

Development of Heated Jacket for bike riders using Kansei Engineering

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Abstract: Due to metabolic heat generation of our body, we are very uncomfortable in both cold and hot weather, especially when we work hard. In cold weather we wear jackets & trousers to have more comfort. Thus, we have developed an innovative evaporative type of motor bike seat, jacket and a trouser that have been designed and fabricated using multiple heating coils. Measurements are taken from multiple feedback thermal sensors which are widely spread in the seat, jacket and the trouser. Then those readings are sent to the Control Unit and after that, the heating coils adjust the temperature to match the demand of the body temperature. We have designed the bike seat to transmit the electricity power to the trouser using wireless power transmission. This trouser has a small power cord that connects to jacket for the purpose of distributing power to the top of the jacket.

Keywords: Heated Jacket, Kansei Engineering, Bike Riders

1. Introduction

Motorbike jacket is very essential for bike riders as it offers protection for the riders in case of an accident or a crash. Also, it covers the rider from adverse weather conditions, dust and sun. There are various kind of motorbike jackets available in the market, designed using different materials such as leather motorbike jacket, the wax cotton motorbike jacket, laminated waterproof jacket, mesh motorbike jacket, etc. Other than the most common factors such as appearance, cost, weight, etc., the most important design aspect of a jacket is to provide safety and comfort for the rider. It is said that the most important factor which will ensure a safety ride on a bike is feeling comfortable and relaxed. But during cold and rainy conditions riders may feel uncomfortable and it might affect their safety and health. Therefore, if it is soaking wet and freezing cold It is very important that a biker stays dry and warm. Saying that, it's very important for rider to choose a right jacket by the rider. In this research we have developed a heated motorbike jacket that will be useful for motorbike riders to enhance their comfort during cold weather conditions, using Kansei Engineering (KE).

Kansei Engineering is also known as emotional engineering or affective engineering. It is the process of translating emotions and needs into a product design by using

customers' psychological feelings. The Kansei engineering method involves a series of steps. The first step of the statistical process is to collect suitable Kansei words. The second part of the study involves a Kansei evaluation experiment in which participants rate the designs using Kansei words with a Semantic Difference (SD) scale. Finally, a statistical procedure will be used to analyze how words relate to the product design elements. Several fields are involved in the implementation of Kansei Engineering, including methods from psychology, marketing, and statistics. KE studies are based on quantitative and qualitative research steps.

A. Existing Systems

There exist several heat jackets developed during the past years but most of them are having issues while using the product. Following are some famous products.

1) Torch 2.0 Coat Heater

This Torch Coat Warmer is a small, battery-powered heater that fits inside any jacket. Three thin heat pads offer heat for up to four hours on a single charge, and three heat settings allow precise customization of the temperature. The Torch 2.0 Universal Coat Heater & Warmer is a set of three thin heat pads that can be strategically put inside a coat or jacket, one in the back and two in front, one on each side. When pulled the coat heater and warmer out of the package, there is only one button, the power button, and it is also used to cycle among the three various heat settings, which are accessed by repeatedly pressing the power button. The button is located on the same panel as the secret battery pocket, so once connected, all you have to do is reach into your jacket and touch the conveniently accessible button to switch the device on or off and alter the heat level (Gin, no date).

2) Universal Coat Heater

The universal Coat Heater is a portable, battery-powered warming product that is intended to fit in any jacket. Therefore, the coat can be machine washable and the user can stay warm in anywhere they go. Universal Coat Heater can be quickly removed from your garment and transferred to other coats using Velcro, allowing you to heat any

clothing you possess. (Action Heat Adult 5V Universal Coat Heater | DICK'S Sporting Goods, no date). Therefore, to combat the winter conditions, the user can convert any garment into a battery-powered heated jacket.

3) Alexa-connected heated jacket

Like a future electric blanket, this jacket contains carbon fiber wires running up its back and sleeves to heat it for all weather wear. There were heated Olympic jackets, as well as linked jackets with touch-sensitive fabric, such as Google's and Levi's Commuter jackets. This is unique in that it is an automated heat-regulating jacket. It's just a heated jacket with a thermostat inside that can connect to Alexa via an Alexa skill that runs on echo. The jacket is heated by a normal 10,000 mAh replaceable battery.

The coat is powered for around four hours via a USB connector in the pocket. Internal and exterior temperature sensors, as well as an accelerometer, are incorporated. The motion and temperature sensors in the jacket will automatically regulate the heating based on your surroundings. Three heating options are available via an Android and iOS phone app (low, medium, high), Using machine learning, the app will learn your preferences over time. The Alexa-enabled function just turns the jacket on and off, so in principle you could say "turn my jacket on" as you leave the house and never worry about it again.

Main drawbacks identified in existing heat jackets are that they can only be adjusted to a fixed inner temperature which doesn't depend on existing body temperature and that the existing jackets are having only a limited duration of battery life which doesn't last long.

2. Methodology

Heated Jacket was chosen as the product domain. The participants were the people who ride motorbikes. Kansei words were collected from different sources such as research papers, magazines and literature reviews. Words that had a higher grade were selected. Namely comfortable, flexible, modern, durable, smart, and safe. Through the analysis the likes and dislikes of the people to a this kind of product were identified. The product of this research is a heated jacket that works through DC electricity by using 7 heating coil packs of 3W power with wireless technology. The questionnaire conducted in this research consists of questions about the experience of bike riders in Sri Lanka. The general idea about the heated motorcycle jacket was gathered through the the questionnaire and then the gathered data was analysed in order to design the product. Qualitative responses were quantified through a 1 to 5 likely scale. After describing the meaning of Kansei words, participants were given a brief introduction about how to complete the survey. Fig 1 represents the procedure of this study.

The 20 terms that have been compiled into a new database for the heated jacket are listed in Table 1 below. It was necessary to gather some words (Kansei words) that could represent consumer wants and relate to the product in order

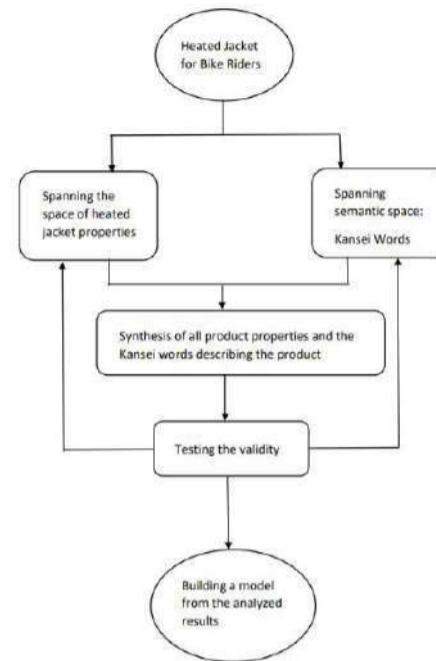


Figure 1. Conceptual Diagram of Heated Jacket using Kansei Engineering

to come up with suggestions for a new product that would suit the client's needs. The Fig 1 represent the procedure of this study.

Table 1. Kansei Words

Modern	Expensive	Comfortable	Durable	Stylish
Sporty	Smart	Unique	Attractive	Flexible
Safety	Simple	Youthful	Elegant	Suitable
Charming	Dressy	Good shape	Trendy	Artistic

3. Results

We have gathered data using the survey, focusing following basic ideas.

- 1.The general idea about the heated motorcycle jacket
- 2.How it affects Sri Lankan community
- 3.Preference of the community to new technology
- 4.Benefits of the product
- 5.Drawbacks of the product

From this survey our aim is not only implementing this jacket but also to introduce this new technology to Sri Lanka and give this marvelous experience to the Sri Lankan. So, we have asked several questions to get to know the community ideas. During the survey, we got responses from

245 persons and following charts shows the results of the survey.

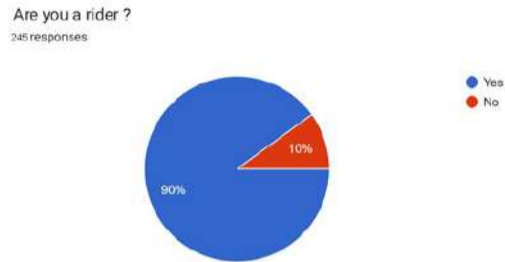


Figure 2. If responder is a rider

In the questionnaire, first we asked the age and gender of the respondents to get an idea about our respondent sample. We were able to gather data from all the ages and genders in order to have clear idea about their opinions. But most of our respondents belong to 18-25 age limit and 68% of our respondents are males and following graphs shows the results.

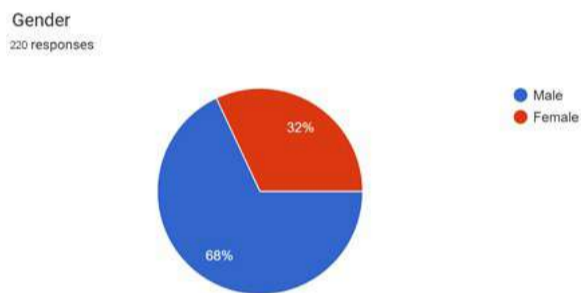


Figure 3. Responders' gender

Also we found out that 55.6% of the responders are riding under cold circumstances and a 18.5% of responders, relatively low number, are riding under warm circumstances. These numbers means most of the people can get benefit from our heated jacket.

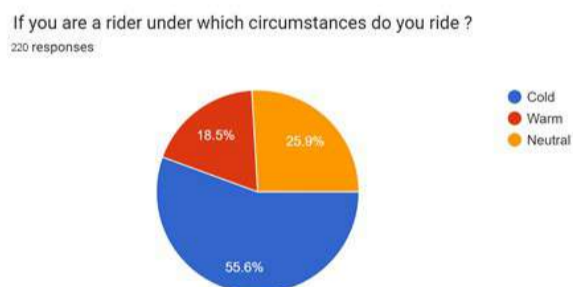


Figure 4. Riding circumstances

According to the next output of the survey, we found out that 32% of the people are used to ride average of 1hour – 2hour per day. Which means we have to consider about the continuous power supply for 1 – 2 hours. A relatively low number, 20% of responders have less than 30min of average riding time per day.

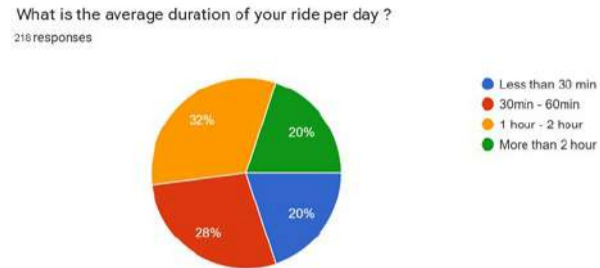


Figure 5. Duration of the ride

Then we found out that the frequency of rides of the responders. 32% of responders ride few times a day which implement that this category benefits mostly from our product. Only 4% of people is riding less than once or twice a week.

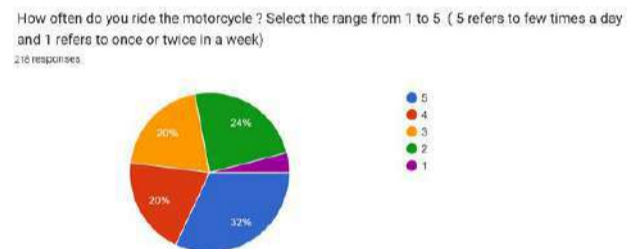


Figure 6. Riding frequency

Next part of the survey reveals that, 60% from the respondents are already using a motorcycle jacket. We can clearly say that since they already used to use a jacket, there will be no issues with them in using a jacket. The other 40% is a drawback and we can focus the reasons of not using a jacket as a further step.

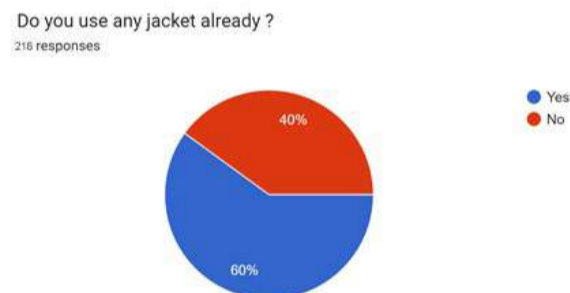


Figure 7. Usage of a jacket

Another problem we identified is backwardness in adapting to new trends. Only 16% of people says that they do not want to try this new technology. 84% of people think they should try out this technology. This is a good situation and below pie chart shows those responses.

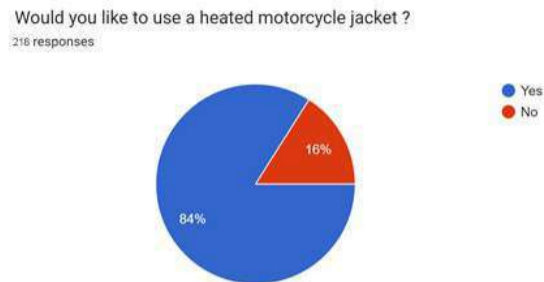


Figure 8. Likely to use a jacket

in the questionnaire we asked some questions regarding the technology they prefer to use for charging and for changing the temperature. 84% of responders prefer to use an automatic temperature changing function for the heated motorcycle jacket. Only 16% of responders think that changing the temperature manually, would be most suitable.

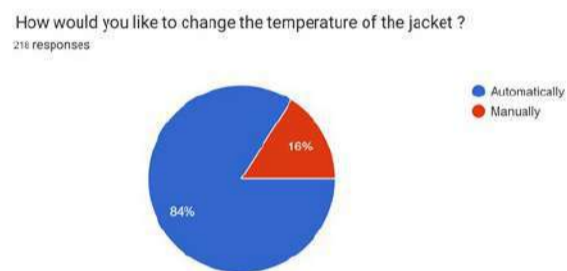


Figure 9. Requirement to change temperature

Another point is whether the people who would like to use our heated jacket will like to use a wireless charging method. 80% of people think it's a good idea to use a wireless technology for this heated jacket.

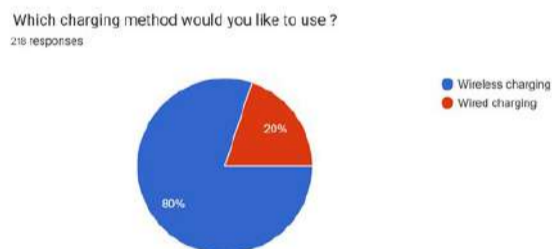


Figure 10. Charging method preferred

A. Final Design

Influenced by the responses of the survey we have designed the final product as follows. In this design we have modified the motorbike seat and the jacket. The design was divided mainly in to two parts.

1. Motor Bike

Seat 2.Motor Bike

Jacket

The heating system of the bike jacket is working through DC electricity by using 3W and 7 coil heating pack. Also this jacket is working using wireless technology. While the rider rides the motor bike, there's a wireless power transmit method between the jacket and motor bike seat to transmit electricity power to the jacket.

1. Motor Bike Seat

This seat already has a power transmit coil pack. Assume it is a 50w electricity transmit coil pack. In the image below the motor bike seat design explain how the power transmit coil pack is included.

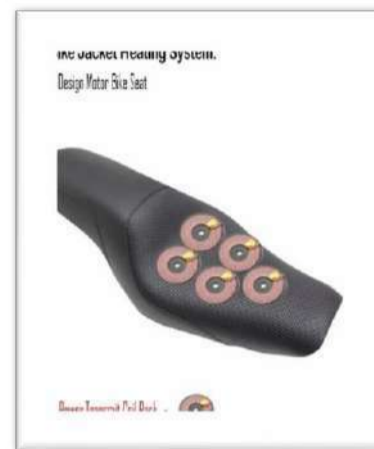


Figure 11. Motor Bike Seat

According to this plan, we have designed the motor bike seat to transmit electricity power without a wired connection to the motorbike jacket.

2. Jacket

Jacket has being designed with two parts.

- Trouser.
- Top of jacket.

Trouser

The trouser includes an electricity power receive coil pack and the power is transmitted to the top of jacket through a wired connection. When the motor bike rider sits on the motor bike seat, this connection automatically transmits electricity power to the trouser's coil pack.



Figure 12. Trouser - Front



Figure 13. Trouser - Rear

In back side of the trouser there is flexible power receive coil pack. The trouser have a small power cord that connects to the top of the jacket in which, the purpose is to distribute power to the top of the jacket.

Top of Jacket.

The top of the jacket includes following

- Heating coil package (Each package 5W)
- Temperature sensor
- Controlling Unit
- Reachable Li-ion battery pack (7.4 v)

The heating coil package warms the inside of the jacket. The body temperature is measured at every instance by multiple temperature sensors and the average value and sent to the controlling unit. The heating coil package is controlled according to this feedback of the control unit. When rider is riding the motor bike, sometimes for few seconds wireless power transmit may get disconnected or get weak. The Li-ion battery pack is used to avoid this issue. As a result of using the Li-ion battery pack, the control unit has continuous

electricity power to maintain the process without any disturbance. This battery pack is also charged from the power received by the trouser. In the back side of the jacket, there is a power code that connects to the trouser in the top of the jacket.



Figure 14. Jacket - Front



Figure 15. Jacket - Rear

4. Discussion

B. Limitations

Wireless charging pads are costlier more than wired chargers. As a pretty new technology, it's more costly to purchase a wireless charging pad, especially when new smartphones come with a wired charger in the box. Charging receptors need to stay on the pad in order to continue charging and takes considerable time to charge. The efficiency of wireless charging is still lower than wired charging, thus it takes more time to charge wirelessly using the same amount of power. Wireless charging supposedly takes 30-80% longer time to fully charge your device than a cable.

C. Further works

Reduction of the power loss due to wireless charging is a major concern to be improved in our next stages. As a result of the ongoing Economic Crisis many people have attracted to use bicycles for their transportation requirements. The target user crowd of the 'Heated Motorcycle Jacket' can be extended to bicycles riders as well.

5. Conclusion

Based on Literature review and methodologies applied herewith its observable that proposed 'Heated Motorcycle Jacket has an admirable advantage to the motor bike riders. Specifically for the riders in cold and soft weather condition changing areas, where the daily precipitation is a cross between mist and drizzle and sometimes referred as "mizzle". The rain does not fall to the ground in heavy droplets but seems to hover and linger in the air which can be very disturbing to the rider. Along with the usage of wireless charging, we have obtained the advantages of having less cords to worry about with wireless technology. User don't need to carry around a USB-c charger. It is just needed of one cable that is connected to the charging mat. Universal compatibility - Qi charging is the universal standard for multiple different wireless capable devices and can be used the same charging pad without any issues.

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