection display. This screen consists of a splash screen, connection tools, and mode selection. Then the display selects a mode, for example when selecting public transportation mode the display will appear as follows. Last display set SNEPY! which consists of an alarm and a heater. The alarm section sets the alarm time, ringtone, volume, and vibration. While the heating section regulates the duration of the heater and the heating level. We made application designs using Figma software.

5. THE VISUALIZATION OF THE PRODUCT DESIGN

5.1. Visualization of The Device

The layout of the electrical and complementary components on the SNEPY device is shown in Figure 1.

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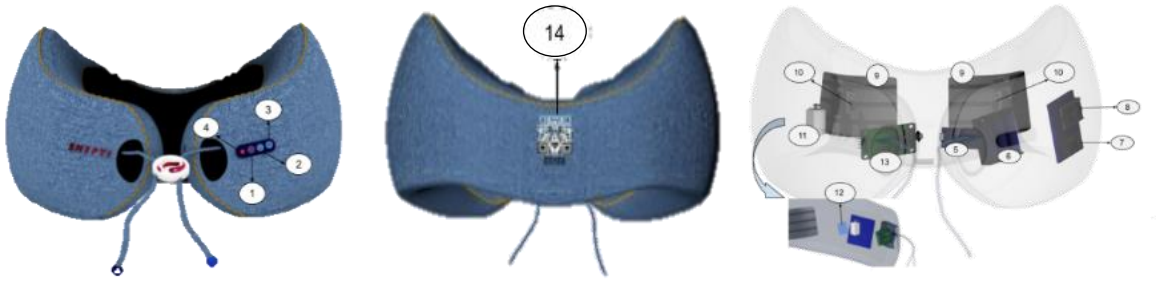

Figure 1: Design visualization of SNEPY! pillow (left) front view, (center) rear view, (right) front transparent view.

The explanation of Figure 1 is as follows (1) On / Off button, (2) Heat level button, (3) Heat duration button, (4) Indicator light, (5) Battery management system, (6) Battery, (7)) Bluetooth 4.0 module, (8) Microcontroller: Arduino nano, (9) Heater: Graphene fiber, (10) Temperature sensor, (11) Mini DC motor, (12) Motor driver, (13) Micro SD MP3 player module, and (14) QR code.

SNEPY! device has dimensions of 26 cm x 21 cm x 11 cm (length x width x height) and weight of 493 grams. The size of the snepy device can be seen in Figure 2.

Figure 2: SNEPY! device size seen from top (left), top (center), and side (right).

5.2. Visualization of The Application

The application design consists of 3 main views: SNEPY! connection display, select mode display, and SNEPY! setting display. SNEPY! connection display consists of a splash screen, connection tools, and mode selection which can be seen in Figure 3. Select mode display can be seen in Figure 4. SNEPY! setting display can be seen in Figure 5.

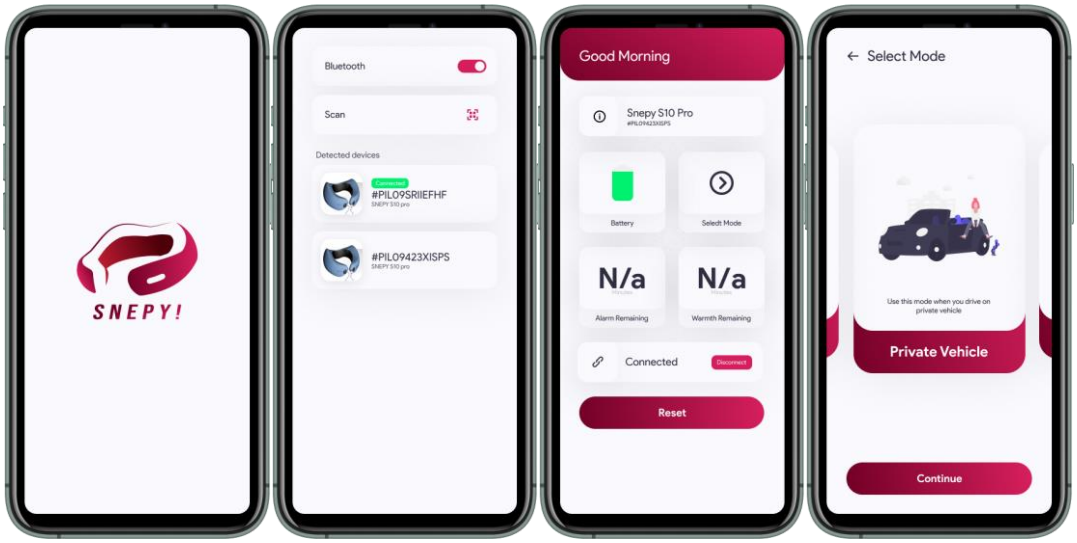

Figure 3: SNEPY! connection display

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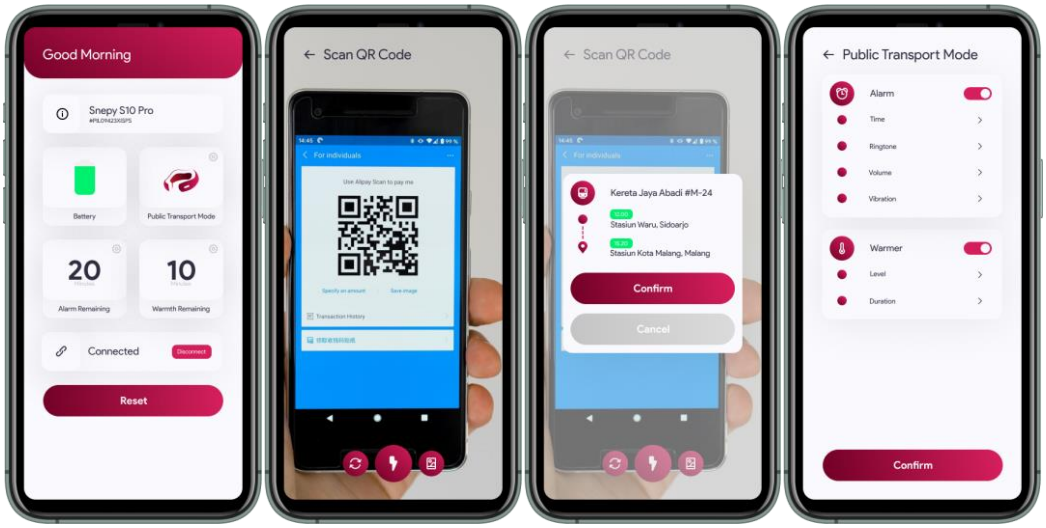

Figure 4: SNEPY! connection display

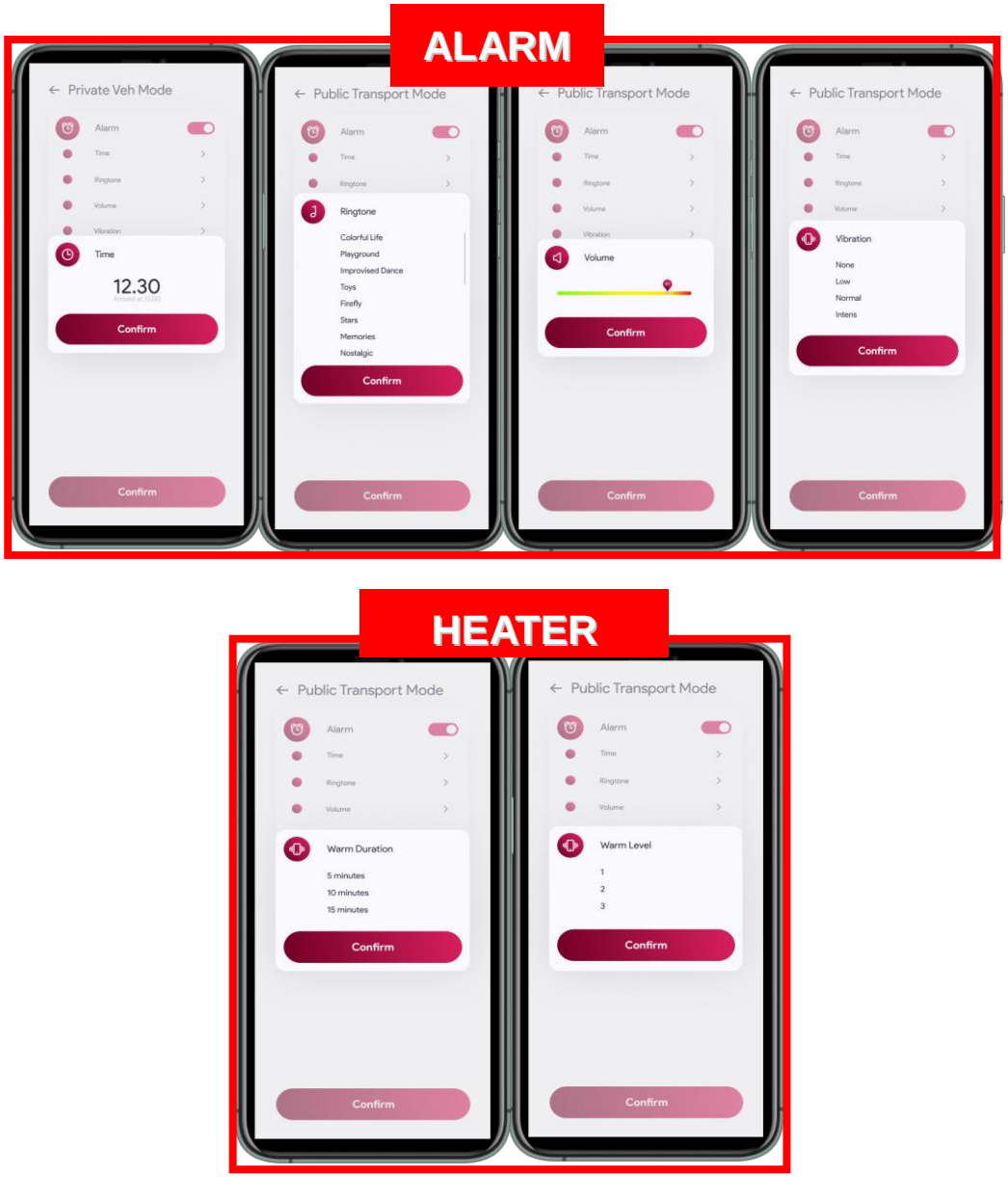

Figure 5: SNEPY! setting display

6. CONCLUSION AND RECOMMENDATION

6.1. Conclusion

SNEPY! is an innovative smart neck pillow based on thermal theraphy and real-time alarm for public transportation users to prevent tension neck syndrome and oversleeping.

6.2. Recommendation

Based on the results of this study, the authors propose several recommendations including:

1. It is necessary to hold a market survey to find out the public's interest in SNEPY!'s innovation!
2. It is necessary to cooperate with several manufacturing industries to produce SNEPY! in larger quantities for commercialization
3. It is necessary to present SNEPY! to IMTA (Indonesian Medical Technology Expert Association), State-Owned Enterprises (BUMN), and other companies to show SNEPY! Will be of great help in the future

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