

# Wearable Computing: Canonical Correlation Analysis (CFA) Statistical Method to Validate the Measurement Models Smart Ergonomic Shoes

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**Abstract:** Wearable sensors have become increasingly popular over the past few years, and there are now a number of different products on the market that may be used for monitoring one's own health and activities. A more modern health care system ought to be able to provide better medical services to people at any time and any location, in a manner that is both inexpensive and patient-friendly. This study intends to evaluate the measuring model and offer evidence for the links between influential factors and purchase intention. To do so, it will make use of CFA. The results of the CFA will contribute to a better knowledge of the elements that have a substantial impact on purchase intention in the context of smart ergonomic footwear, since this understanding will be furthered by the findings of the CFA. In general, canonical correlation analysis (CFA) is an effective statistical method that contributes to the validation of measurement models, the evaluation of correlations between variables, and the improvement of the robustness of the study's conclusions. The coefficient for Customer Perceived Values is statistically significant at the 0.05 level (since the p-value is less than 0.05). The positive coefficient suggests that there is a positive relationship between Customer Perceived Values and the outcome variable (purchase intention) in the analysis. The coefficient for Personal Values is statistically significant at the 0.05 level. The positive coefficient suggests that there is a positive relationship between Personal Values and purchase intention in the analysis. The coefficient for Social Factors is highly statistically significant (p-value is close to 0) at the 0.05 level.

**Keywords:** *Wearable sensors, Smart ergonomic shoes, technical factors*

## 1. Introduction

Wearable sensors have become increasingly popular over the past few years, and there are now a number of different products on the market that may be used for monitoring one's own health and activities (Meshram, 2019). A more modern health care system ought to be able to provide better medical services to people at any time and any location, in a manner that is both inexpensive and patient-friendly.

At this point in time, as we have advanced into the 21st century, the rising outcomes of mature communities have begun to control the expanding demand on the medical system. There will frequently be a resolution regarding the proper treatment of the elderly. Those who are able to pay the high costs of an elderly care facility are eligible to apply. People who are unable to afford additional expenses typically choose to remain at home; however, this choice can lead to a lack of correct observing, which in turn can lead to a lack of a health control system that is able to give necessary biomedical and also good health information to the caregiver as well as the user (Gawande et al., 2020).

## 1.1 Background

The creation of cutting-edge healthcare concepts is made possible by the increasing importance of new smart technologies and the internet of things in healthcare and wellness. These tools provide a complete picture of a person's movement and mobility, which may encourage healthy behaviour and serve as a complement to diagnostic procedures and the tracking of therapy progress. Every person needs shoes because they provide more than simply protection and comfort. Additionally, it conveys an individual's status and sense of style; crucially, they will worry about their footwear selection if it endangers their health (Escoffier et al., 2017). The term "smart shoes" refers to a type of footwear that utilises intelligent technology and is worn to give the wearer with increased comfort and protection while walking, running, or engaging in other types of physical activity. They are embedded with monitoring navigation and positioning, electronic systems, microchips, pressure sensors, and batteries, and they are digitally connected to applications that run on smartphones. The widespread use of smart shoes has led to the creation of accurate data as well as individualised feedback on aspects such as fatigue, health, steps, and calorie consumption as well as posture.

## 1.2 Scientific and technical aspects

A smart shoe is a regular shoe that has been upgraded with technological capabilities, such as the ability to

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automatically alter size for a custom fit and record user biometric data and activities. The user can access personalised data from a few smart shoe brands via an app.

## 2. Literature Review

A tracker built into a smart shoe makes it easier to determine how many steps you've walked, which part of your feet is touched the most, how many calories you've burned, and how many more you should burn each day. A smart shoe can also automatically tighten the shoelaces, change its color with LED strip lights, and have other functionalities (Bhattacharya, 2020). With a continuous assessment of gait and mobility, smart shoes provide the potential to enhance preventive, diagnostic work-up, therapeutic decisions, and individual disease monitoring.

For persons who are blind or visually challenged, a clever assistive shoe can let them stop wearing shoes and become more independent. The shoes will sound an audible or vibrate a message to the receiver when they identify nearby obstructions (Porkodi, 2021). The goal of the integrated smart shoes is to provide an Electronic Traveling Aid (ETA) for those who are blind or visually impaired that will aid them in securely navigating. Wearable technology will assist in path navigation with the aid of an Android app. Data can be transferred using Li-Fi technology and LEDs. Similar to Wi-Fi, it is a fast wireless communication system. Through voice commands that are transmitted through light sources in the way, this smart shoe aids the blind in navigating. The LiFi receiver receives the data from the LiFi transmitter. Data concerning data will be included in the received data. The ability to travel independently is made possible for the vision handicapped by smart shoes that offer reliable navigation. A huge number of companies have implemented beneficial ergonomic practises in their industrial parks as a result of the implementation of ergonomic projects, and the number of ergonomic studies developed in the shoe industry is growing at an increasing rate (Renner & Bühler, 2006)

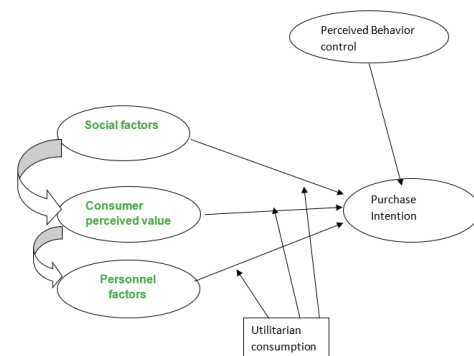
When applied to the world of work, issues with the musculoskeletal system are a prevalent cause of work incapability as well as early retirement (due to reduced ability to work). The bulk of complaints are associated with the spine and the joints. The occurrence of these disorders is linked to a variety of factors, including but not limited to the type of activity, the amount of energy expended, the loads, posture, vibration, and weariness. Adjustments need to be made to work processes, workplaces, and conditions to address this issue. These modifications fall under the overarching category of ergonomics in the workplace (Safety footwear and ergonomics, 2014). In the first instance, adjustments need to be made. When working in locations that need the use of protective clothes and safety gear, one additional component that has not received a lot of attention up to this point is safety footwear, despite the

fact that it has a significant impact on the body, mobility, and load.

## 3. Conceptual Framework

The conceptual framework that was utilized in the research on the elements that influence the purchase intention of smart ergonomic footwear in India was designed to provide a graphical depiction of the correlations that exist between the variables. The framework is a visual guide that helps individuals understand how various aspects are connected and contribute to their intention to purchase smart ergonomic footwear. It is anticipated that the consumers' perceptions and evaluations of the footwear will be shaped by these characteristics, which will in turn influence their intention to purchase the footwear.

The conceptual framework offers a route for the research investigation through a graphical representation of the relationships that exist between the variables being considered. Researchers can better comprehend the intricate interplay between the factors that influence purchase intention as a result of this, and a structured analysis of the data is made possible as a result of this as well. A framework is a useful tool for investigating the special context of smart ergonomic footwear in India, and it adds to the overall objective of the study by offering insights into the elements that affect individuals' desire to purchase these items. In other words, the framework serves as a beneficial tool for investigating the specific context of smart ergonomic footwear in India.



- **Research Question 1:** What is the level of awareness towards smart ergonomic footwear in the NCR region of India?
- **Research Question 2:** How does utilitarian consumption moderate the relationship between influencing factors and purchase intention?
- **Research Question 3:** What is the relationship between the influencing elements and purchase intention of Smart ergonomic footwear in India?

- **Research Question 4:** How does utilitarian consumption influence the relationship between influencing factors and purchase intent in the context of Smart ergonomic
- H01: There is no significant difference in the level of awareness towards smart ergonomic footwear in the NCR region of India.
- Ha1: There is a significant difference in the level of awareness towards smart ergonomic footwear in the NCR region of India.
- H02: Utilitarian consumption does not moderate the relationship between influencing factors and purchase intention.
- Ha2: Utilitarian consumption moderate the relationship between influencing factors and purchase intention.
- H03: There is no relationship between the influencing elements and purchase intention of Smart ergonomic footwear in India.
- Ha3: There is a relationship between the influencing elements and purchase intention of Smart ergonomic footwear in India.
- H04: Utilitarian consumption does not play a moderating role in the relationship between influencing factors and purchase intent in the context of Smart ergonomic footwear in India.
- Ha4: Utilitarian consumption plays a moderating role in the relationship between influencing factors and purchases intent in the context of Smart ergonomic footwear in India.

#### 4. Data Analysis

Discriminant validity is used to establish the relationship between theoretically unrelated constructs. many regressions is a statistical methodology employed to investigate the association between a dependent variable and many independent variables. This process facilitates the identification of independent variables that exhibit significant associations with the dependent variable, as well as the magnitude of these associations. To derive meaningful interpretations of coefficients in multiple regression analysis, it is imperative to take into account the estimated coefficients and their associated p-values. Every coefficient in the model signifies the impact on the dependent variable when there is a one-unit change in the independent variable, while keeping all other variables constant. (Gujarati et.al., 2009).

#### Discriminant validity

	General Factors	Customer Perceived values	Personal values	Social Factors
General Factors	0.840			
Customer Perceived values	0.674	0.915		
Personal values	0.545	0.544	0.900	
Social Factors	0.631	0.476	0.652	0.876

The magnitude and direction of the association between each value and purchase intention are shown by these correlation coefficients. A stronger positive correlation indicates a stronger influence, whilst a weaker correlation indicates a more moderate influence. It's critical to remember that correlation does not imply causality and that other things could possibly influence the inclination to purchase.

#### Multiple Regression Analysis

All four factors are statistically significant predictors of the outcome variable based on their respective p-values, indicating that they are likely important in explaining the variation in the dependent variable.

	Coefficient	T statistics	P values	Inference
Customer perceived Values	0.290	3.245	0.001	Significant
Personal values	0.266	2.345	0.012	Significant
Social Factors	0.126	5.365	0.000	Significant
General Factors	0.139	4.216	0.000	Significant

The coefficient for Customer Perceived Values is statistically significant at the 0.05 level (since the p-value is less than 0.05). The positive coefficient suggests that there is a positive relationship between Customer Perceived Values and the outcome variable (purchase intention) in the analysis. The coefficient for Personal Values is statistically significant at the 0.05 level. The positive coefficient

suggests that there is a positive relationship between Personal Values and purchase intention in the analysis. The coefficient for Social Factors is highly statistically significant (p-value is close to 0) at the 0.05 level. The positive coefficient indicates a positive relationship between Social Factors and the purchase intention". The coefficient for General Factors is highly statistically significant at the 0.05 level. The positive coefficient suggests that there is a positive relationship between General Factors and purchase intention.

The adjusted R-squared is a variant of the R-squared metric that incorporates the influence of the number of predictors included in the model. The R-squared score is penalized when incorporating extra predictors that do not yield a meaningful enhancement to the model's performance. The adjusted R-squared can be lower than the R-squared if adding more predictors does not improve the model substantially. In this case, the adjusted R-squared value is 0.704. It is slightly lower than the R-squared value, which is expected when there are multiple predictors in the model. The adjusted R-squared is generally used as a more reliable measure of model fit when there are multiple predictors.

From the above, "33.3% of the respondents disagreed that the design of shoe provided anatomical arch support, 30.6% neither opposed nor proposed, 36.1% agreed. 21.8% disagreed that the shoe kept feet in proper position in-case of medical conditions, 24.5% neither proposed nor opposed, 26.5% agreed and 27.2% strongly agreed. 31.3% of the respondents disagreed that the shoe helped in relieving fatigue, 36.1% neither agreed nor disagreed and 32.7% of the respondents agreed". From the above, "the shoe keeps the feet in good conditions in cases of medical attention came first with a mean of 3.59, the shoe helps in preventing deformity came second with a mean of 3.04, the shoe

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provides anatomical arch support came third with a mean of 3.03 and finally the shoe helps in relieving fatigue had a mean of 3.01".

The "coherence degree and dependability of a group of measurements or items within a group is referred to as internal consistency. The degree to which a measuring tool's parts consistently evaluate the same core idea is referred to as reliability. The evaluation focuses on the accuracy or consistency of the items used to measure a single construct. A popular metric for evaluating the dependability of internal consistency is Cronbach's Alpha. The commonly recognised minimum threshold value is typically 0.6, indicating that a minimum of 60% of the variance in the items may be attributable to the underlying concept. As stated by Nunnally (1994), convergent validity refers to a statistical technique employed to analyse the extent to which many measures intended to assess a specific construct produce similar results.

## 5. Conclusion

The assessment's goal is to figure out how closely related different measurements are to one another. A statistic used to assess a construct's convergent validity is the Average Variance Extracted (AVE). The measure of the degree to which the items converge or share similar variation is the average variance of the construct, which is represented. The summation of the squared factor loadings of the items yields the Average Variance Extracted (AVE), which is subsequently divided by the sum of the squared factor loadings and the error variance. As stated by Hair et al. (2010), it is deemed suitable to establish a minimum threshold value of 0.5, indicating that the construct under consideration explains at least 50% of the variance in the items.

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