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A Design of the Digital Bag for Pilgrim's Safety

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ABSTRACT

The study aimed to design digital bags that comply with the functional requirements of Hajj and Umrah pilgrims in the light of ergonomics and then to identify the differences between specialists in achieving design patterns of bags made for pilgrims' safety. It also aimed to measure the extent to which Hajj and Umrah pilgrims are satisfied with the proposed designs. The research employed a mixed-methods approach, with a study sample of (301) individuals who had participated in Hajj and Umrah pilgrimages. The study's findings indicated statistically significant variations, at a significance level of (0.01) among the six suggested designs for smart bags, based on the feedback from Hajj and Umrah pilgrims. When testing the direction of significance, the two researchers found that design no. 1 was the best among all designs, followed by design no. 3, then design no. 6. Results also showed statistically significant differences at the level of (0.01) among the six suggested designs for smart bags based on the experts' assessments. When testing the direction of significance, the researchers found that design no. 1 stood out as the optimal choice, followed by design no. 6, then design no. 2. The study concluded that the ergonomic standards should be applied in the smart design, taking into consideration the safety factor, as the two researchers followed the ergonomic standards within the framework of designing smart bags through several elements, namely locating the bag, combating thefts, and enabling bags with RFID technology to identify the user's identity. The study provided an overview of recent trends in the ergonomic field to improve human performance and achieve product development. It resulted in a practical guide to understanding the ergonomic guidelines in smart design. The two researchers recommended considering the ergonomic aspects of fashion design and its supplements, especially the smart ones. They also recommended conducting several studies dealing with the impact of ergonomic considerations on fashion design and its supplements.

Keywords: Safety, Digital bags, Wearable technology, Hajj, Umrah, Pilgrim's safety, and Umrah.

INTRODUCTION:

Mecca holds a prominent religious significance predating the emergence of Islam, as the Holy Mosque contains the Kaaba within its premises. Mecca has long been a destination for pilgrims undertaking the Hajj pilgrimage (Al-Matrafi, 2021). Hajj is a religious duty that must be fulfilled once in a lifetime by every mentally sound adult Muslim who can afford it. At the same time, Umrah is a religious practice associated with Hajj. It is frequently referred to as the minor pilgrimage. However, Hajj and Umrah must be performed at the Holy Mosque (Muneeza and Mustapha,

2021). It is one of the most substantial yearly religious congregations globally, from the eighth to the twelfth month of Dhul-Hijjah of the Islamic calendar. Conversely, Umrah is open for performance at any time throughout the year. Umrah contributes significantly to the genuine and all-encompassing economic advancement of the Kingdom of Saudi Arabia, as it has become one of the most important drives of the overall influx of private financial resources. Among the benefits of Umrah are interaction with cultures worldwide, active involvement in promoting economic activity, and serving as one of the focal points of the Kingdom's Vision 2030 to facilitate approximately (30) million Umrah pilgrims by 2030. Besides, according to the statistical metrics of the Umrah sector in the Kingdom, Madinah receives annual visits by (11) million visitors from inside and outside the Kingdom (Seasonal Bulletin of the Chamber of Commerce, Madinah, 1439 AH) (Al-Harbi, 2021).

The Hajj encompasses numerous rituals that must be conducted in a specific sequential order at different locations. It starts with the intention to perform Hajj, then wearing Ihram clothing, and concludes with the final circumambulation around the Kaaba as a farewell (Tawaf al-wada'a) and the departure from Mecca. During this sacred journey (Khan & Shambour, 2021) and taking into account the reality that Hajj represents the densest gathering of Muslims, and due to its distinctive characteristics about the individuals participating in it (i.e., Hajj pilgrims), the place where they meet, and the rituals they perform, these characteristics present a series of difficulties for authorities in managing the crowd and verifying the identities of the pilgrims. The situation is further complicated because pilgrims dress alike and collectively engage in the same rituals (Muneeza & Mustapha, 2021). So efforts are made to fulfill the objectives outlined in the Kingdom's Vision 2030, in line with the "Guests of Rahman (pilgrims)" program, which is a part of the Kingdom's programs to bring about a substantial improvement in the service provided to pilgrims, aiming to enrich the religious and cultural experience of Hajj and Umrah pilgrims (Mlibari, 2021).

Assisting Hajj and Umrah pilgrims is a national duty and everyone's responsibility. God has honored us in this country by serving His Sacred House and the Mosque of His Noble Prophet (PBUH). Technology should be crucial in enhancing the pilgrimage experience and facilitating the fastest use of services. This includes creating the appropriate environment, offering pilgrim's advantages, and offering them some facilities (Mlibari, 2021). In this environment, the designers are looking for an opportunity to integrate computers and sensors with the human body to facilitate the communication between humans and the computer components they wear, as they are integrated into clothes, shoes (Ali, 2021), and bags. The study conducted by Al-Sharif, (2021) touched on the necessary services provided to pilgrims who lost their official documents because of road congestion or in their places of residence.

This matter has become an urgent necessity by the competent government agencies, as the document of the "Serving the Guests of Rahman" Program, which was launched by HH the Custodian of the Two Holy Mosques in Ramadan 1440 AH, is considered one of the most important initiatives of Vision 2030 that aims to achieve a significant improvement in serving the pilgrims. The Ministry of Hajj calls that document "the service document for the rights of the pilgrim's participating in Hajj and Umrah," which allows the pilgrim to become familiar with the rights granted to him (Al-Harbi, 2021). As highlighted in the study by Khan and Shambour, (2021) many governments, companies, and individuals offer various services and amenities to address the challenges that pilgrims might encounter. Moreover, according to the suggestions provided by Al-Sharif, (2021) utilizing contemporary technology is essential to ease the pilgrims' experience throughout the various rituals, especially when losing their official documents. Consequently, the two researchers were dedicated to examining studies and research relevant to the current study to build bases aimed at enhancing the experience of the pilgrims on their spiritual journey. Therefore, with the aim of advancing the Hajj and Umrah industry led by the government of HH, the Custodian of the Two Holy Mosques towards serving the pilgrims and proceeding from the Kingdom's vision 2030 to prepare to serve the pilgrims, and the national transformation initiatives 2020, the two researchers are carried out this study. Therefore, the two researchers aspire to cater to the needs of Hajj and

Umrah pilgrims by creating an innovative product (smart bag) that performs a utilitarian function by using the science of ergonomics. Due to a lack of smart bags designed specifically for Hajj and Umrah pilgrims during their rituals, and considering that many available bags in the market do not address the unique requirements of Hajj and Umrah pilgrims, the two researchers recognize the importance of examining the incorporation of safety aspects in the design of Hajj and Umrah bags. On the other hand, the findings from the research conducted by Shambour & Khan, (2021) revealed a relative deficiency in research studies and quotes related to the Two Holy Mosques and the Holy Sites compared to other branches of science. Accordingly, the study problem can be identified in the following questions:

What statistically significant distinctions exist among the designs of smart bags aimed at ensuring safety, according to the assessments of specialists?
What statistically significant distinctions exist among the designs of smart bags aimed at ensuring safety, according to the opinions of the pilgrims participating in Hajj and Umrah?

Objectives of the Study

Design of digital bags that adhere to the safety standards for Hajj and Umrah pilgrims.
Determination of the differences between specialists in designing smart bag patterns prioritizing safety.
Determination of the differences between Hajj and Umrah pilgrims in their acceptance of the suggested designs for smart bags.

Importance of the Study

They were enhancing the care for Hajj and Umrah pilgrims, in line with the vision of the Kingdom of Saudi Arabia 2030, by providing top-notch services to Hajj pilgrims, starting from their arrival in the Kingdom until their departure to their country after God blessed them to perform their rituals with ease and tranquillity.

Design of the Study

The two researchers embraced a pragmatic philosophy due to its alignment with the research objectives. They employed a mixed research methodology to attain a more profound comprehension of the study population. This data will assist the two researchers in formulating questions related to the research tools. In this methodology, the two researchers employed the simultaneous embedded design to enhance their comprehension of the research questions, objectives, and theories guiding the study .The methodologies employed in this study encompass the data collection tools utilized by the researchers and the data analysis and processing techniques. Additionally, the study suggests specific methods for concluding.

Population and Sample of the Study

The study population comprises Hajj and Umrah pilgrims participating in the Hajj season, (1442 AH). The determination of this population is aligned with the study's objective, which focuses on designing bags that meet the safety requirements of Hajj and Umrah pilgrims. The current study's sample comprises a deliberate selection of (301) Hajj and Umrah pilgrims. The sample size was determined using a statistical equation to calculate the sample size with a confidence interval of 5.6% and a confidence level of 95%. The electronic questionnaire was distributed through campaigns targeting the assisting of domestic pilgrims.

Limitations of the Study

Temporal limitations: The temporal boundaries in this study are restricted to the Hajj season of the year 1442 AH. (2021 AD), which is the period of performing the Hajj rituals for 1442 AH (2021 AD).
Spatial limitations: The Holy Sites and their facilities in the Kingdom of Saudi Arabia.
Objective limitations: While designing the bags, the two researchers built their "Reduction Theory," which depends on the utmost simplicity in design and the ergonomics theory in design. In this study, it was limited to the "safety factor."
Human limitations: The human limitations are set to include the pilgrims involved in the rituals of both Hajj and Umrah only, considering what was decided by the Ministry dedicated to the coordination of Hajj and Umrah, affairs for the season (1442 AH) of controls and mechanisms followed in the Kingdom for precautionary measures.

Terminology of the study

1. Safety: It is an internal feeling that results from security achieved, and it is represented in people's sense of comfort and tranquility, which creates an

appropriate atmosphere for them to carry out all forms of daily life activities without fear, anxiety, or tension (Ibrahim & Abu Al-Saud, 2021).

2. Wearable technology: a subset of interactive devices worn on the body (Dierk, 2020).

3. Digital Hajj bags: Hajj is to go to Makkah Al-Mokarramah (Mecca) during the months appointed to complete the rituals prescribed for Hajj to draw closer to God (Al-Husni, 2020). Umrah is devotion to God Almighty by circumambulating the House (Tawaf), Sa'i between As-Safa and Al-Marwah, and decomposition of Ihram by shaving or trimming hair (Al-Sarhan, 2020). The researchers defined digital Hajj bags procedurally as innovative bags designed based on adaptive features, with an interactive design linked with smart technology and security features appropriate for the target group.

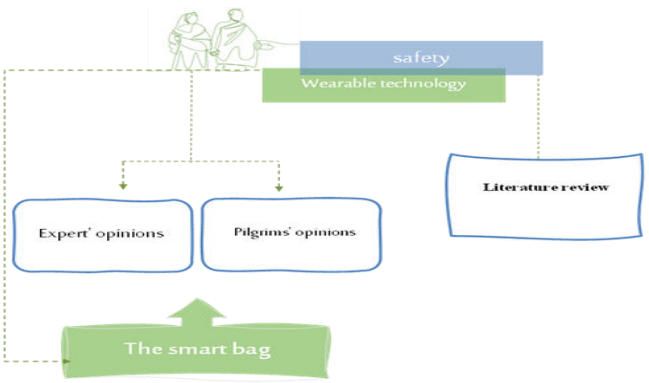

Fig. 1: Shows the conceptual framework of the study (designed by the researchers).

Review of Literature

According to a review of previous literature related to Hajj and Umrah pilgrims, the research acquires its importance from the scarcity of studies and research that dealt with the bags used in the Hajj season. Previous studies dealt with other topics, such as the study conducted by Al-Hasani's study on the forbidden women's clothing (2020), Al-Sarhan's study on the production of women's clothing proposed for Hajj and Umrah with good performance (2020), and many other studies that dealt with Ihram clothing (for men or women). This is along with the study conducted by Bala'mash and Salem, (2020) in which they took multiple approaches, all of which were striving for the same goal related to fabric, whether in Ihram or rugs or in masks or scarves. Therefore, the two researchers decided to study this problem to develop a scientific conception of the bags intended for use during the Hajj and Umrah rituals. There is no doubt that these desired results acquire great importance at present in light of the Kingdom's Vision 2030. As far as the two researchers know, none of the previous studies dealt with the pilgrims' bags. The two researchers framed the current study with the framework of the Ergonomics Theory, which is the theoretical and basic understanding of human behavior and applying this understanding to design, that is, the practice of understanding people and their characteristics (human factors) about design. Ergonomics Theory is considered a suitable entry point for this study. Procedurally, the researchers define ergonomics as the science that applies design data and theories related to human features to the design of tools, machines, systems, and products made for safer and more comfortable functional and aesthetic use. From a review of the previous fields, the two researchers believe that physical ergonomics is the most appropriate field related to the subject of the study, as it supports the study of the pilgrim by understanding the physical characteristics, capabilities, functions, and tasks to achieve compatibility between the proposed Hajj smart bags and their places of wearing.

There are several factors a designer takes into consideration in terms of human kinetic performance. Most technologies needed to alleviate these health concerns related to the carriage of bags have already been invented and only need to be implemented. The general ergonomic principle here is to avoid overexerting the muscles. For instance, the Daffin *et al.* (2020) study found that backpack users must consider not only the overall weight of their pack but also the arrangement of specific things within the pockets. They are placing heavy objects closest to the backpack carrier's center (Faravarde and Anboohi, 2023).

Safety

Since ergonomics aims to improve the link between humans, the product, and the environment, it becomes necessary to study everything that affects the efficiency and safety of performance between humans and the product (Ibrahim & Al-Saud, 2021). Therefore, the designer must avoid possible harm to the human body or others from using the product, so he/she should avoid shapes with pointed ends and serrated edges so as not to cause injury to the user's body; the bag must

also be free from any stinging or roughness when rubbing so as not to give a feeling of discomfort (Harby, 2020). The safety factor is often achieved in smart bags, as in the study of Ali *et al.* (2021), they designed a bag with the latest modern technology that is equipped with a camera connected to the bag to take a shot of the attacker and send a message via GSM network to the victim's family. Kumar *et al.* (2020) used the electromagnetic zipper from the fingerprint sensor that allows only the authorized user to open the bag with the help of electromagnets placed on each of the compressed slides. The bag designed by Jadhav *et al.* (2020) features an anti-theft design that provides safety for the bag contents placed for security purposes and the capability of tracking the location of the bag, which will be useful in case it is stolen or lost. This is consistent with the study conducted by Jokić *et al.* (2019), which presented a USB smart digital wallet made for cryptocurrency. This wallet provides safety. The choice to secure it with a PIN code and make a backup copy of the information is also available. It also has a small screen on the front side to manage it easily. Many functions are also available, such as cryptocurrency exchange and money transfer from one account to another. The research conducted by Abdalrdha and Mohammmed, (2020) also complies with the current study in its main purpose: designing and implementing an anti-theft smart bag. Smart bag application simulation is an essential platform for the next generation of assistive devices. It provides a low-cost, reliable, portable, and low-energy solution to protect people's property with a short response time. This includes a method for global positioning to determine a bag's location using GSM and GPS modules, which link the bag's location to a nearby location.

Wearable technology

Wearable technology creates a new kind of self-identity that involves functional and aesthetic elements and self-expression. For the product to have a wearable technology advantage, it must transmit information from smart sensors to the smartphone by connecting it via Bluetooth or a wireless network (Erkilic & Yalcin, 2020). Designers are looking for an opportunity to integrate computers and sensors with the human body to facilitate communication between humans and the computer components worn, as they are integrated into clothes, shoes, jewelry, and bags (Ali, 2021). "Wearable devices" are an example of the importance of technology for a renewed focus on physicality as an Abdalrdha & Mohammmed, (2020) bag. Advances in smart clothing have been insignificant so far due to many factors, such as the impermeable components, the high cost of manufacturing such clothing, and the inability to wash it. Besides, some of them are uncomfortable to wear as they are based on electronic textiles (i.e., textiles with electrical conductivity) (Joler *et al.,* 2019). As such, it is considered impractical for everyday wear, which forces us to study the combination of modern optical and technical characteristics. Smart clothing has multiple benefits that meet the different clothing needs of modern designers (e.g., safety and protection). The same was explained by Chauhan and Nigam, (2021) in their study, which developed a smart bag that uses an RFID sensor and an HX711 sensor for load cells. Items can be identified using an RFID tag, then several items will be stored in the bag's memory, and the items will be matched according to the schedule set. The communication circuit consists of the NodeMCU and RFID receiver, where alerts are passed when items are placed inside the bag; then, the RFID receiver reads the RFID tag and sends the data of items to the NodeMCU to compare it to the schedule list. If any item is missing, NodeMCU will alert the user. Technology can improve the speed of designing the elements of products offered to Pilgrims undertaking Hajj and Umrah, especially with the numbers targeted to achieve Vision 2030 to reach (5) million Hajj pilgrims and (30) million pilgrims performing Umrah by the year (1452 AH), provided that the highest standards of security and safety are observed. The study by Lee, (2020) entitled "smart-fashion Product" outlined attempts to bring fashion and technology together to provide digital benefits to users. This study aimed to explore the optimal way to develop smart fashion patterns that provide multiple user-oriented functions to increase the potential features of fashion. Market Analytics forecasts steady growth in this segment of the smart design market at an annual rate of 12%, up to 25%, and up to the year 2222 (Jolar *et al.,* 2019). Wearable technology has become one of the important applications rapidly developing in the global market and provides innovative products in line

with advancements in information and communication technology (Erkilic and Yalcin, 2020). Research areas of flexible and wearable electronics are now covered from applied physics, chemistry, mechanical engineering, materials science, biomedicine, and apparel technology. Researchers and the public are now paying increasing attention to flexible electronic wear (Wang & Wang, 2020). Recent reports indicate that the global wearable technology market will exceed 62.82 billion US dollars by 2025 (Dierk, 2020). The development of digital and mobile technologies has changed many aspects of our lives, and these technological advances have led to the emergence of wearable technologies that lay the foundation for the next stage of the digital revolution, where technology is not only usable but also wearable (Erkilic & Yalcin, 2020). It paves the way for the introduction of smart clothes that perform their functions according to the needs and requirements of the body so that it adapts to its surroundings. The starting point of wearable technology goes back to the 13th century when the first wearable computer, a shoe device, was created in 1961 (Erkilic & Yalcin, 2020; Hossain *et al*., 2023).

Designing bags

The current study attempts to provide a clothing commodity for the category of Hajj and Umrah pilgrims that is compatible with the appropriate functionality of this ritual and opens the door to research in the field of ergonomic bag design. Therefore, we have to study the set of modern visual and technical characteristics of shape, color, and interactive effects, which can be used in a new way that depends on innovative thought and breaking out of the ordinary in order to achieve creative thought and thus capture the interest of the target audience (Jalil *et al.,* 2019). As has been inferred from the inductive review of the previous literature, there has been some research that has discussed smart bags, which has led to the emergence of some products on the market, such as the bag in Yang *et al.* (2021) study that comes with trackers and bags that have a safety button. There is a lack of solutions that can address all these issues and include some smart features that can provide smart analytics and services to the user, along with the bags that track their owner using human detection technology using ultrasound sensors. Building the Study Tools. The two researchers prepared two questionnaires, each containing a cover with an introduction to pave the questionnaire's content. It included welcoming the target group, introducing the two researchers and the study's title, clarifying its most important objectives, and determining what is required of the arbitrators. It also contained the primary data of the intended group. In order to verify the validity of the questionnaires, they were presented in their initial form to a group of 10 arbitrators from the faculty members of the Department of the Fashion Design, College of Designs and Arts, University of Jeddah, and the Department of Fashion and Textiles, College of Art and Design, King Abdul Aziz University.

This was done to get to know the views of arbitrators on the research tool, the extent to which it achieved the goal for which it was set, and the availability of the following items in the tool (phrasing, clarity of the phrase, sequence, and organization, number of phrases and inclusion of the questionnaire for the objectives of the research). Thus, the search tool became ready for application in its final form. Cronbach's alpha coefficient also verified stability.

The first tool: a questionnaire to evaluate the proposed smart bag designs (for specialists)

It is a questionnaire for specialists to evaluate the proposed smart bag designs. The questionnaire included four axes, namely (the axis of achieving aesthetic values, achieving functional values, the axis of safety, and the axis of ease of use). The first axis contained 14 phrases; the second axis contained 14 phrases; the third axis contained 6 phrases; and the fourth axis contained 8 phrases. The questionnaire included a triple assessment scale for the answer (agree, agree to some extent, and disagree).

The Second Tool: A Questionnaire to Evaluate the Proposed Smart Bags (for Pilgrims Performing Hajj and Umrah)

It is a questionnaire for the research sample of pilgrims performing Hajj and Umrah that aims to evaluate the proposed smart bags, and it included a triple assessment scale for the answer, which is (agree, agree to some extent, and disagree).

Preparing the proposed designs of smart bags

The two researchers prepared the proposed designs as a result of what was studied in the previous literature

related to the field of research and from the theoretical framework that dealt with all the variables and aspects of the research. Moreover, according to the studies conducted by (Hassan, 2019; Fatah *et al.,* 2020), the procedural stages of designing the bags include the following: defining the problem, studying the literature, gathering information and ideas from the source of inspiration, preparing an inspiration board, preparing sketches, then preparing illustration designs and preparing a prototype for the sample. The two researchers prepared 6 smart bag designs due to what was studied in the previous chapters. The following is a detailed presentation of those designs and their analysis, in terms of a description of the design and its idea, with a presentation of the formal composition (design shape) and techniques of connecting parts, preparing the flat design, and then preparing the original pattern of the design in preparation for the 3D design of the bag:

Table 1: Specifications of the proposed bags (prepared by the two researchers).

<table>
<tr><td colspan="4">  </td></tr>
<tr><td colspan="4">Specifications of the first proposed bag</td></tr>
<tr><td>Color</td><td>Grey</td><td>Model</td><td>Chest bag</td></tr>
<tr><td>Dimensions</td><td>31.2 x 24.6 x 5.8 cm</td><td>Closure method</td><td>Zipper</td></tr>
<tr><td colspan="4">Design lines: The body is simple (reduction theory). It stabilizes the bag's overall composition, creating visual comfort and symmetry. The design is lightweight and wraps well around the user's body with a tight closure.
Technologies provided:
RFID - USB port</td></tr>
<tr><td colspan="4">  </td></tr>
<tr><td colspan="4">Specifications of the second proposed bag</td></tr>
<tr><td>Color</td><td>Blue</td><td>Model</td><td>Bum bag</td></tr>
<tr><td>Dimensions</td><td>4.6 x 30.8 x 25 cm</td><td>Closure method</td><td>Zipper and Velcro</td></tr>
<tr><td colspan="4">Design lines
The shape is regular and coherent while maintaining the proportions between the parts. The color of the supplements was standardized (black) to maintain harmony with the design style.
Technologies provided:
RFID- USB port</td></tr>
<tr><td colspan="4">  </td></tr>
<tr><td colspan="4">Specifications of the third proposed bag</td></tr>
<tr><td>Color</td><td>Blue, grey, and black</td><td>Model</td><td>Backpack</td></tr>
<tr><td>Dimensions</td><td>45.6 x 32.6 x 8.6 cm</td><td>Closure method</td><td>Zipper</td></tr>
</table>

Design lines

The body is balanced and harmonious with an oval shape, with curved corners, using color diversity to eliminate the empty space, and with a few lines to create a formal diversity.

Technologies provided

GPS – RFID- USB port

Specifications of the fourth proposed bag

Color	Green	Model	Backpack – Handbag
Dimensions	36.4 x 27 x 1.6 cm	Closure method	Zipper

Design lines

am making full use of the space of the two facades. The shape is wide cylindrical, with straight and curved perpendicular lines and visible seams to eliminate free space.

Technologies provided:

USB port- RFID

Specifications of the fifth proposed bag

Color	Pale black	Model	Bum bag
Dimensions	28.7 x 17.8 x 4.8 cm	Closure method	Zipper

Design lines

The body has straight and regular lines, and the proportions have been considered in the distribution of the front pockets to get rid of the space. The body is static with a slight chromatic contrast.

Technologies provided:

RFID - USB

Specifications of the sixth proposed bag

Color	Paige and grey	Model	Chest bag
Dimensions	31 x 19.9 x 3.7 cm	Closure method	Zipper

Design lines

The general composition of the front facade is the center of attention. There is a formal variety due to the varying sizes of the external pockets. At the same time, the back facade is devoid of any lines except for a horizontal line on the hidden pocket.

Technologies provided:

RFID - USB

There are many ways to classify smart designs based on their multiple fields and their use. The study completed by Shambour and Kha, (2021) touched on many of the technologies used to serve pilgrims during the

seasons of Hajj and Umrah. These various systems included GPS, ground tracking systems, RFID/NFC, Bluetooth, Wi-Fi, image-based scene analysis, and barcode systems to meet the needs of Hajj and Umrah pilgrims. Technological progress and modern technologies in the digital environment were not limited to exchanging information and research but rather planning to do so. Thus it has emerged as one of the most significant means of design, and due to its speed and modern techniques, it has been used in many design programs in general, particularly fashion (Ahmed, 2021). Given the importance of applying technologies and adapting them to cater to the needs of pilgrims performing Hajj and Umrah, it is essential to list the techniques and the applications associated with them that the two researchers used in designing the bags in the following form:

Fig. 2: Shows the techniques used in the bag.

Implementation of the proposed smart bag

After the two researchers developed the primary conceptualization of the design that fits the ergonomic requirements and underpins the initial steps of designing the smart bag, considering this, the two researchers implemented the bag that was highly praised by the research sample, according to the outcomes of the statistical analysis.

Fig. 3: The digital bag (photo by the researchers).

RESULTS:

Results of the first hypothesis

The first hypothesis states, "Statistically significant variances exist among the six proposed smart bag designs concerning safety, as indicated by the specialists' assessments." Moreover, to verify this hypothesis, the analysis of variance was calculated for the average scores of the six proposed designs for smart bags in safety, according to the assessments of specialists, as illustrated in the following tables:

From the **Table 2**, the value of (F) was (33,538), which represents a statistically significant value at the level of (0.01), signifying variations among the six suggested designs for smart bags in terms of safety, as per the evaluations of specialists, and to determine the direction of the significance.

Table 2: Anova test of the six proposed smart bag designs according to the specialists.

Safety	Sum of squares	MS	Degrees of freedom	(F)	Significant
Within	3490،798	698،160	5	33.538	(0.01)
Between	1249،026	20،817	60		
Total	4739،824		65		

The LSD test for multiple comparisons was applied as shown in the below **Fig. 4**. From **Fig. 4**, it is clear that there are statistically noteworthy variances between the six proposed designs for smart bags in safety; according to the assessments of specialists at a level of significance of 0.01, we observe that the “first” design proved to be the most effective in achieving safety, followed by the “fifth” design, then the "sixth" design, then the "fourth" design, then the "second" design, and finally the "third" design. There are also differences at the significance level of 0.05 between the "first" design and the "fifth" design in favor of the "first" design.

Fig. 4: Shows the average safety scores of the bag designs, according to specialists' assessments.

There are differences at a level of significance of 0.05 between the "second" design and the "third" design in favor of the "second" design. There are also differences at a level of significance of 0.05 between design "5" and "sixth" design in favor of design "fifth." No distinctions were found between the "second" and "fourth" designs. To verify the fifth hypothesis, this study tried to highlight all the problems and issues that may face those who are interested in ergonomics in terms of providing human convenience and comfort, in addition to studying the methods that achieve safety for him, as mentioned by Muhammad & Ahmed, (2020). What supports the importance of the level of safety achieved by the proposed bag during use is the freedom to move around with identification papers during the Hajj and Umrah rituals using the GPS feature, as mentioned in the study done by Karmakar and Tapan, (2020) which aimed to design a smart bag that provides safety for women, where the smart case consists of a GSM module, sound sensor, emergency switch, Arduino board, and different motors. Moreover, the study conducted by George and Saha, (2021) used the antenna (microstrip patch) and the radio frequency transmission system in the smart bag to send a message to the customer's phone through cellular communication, which helps the user locate the bag when it is lost or stolen. Moreover, the study of Shukla *et al.* (2021) presented the concept of a smart bag package to protect and monitor the bag while on the move. The present study differs from prior literature regarding the design's target audience, specifically focusing on (pilgrims performing Hajj and Umrah). In the same framework, it is clear from the proposed design of bags represented in the materials used and functional accessories. This result is consistent with many studies where the use of high-quality materials achieves a satisfactory level of safety, such as raw materials treated against wetness and dirt and hidden locking tools that protect against theft, as mentioned in the studies done by (Wang & Wang, 2020; Darwish, 2021; Harby, 2020). Moreover, the studies by (Ibrahim and Abdel-Khaleq, 2021; Samaan *et al.* 2019) employed various materials and techniques to produce bags, considering their size, shape, and the occasion they are worn. In contrast Joler *et al.* (2019) find in their study that the achievements in smart clothing have been insignificant so far due to many factors: the prohibitive cost of manufacturing such clothes and the inability to wash them. Besides, some are uncomfortable to wear because they are based on electronic textiles. As such, it is considered impractical or safe for daily wear, and this result differs from the current study because the techniques used in it are removable.

The pilgrimage itinerary follows several steps, spread over many days; this causes certain challenges due to the large crowds participating in all activities collectively simultaneously. Therefore, several studies have resulted in the importance of further evaluation of the functionality, safety, or usability of the products, such as the Tsaklis study, (2020) which confirms that among the most important basic parameters that affect the final consumer judgment on the product come "aesthetics, safety, and price." This is consistent with the current study in that "ergonomic design" means creating products suitable for safe use in proportion to the physical and mental characteristics of the user. To ensure the safety of the bag's wearer, the study by Khalil and Fadel, (2019) recommends changing the wearing side of the bag from one side to the other to reduce shoulder and neck pains. Choosing the appro-

priate bag shape to distribute the load is also preferable, as it maintains the spine's integrity. The study recommended filling the bags with the necessary needs only because filling them increases their weight, which affects the health of the body. The researchers attribute the first design's highest safety rating to the method of carrying the bag. The study conducted by Kim *et al.* (2021) confirmed that carrying a heavy bag to one side may lead to abnormal stress on the body and problems in the musculoskeletal system. It was confirmed by Chen *et al.* (2021) that carrying the bag cross-body is among the frequently used methods. Moreover, the study of Sturdy *et al.* (2021) confirmed that the abdominal muscles enjoyed greater activity during loading, standing, and walking. This result is consistent with the results of the study by Ali *et al.* (2021), the study by Dierk, (2020) and the study by Ibrahim & Al-Saud, (2021) which argued for the importance of the ergonomics of design and its influence on safety. The study examined the situation in the fashion and textile sector today, which makes it necessary to keep pace with the rapid developments in the field of pilgrim services to invest in the development and development of this sector and to update the knowledge frameworks and the structural aspects on which it is based.

In this context, the study of Abdalrdha *et al.* (2020) entitled (Smart Anti-Theft Bag) to Protect Users from Theft emphasized that emulation of the smart bag application is an essential platform for the next generation of assistive devices to help people keep documents safely inside and outside, which leads to good results in detecting attempts to open the bag through the first (20) seconds, in order to detect the identity of the thief. The system works based on the Raspberry (Pi3) board by implementing the technology that determines the speed of approaching obstacles. This was confirmed by a study by (Jokić *et al.,* 2019; Jadhav *et al.,* 2020).

The Results of the Second Hypothesis

The second hypothesis states, "There are statistically noteworthy variances among the six proposed smart bag designs based on the feedback from Hajj and Umrah pilgrims." To verify this hypothesis, the analysis of variance was calculated for the average scores of the six proposed designs for smart bags, according to the feedback of pilgrims, as illustrated in the following tables:

Table 3: Anova test of the six proposed smart bag designs according to the pilgrims.

Source	Sum of squares	MS	Degrees of freedom	(F)	significant
Within	69017.568	13803.514	5	53.960	(0.01)
Between	458926.605	255.812	1794		
Total	527944.173		1799		

It is clear from the **Table 3** that the value of (D) was (53.960), which is a statistically significant value at the level of (0.01), signifying distinctions among the six proposed designs of smart bags, according to feedback from pilgrims performing Hajj and Umrah. To identify the direction of significance, the LSD test for multiple comparisons was applied, as illustrated in the **Fig. 5**.

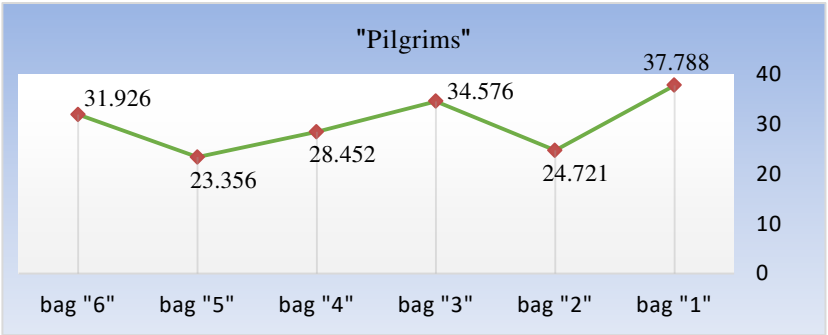

Fig. 5: Shows the average scores of the bag's designs, according to the opinions of pilgrims.

From the **Fig. 5**, there are statistically noteworthy variations among the six proposed designs for smart bags,

according to feedback from pilgrims performing Hajj and Umrah at a significance level of 0.01. We find that the "first" design was the best design, followed by the "third" design, then the "sixth" design, then the "fourth" design, then the "second" design, and finally the "fifth" design. There are also differences at a significance level of 0.05 between the "third" design and the "sixth" design in favor of the "third" design. There are no distinctions between the "second" and "fifth" designs. From the above, the statistical results indicate the validity of the second hypothesis due to the use of technology in the offered designs for Hajj bags, which provide good solutions to many problems and contribute to overcoming many difficulties. The two researchers attribute that the 1st design obtained the highest ergonomic evaluation, according to the opinions of the research sample of Hajj and Umrah pilgrims, of the availability of safety causes represented in the freedom to roam with their identification papers throughout the diverse rituals, and the availability of the location tracking feature when wearing the bag. Moreover, that was confirmed by the study of Shambour & Khan, (2021) as pilgrims performing Hajj and Umrah have access to the electronic services provided by many governmental and private sectors within the Kingdom of Saudi Arabia. The first and third designs conformed to the personal taste of the study sample. The bags were also in line with modern technology. Besides, the sample confirmed the suitability of the bag design with the local environmental and climatic factors. This result aligns with the findings of the study of Daoud, (2021) where the designer of bags for Hajj and Umrah must apply ergonomic considerations so that the pilgrims perform the tasks required during the Hajj and Umrah efficiently with satisfaction and with the least effort.

Summary of results

From the conducted study and analysis, the key findings can be summarized as follows:

The results revealed that there are differences between the six proposed designs for the smart bags in safety, according to the assessments of specialists, as the value of (D) was (33.538), which is a statistically significant value at the level of (0.01). So, we find that the "first" design was the most effective in ensuring safety. Thus, the fifth hypothesis is true. The results revealed statistically significant differences between the six proposed designs for the smart bags at a significance level of (0.01). So, we find that the "first" design received the most positive feedback from Hajj and Umrah pilgrims, affirming the validity of the eighth hypothesis.

Answers to the questions of the study

To answer the first question: "What are the statistically significant differences between the patterns of smart bags designed to achieve safety, according to the assessments of specialists?" The two researchers presented the six proposed smart bag designs to a group of fashion and textile design specialists through the study tool (the questionnaire); then, the questionnaire data was statistically processed and graphically tabulated and represented. To answer the second question: "What are the statistically significant differences between the patterns of smart bags designed to achieve safety, according to the feedback of Hajj and Umrah pilgrims?" The designs of the six proposed smart bag designs were presented through the study tool (the questionnaire) to a group of (301) Hajj and Umrah pilgrims in the Hajj season of the year (1442 AH). The questionnaire data was collected and statistically processed and then graphically tabulated and represented.

CONCLUSION AND RECOMMENDATIONS:

The study reached several scientific conclusions in the light of the discussion of the results, which are:

This study constitutes a first step in designing bags for Hajj and Umrah, as it highlighted the ergonomic measures that increase the effectiveness of performance and design. Considering the safety aspect during designing for visitors to the Holy Mosque improves the psychological state of the pilgrim and makes him feel reassured. The study sample highly accepted the proposed design of bags, which indicates that the ergonomic considerations considered when designing the proposed patterns are consistent with the purpose of the design. In light of the findings of the research, the two researchers included in this framework several recommendations, which they direct to all designers and decision-makers in colleges and institutes and service providers in Hajj and Umrah, as follows:

Using smart technologies to facilitate services provided to pilgrims performing Hajj and Umrah to service providers from the governmental, private, and charit-

able sectors. I am conducting a quasi-experimental study to test the thermal comfort of the bag implemented on pilgrims performing Hajj and Umrah. Pilgrims performing Hajj and Umrah must know the specifications when choosing bags while performing the various rituals. It is developing a detailed and comprehensive reference that gathers design criteria for bags regarding ergonomic considerations.

Proposals of the Study

The following is an explanation of future research trends that the two researchers proposed to complement the aspects of ergonomic design and intelligent design:

Effectiveness of engaging smart IOT devices to assist decision-makers responsible for Hajj and Umrah procedures. Designing functional bags for pilgrims with special needs performing Hajj and Umrah. Urging to repeat the scientific experiment of the ergo-nomic design of smart bags on other samples, such as children with special needs or KG students.

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CONFLICTS OF INTEREST:

The authors assert that no apparent financial conflicts of interest or the personal relationships could have influenced the work described in this research.

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