

**Kingdom of Saudi Arabia**

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**Prince Sattam Bin Abdulaziz**

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جامعة الأمير سطام بن عبد العزيز  
PRINCE SATTAM BIN ABDULAZIZ UNIVERSITY

المملكة العربية السعودية

وزارة التعليم

جامعة الأمير سطام بن عبد العزيز

كلية هندسة وعلوم الحاسب

قسم نظم المعلومات

## **Using data science to identify Hajj challenges**

### **Prepared By:**

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### **To Obtain**

Bachelor's in Information Systems

Department of Information Systems

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June / 2023

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## DECLARATION

We hereby declare that this project report is based on our original work except for citations and quotations which have been duly acknowledged. We also declare that it has not been previously or concurrently submitted for any other degree at PSAU or any other institution.

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## APPROVAL FOR SUBMISSION

I certify that this project report entitled "**Using data science to identify Hajj challenges**" was prepared by Nouf Saeed Al-dawsari, Ahad Hadi Al-douser, Reem Raja Al-shammri has met the required standard for submission in partial fulfillment of the requirements for the degree of Bachelor of Science in Computer Science and Engineering at PSAU.

Approved by:

Supervisor: Dr. Elham kariri

Date: 1 June 2023

## ACKNOWLEDGEMENTS

We would like to thank everyone who had contributed to successful completion of this project.

### Using data science to identify Hajj challenges

#### ABSTRACT(English)

The Saudi Ministry of Hajj and Umrah seeks to achieve its part of Vision 2030 under the program to serve the guests of Rahman. Which among its strategic objectives is to provide high-quality services to pilgrims and enrich their religious and cultural experience. In this study, we focus on classifying the challenges and difficulties faced by the pilgrims, as we conducted a qualitative study and classification data on a sample of pilgrims and identified 4 categories of challenges. and make recommendations so that the responsible authorities can benefit from this in making the right developmental decisions to overcome any of these challenges.

#### ABSTRACT(Arabic)

تسعى وزارة الحج والعمرة السعودية الى تحقيق الجزء الخاص بها من رؤية 2030 تحت برنامج خدمة ضيوف الرحمن والذي من بين اهدافها الاستراتيجية تقديم خدمات عالية الجودة للحجاج وإثراء تجربتهم الدينية والثقافية، نركز فيه هذه الدراسة الى تصنيف التحديات والصعوبات التي واجهت الحجاج، حيث أجرينا دراسة نوعية وبيانات التصنيف على عينه من الحجاج وحددنا من خلالها 4 فئات من التحديات. ثم تم بناء توصيات بحيث تستطيع الجهات المسؤولة الاستفادة منها في اتخاذ القرارات التطويرية الصحيحة للتغلب على اي من هذه التحديات.

**LIST OF KEYWORDS:** Pilgrimage, Pilgrims, services, Qualitative data analysis.

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## **Chapter 1 – Introduction**

### **1.1 Background**

Hajj in Islam is the fifth pillar of islam and is obligatory for every adult muslim once in a lifetime. As muslim go to Makkah Al-Mukarramah in a specific season of each year to perform the Hajj on the eighth day of the month of Dhul-Hijjah. It is under the supervision of the Saudi Ministry of Hajj and Umrah. Which seeks to achieve its part of Vision 2030 launched by the Custodian of the Two Holy Mosques King Salman bin Abdulaziz Al Saud. Where specifically in the year 2019 the program of serving the guests of Rahman was launched [1]. which among its strategic objectives is to provide high-quality services to pilgrims and enrich their experience Religious and cultural. and also one of its most prominent goals by the year 2025 is for the satisfaction rate of the guests of Rahman with the services provided to them during the trip to be around 85%. Therefore, we seek, through our work, to contribute to making the right developmental decisions by the responsible authorities.

### **1.2 Problem Description**

During the previous years, the pilgrims faced many challenges and difficulties while performing the rituals of Hajj. The Ministry of Hajj and Umrah also seeks to provide high-quality services to the pilgrims. Therefore, this is not considered negligence on their part. It is rather a result of the difficulty of identifying precisely the challenges and difficulties faced by the pilgrims and what are the appropriate ways to overcome them. Or you may make wrong developmental decisions.

## 1.3 Proposed Solution

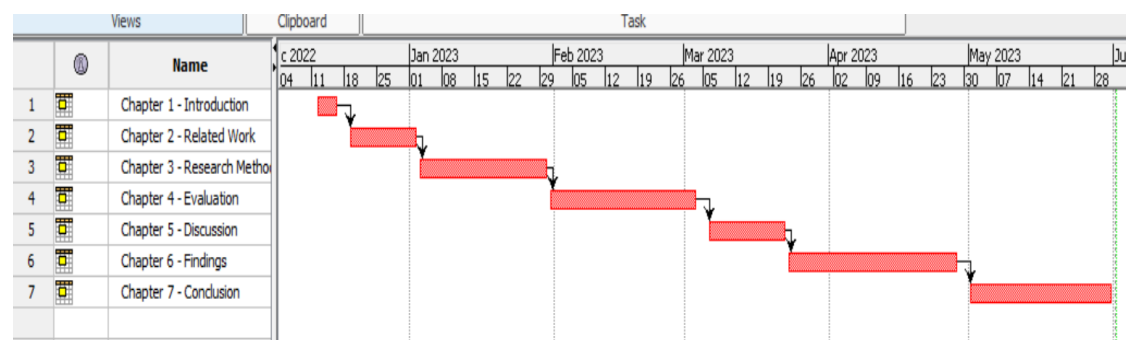
Our work will classify the challenges and difficulties faced by the pilgrims during the previous years starting from 2018 to 2022. And find relationships by analyzing the data of the pilgrims' opinions about the quality of the services provided to them by the campaigns. Then building recommendations to overcome these challenges resulting from the knowledge of the data. So that they can be used to contribute to supporting the responsible authorities on making the right developmental decisions to overcome these challenges.

## 1.4 Project Objectives

- Contribute to the development and provision of high-quality services to the pilgrims to achieve one of the goals of Vision 2030.
- Identifying the challenges facing pilgrims based on data analysis, which helps the responsible authorities to make the right development decisions.
- Contribute to help pilgrims perform Hajj rituals with ease and comfort.

## 1.5 Project Plan

Shows the tasks we have been working on.



**Figure 1.** Gantt chart.



## **1.6 Description of Remaining Chapters**

Chapter 2 will include some literature reviews, applications to serve pilgrims, and our proposed solution.

Chapter 3 we will discuss the dataset used as well as the qualitative method employed for the analysis.

Chapter 4 we will discuss evaluation including experimental Setup and evaluation metrics.

Chapter 5 we will discuss the challenges and limitations that we faced through our research, as well as the findings obtained, and some recommendations.

## Chapter 2 - Related work

Many applications and research have emerged to solve the challenges facing pilgrims. Through research we have found many gaps in research and applications including:

- Focus to solve one problem.
- Not taking the pilgrims' opinions and understanding what challenges they faced.

Maksd has provided an electronic navigation system for the no man's land mosque, facilitating access to many locations within the no man's land mosque. The main goal of this app is to help visitors to Mecca Mosque find anywhere they want in the sanctuary only [7].

The RFID system was developed through a wrist containing Hajj information, including its personal information, such as its name and health information, usually due to its low cost. Tested on 6 people and the latest output showed that it needed further development to verify [3].

Manasikana provide range of services such as exchanging currencies and sites of interest to Hajj during his trip and recording emergency numbers and the way Hajj is described and prayer dates [2]. There was an initiative to provide pre-cooked frozen and sterile meals. In order to avoid food poisoning among pilgrims - like God - and weak control of kitchens and some failure to apply hygiene requirements. It leads to mass poisoning of pilgrims, through the initiative can ensure access to pollutant-free meals, with the calories the pilgrimage needs [4].

All the studies were done without reference to the pilgrims and understanding what they needed, and every research was talking about solving one problem.

In our work, we focus on classifying challenges and difficulties through the opinions of pilgrims about the quality of service provided to them through campaigns, in order to contribute to supporting the responsible authorities in making the right development decisions.

	Maksud	RFID-Based System for Pilgrims Identification and Tracking	Manasikana Application	The Impact of Providing Ready Meals to the Pilgrims on Improving the Experience of the Pilgrims' Journey to the Holy Places
Has the pilgrims' opinion been taken?	No	No	No	No
Was the solution radical?	No	No	No	Yes
Has more than one challenge been mentioned?	No	No	Yes	No

**Table 1.** Literature Review Summary.

## **Chapter 3 - Research methodology**

This section describes the methodology used in conducting this study. In the following sections, we discuss the dataset used as well as the qualitative research method employed for the analysis.

### **3.1 Dataset**

The dataset used in this study originated from 4 sources. Firstly Haji & mutamers awareness website [5]. Haji & mutamers awareness presents the levels of campaigns and services provided, as well as the personal experiences, and opinions of pilgrims during the previous years. The opinions that will be included in our study were selected through random pilgrims in 40 campaigns during the year 2018 to 2022.

Secondly, the General Authority for Statistics [8] . As it contains statistics for the years 2018, 2019 and 2021 only. Including whether the pilgrim is Saudis or not , Pilgrim's gender , number of volunteers , and some of the services provided, including supervision and follow up services, public services, transportation services, communication services, and health services. Also, the way to reach Makkah whether it is air, land, or sea. Third, As for the statistics for the years 2020 and 2022, they were found from some news sites such as CNN. Fourthly a questionnaire [9] was published to survey the challenges facing pilgrims the number of answers was 34. Where the dataset consisted of 305 rows representing opinions. And 16 columns, where the first column represents the username, the second is the campaign link, the third is nationality, the fourth is the opinion of the pilgrim, and the remaining 12 are the categories that will be discussed in Chapter 5.

### **3.2 Qualitative analysis**

In this study we used the content analysis technique [6]. Where the opinions of the targeted sample, who are the pilgrims, were collected by searching for campaigns (see Figure 2). Then these opinions that appeared on Al-Hajj's comment (see Figure 2). Were identified and classified into preliminary categories. As these primary categories, after being revised and discussed several times, contributed to identifying, organizing, and establishing main categories.

Data collection, creation of preliminary categories and main categories, and data analysis were done manually and with the help of spreadsheets (see Figure 3). And also with the help of open data at the general authority for statistics website.

Show  entries  :SearchReset

Title
شركة نماء البركة لخدمة حجاج الداخل
شركة سدانة لخدمات حجاج الداخل
شركة نور النسك لخدمات الحجاج
شركة بدر يوسف الأحمد وشريكه - ترخيص جديد 10193
شركة محمد قديمي وشريكه
شركة مكارم لخدمات الحجاج
شركة فاخر منصور السهيبي وشريكه

Searching for the campaign

ريان  6 شهر مضت

التقييم العام للحملة :

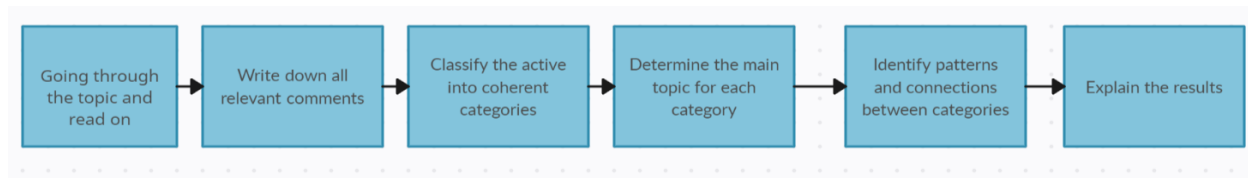
اسوء حمله من ناحيه المعيشه تنظيم المخيم التكييف النظافه الحمامات جميع الخدمات سيئه

مستوى التفويج الى المشاعر	ضعيف
مستوى التنظيم	ضعيف
هل تنصح بالحملة؟	لا

أضف رد 0

Opinion pilgrim

**Figure 2.** The figure shows the method of searching for campaigns, in addition to the comment of one of the pilgrims about the services of a particular campaign.



**Figure 3.** Steps to compile and analyze datasets.

## **Chapter 4 –Evaluation**

This section describes the evaluation of the algorithms used in the search.

### **4.1 Experimental Setup**

This study was based on the General Authority for Statistics to support the Rahman Guests Program by increasing the percentage of assistance each year and increasing the readiness of sacred feelings and supporting incoming pilgrims. The first phase of this study was the search for the number of pilgrims. Statistics for 2018, 2019, 2021 were found on the General Authority for Statistics and 2020, 2022 were found on some news sites such as CNN. (See Figure 4). In the second phase, the opinions of the pilgrims were collected during the past five years through the Haji & mutamers awareness website, in addition to a questionnaire published for the pilgrimage, and all the data mentioned in the database were organized using Excel. (see Figure 5).

Classification algorithms have been applied which is the process of putting different types of organisms together. When we classify anything, we divide it into categories by its attributes [10]. The classification was used data which

1. Data classification was intended to help us identify challenges accurately.
2. Data collected from Haji & mutamers awareness website and from a questionnaire published.
3. The database collected contained 305 comments from El Hadj and the number of challenges represented in 12 categories.
4. Classified 4 main categories.
5. Some recommendations have been made to assist officials to solve challenges.

Years	Saudis	Non-Saudis	Males	Females	Supervision and follow up Services	*Public Services	Health Services	Transportation Services	Communication Services	volunteers	Air	Land	Sea
2018	209,415	390,693	1,334,080	1,018,042	7,310	192254	32579	47,765	7,411	9,975	1,656,936	85,623	16163
2019	211,003	423,376	978,987	876040	6,336	257763	30908	38,750	7,098	8,564	1,741,568	96209	17250
2020	1,000	0	0	0									
2021	33,034	25,711	32,954										
2022	119,434	779,919	486,458	412,895	228,721	6,734	21,062	19,817	3,294	100,570	738,680	45,210	6,029

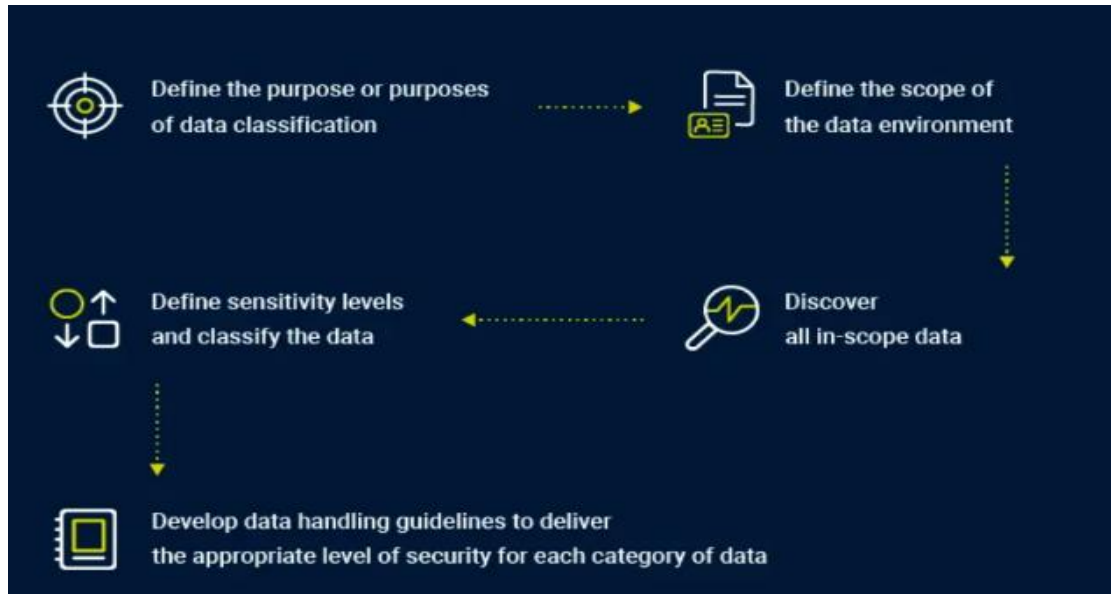
**Figure 4.** The figure represents the data obtained from the General Authority for Statistics and CNN.

comment	getting lost	Poor food service	Poor camp services	Prices are high	supervisors are bad	Lack of train
235 hey need to change chef		1				
236 lack of respect in dealing			1			1
237 he food is bad			1			
238 he food is bad. The shelves that carry luggage, from me felt The bus is down			1			
239 he arrival of the bus is too late for the date of the gathering Hygiene tools and wipes are few and			1			
240 he arrival of the bus is too late for the date of the gathering Hygiene tools and wipes are few and			1			
241 he arrival of the bus is too late for the date of the gathering Hygiene tools and wipes are few and			1			
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252 he arrival of the bus is too late for the date of the gathering Hygiene tools and wipes are few and			1			
253 he arrival of the bus is too late for the date of the gathering Hygiene tools and wipes are few and			1			

**Figure 5.** The figure represents the dataset that contains the opinions of the pilgrims.

## 4.2 Evaluation metrics

During this research several algorithms were used. First, the qualitative analysis, as this analysis deals with data that is difficult to collect and measure. Where the process began to collect research data, then what was collected was evacuation into the Excel program, which helped us clean the data (see Figure3). Secondly, classification data, which helps to estimate the value of data, identify its weaknesses, and establish controls to reduce risks. It was used to analyze the pilgrims' comments as described in the previous paragraph, and also using the cheat sheet method (see Figure 6). All the mentioned data is represented in the form of a dashboard (see Dashboard).



**Figure 6.** This figure shows the steps of data classification process.

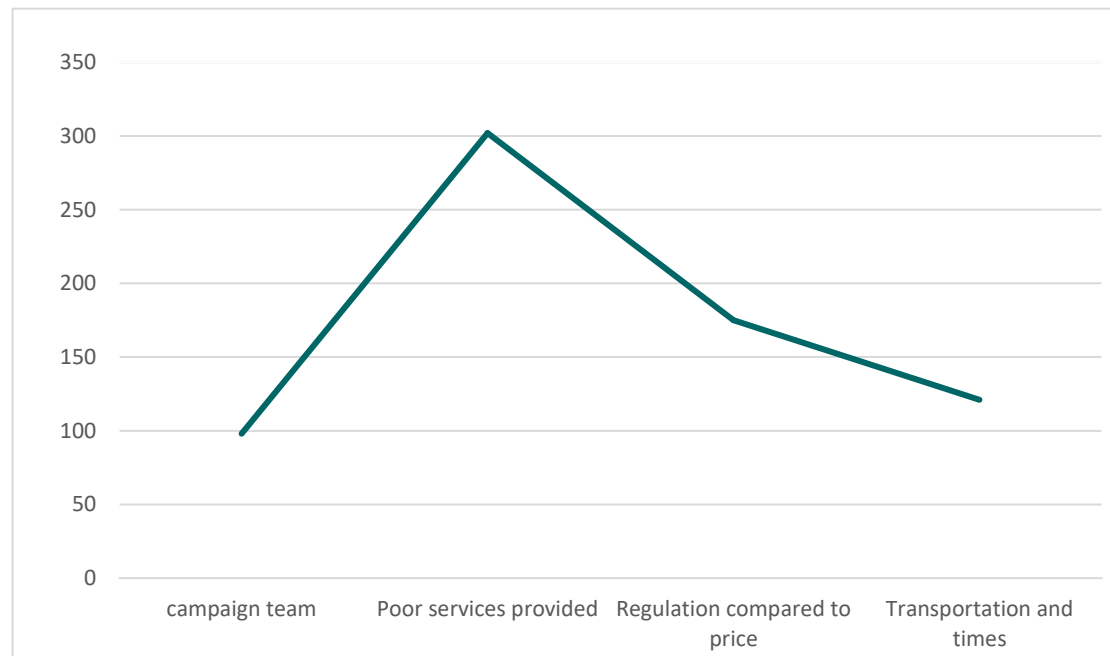


## Chapter 5 – Discussion

This section describes the discussion of the challenges and limitations that we encountered through our research, as well as the findings obtained, and some recommendations to overcome the challenges of Hajj.

### 5.1 Findings

By the methodology set out in Chapter 3, 4 categories have been identified as shown in (Table 2). Each of these categories will be discussed below. The category of poor services provided was higher because it contained 302 comments (see figure7), including medical, food, and camp services. Then regulation compared to price containing 175 comments (see Table 2) on prices is high, poor regulation, no regulation, and low level of service. After that Transportation and times by 121 (see Table2) getting lost, lack of transportation, and accurate flight schedule. Followed by the campaign team (see Table 2) Supervisors are bad, there are no advocates.



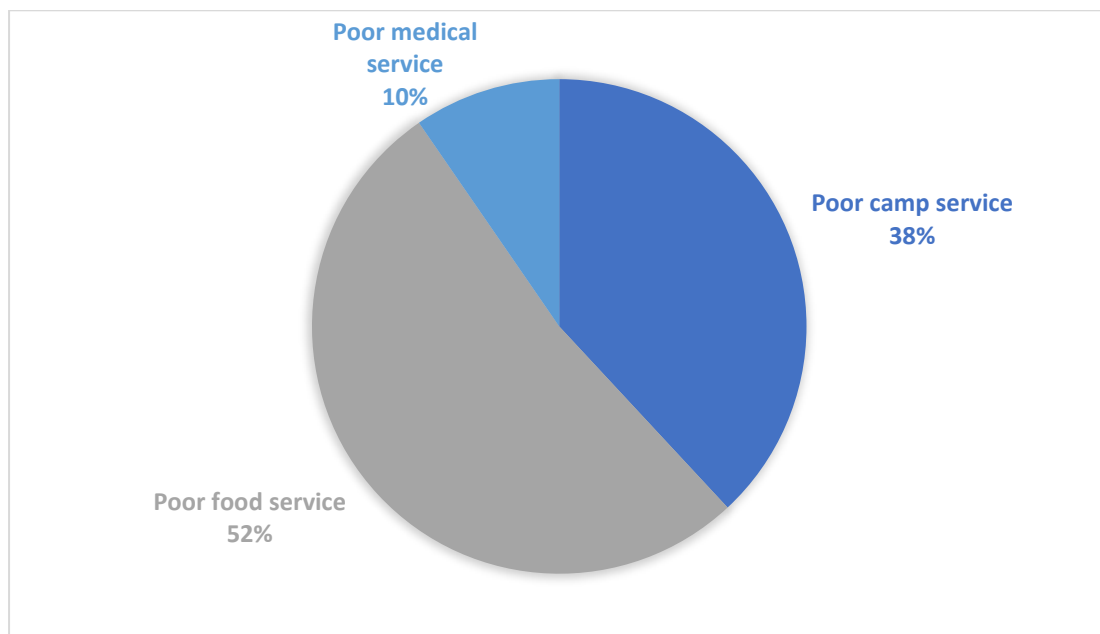
**Figure 7.** This figure represents a breakdown of categories.

<b>Hajj challenges</b>	<b>Total number</b>
<b>1- Poor services provided</b>	<b>302</b>
<ul style="list-style-type: none"> <li>• Poor food service (158)</li> <li>• Poor camp service (115)</li> <li>• Poor medical service (29)</li> </ul>	
<b>2- Regulation compared to price.</b>	<b>175</b>
<ul style="list-style-type: none"> <li>• Prices are high (30)</li> <li>• Poor organization (115)</li> <li>• There is no regulation (13)</li> <li>• Low level of service (17)</li> </ul>	
<b>3- Transportation and times</b>	<b>121</b>
<ul style="list-style-type: none"> <li>• Getting lost (24)</li> <li>• Lack of Transportation (64)</li> <li>• Accurate flight schedule (33)</li> </ul>	
<b>4- Campaign team</b>	<b>98</b>
<ul style="list-style-type: none"> <li>• Supervisors are bad (87)</li> <li>• There are no advocates (11)</li> </ul>	

**Table 2.** Basic information for the categories, the number shown in parentheses is the frequency of the pilgrims' opinion of a particular service.

### 5.1.1 Poor services provided

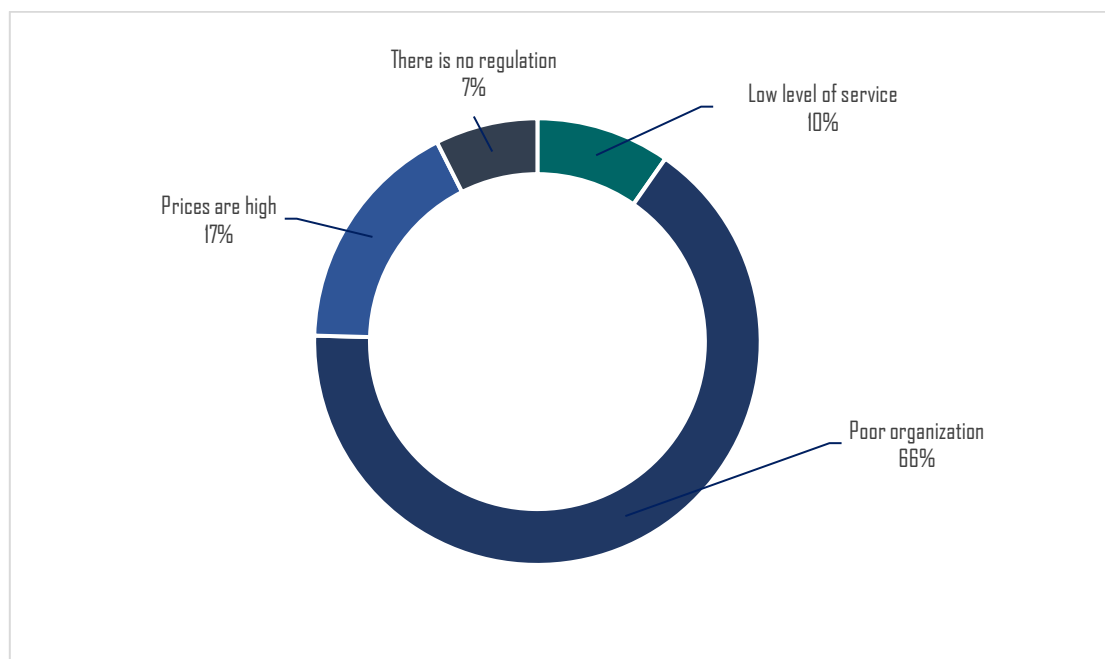
We found that the category of poor services provided got the largest number of comments with a total of 302 comments. As this category represents the biggest challenge for pilgrims, as shown in (Figure 7). Poor food service was represented by (52%), where the opinions of pilgrims were regarding its cleanliness, availability, and ease of access when needed. Followed by poor camp service (38%), where pilgrims' opinions were often about the neglect of cleanliness, and this often leads to the spread of the enemy, as well as poor sleeping places and how comfortable they are. When see the percentages shown in (Figure 8), medical service got (10%), and this is a good point for the importance of the pilgrim's health as well as the development of the health sector.



**Figure 8.** Categories of poor services provided

### 5.1.2 Regulation Compared to Price

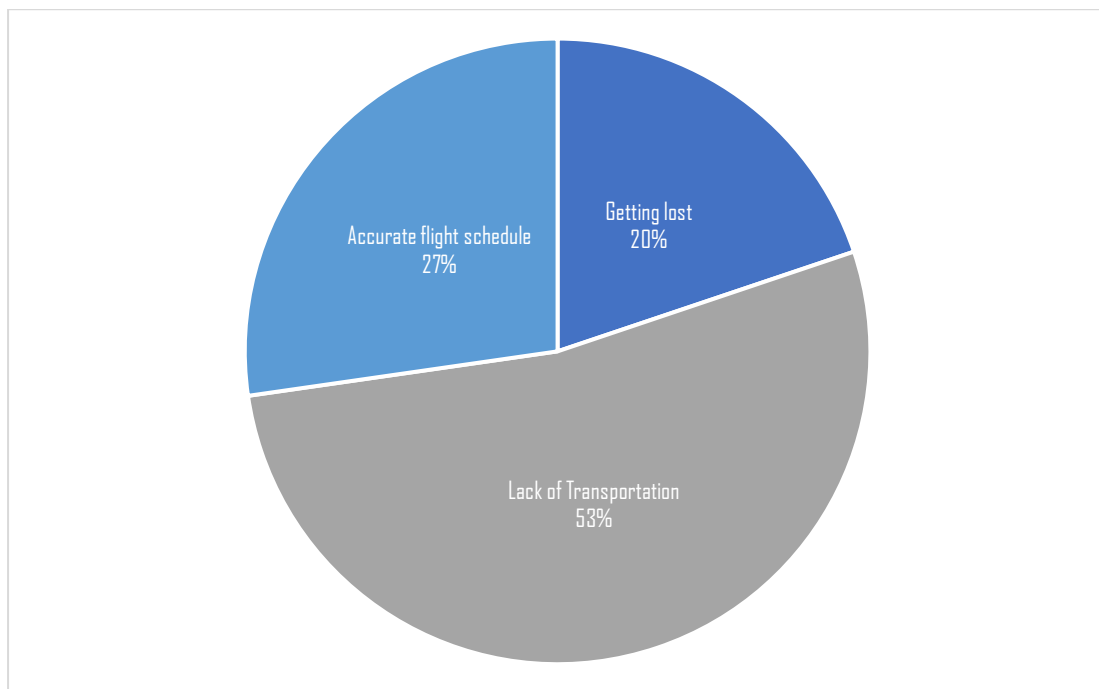
Regulation compared to price This category is rated as the second biggest challenge for pilgrims with 175 comments. When looking at (Figure 9) we find poor organization reached (66%) where the opinions of pilgrims were about the lack of an organized schedule in terms of catering times or knowing when to perform rituals or periods of absence. Which led to there being no regulation and a low level of service compared to the high price paid for better organization and services.



**Figure 9.** Categories of Regulation compared to Price.

### 5.1.3 Transportation and Times

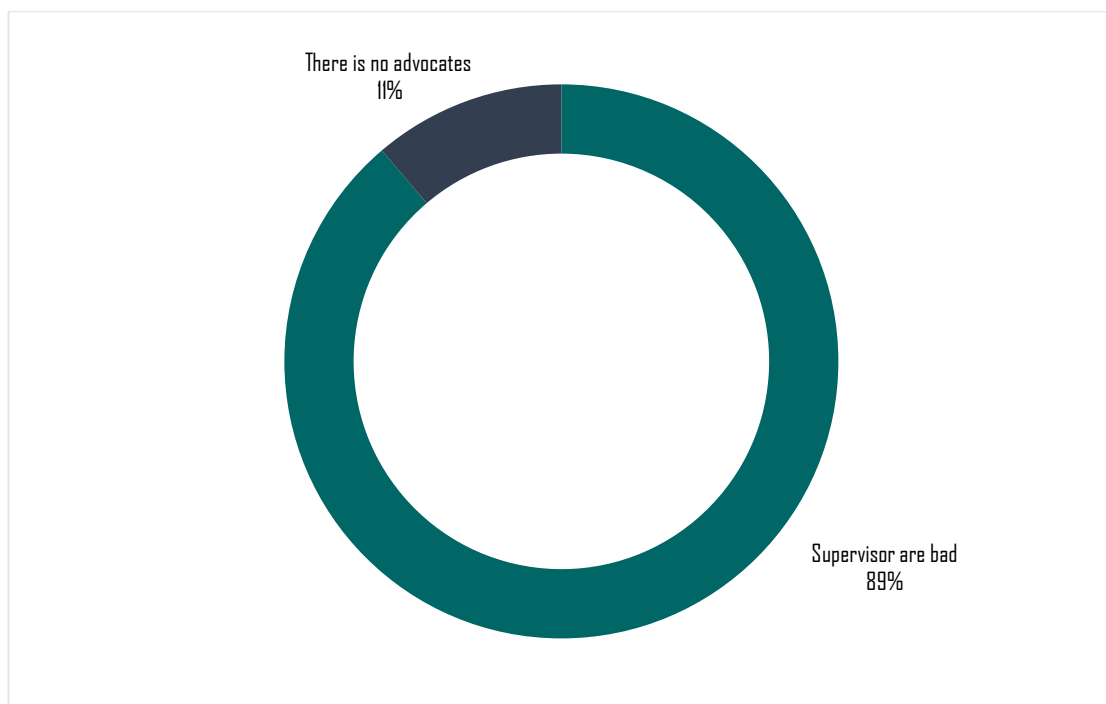
The transportation and times category reached (121) comments which makes it the third biggest challenge for pilgrims. (As shown in Figure 10) as (53%) of the pilgrims' opinions were about the lack of means of transportation. And (27%) about the lack of organizing an accurate schedule for transportation times between the rites. Which led to the loss of pilgrims, specifically non-Arabic speakers by percentage (20%).



**Figure 10.** Categories of transportation and times.

### 5.1.4 Campaign team

The last category of Hajj challenges is the campaign team, which got (98) comments. By looking at ( see Figure 11) (89%) of the pilgrims' opinions revolved around their annoyance with the bad supervisors, as they did not seem interested in guiding the pilgrims or organizing their schedules and promoting them for the rituals. While the remaining (11%) were about there being no advocates, as some pilgrims expressed their need for an advocate since it is a religious occasion and needs guidance with some rites.



**Figure 11.** Categories of the campaign team.

## **5.2 Challenges and limitations**

This study faced some challenges. Firstly, Lack of reliable sources to collect data from the intended sample. Since we started our project before the Hajj, it was impossible to get a modern study sample to be tested. Hajj was also limited to specific categories in previous years due to the Coronavirus, which resulted in the difficulty of having reliable data from reliable and modern samples. secondly, Lack of sufficient resources for scientific study. One of the most prominent difficulties we faced and took a lot of time was the lack of scientific studies that are fully or partially related to the subject of our study. Third, Not having enough time, Since the hajj is for a specific period and it is far from the period in which our study should be presented, this leads to the difficulty of obtaining more up-to-date data. Fourthly, Difficulty formulating results, It took a lot of time to come up with an appropriate and simple way to formulate the results that we got after analyzing the data.

## **5.3 Recommendations**

Developing a site that receives the opinions of pilgrims and has it approved by decision makers to know most of the challenges that pilgrims face to overcome them. By looking at (Figure 12), we developed a design for a site that receives the opinions of pilgrims by default, and we plan to work on it in the future. Setting up a chatbot to help pilgrims particularly who do not speak Arabic and know what they need. (see Figure 13) We made a chatbot in a very simple way to get the idea across Which we plan to develop in the future to solve all challenges. And because the pilgrims are the owners of the real experience, their opinions must be taken seriously, and therefore the challenges will be known and then a solution will be reached for it, and also the pilgrims must seek the services of the guests of Rahman for help them perform this duty in a comfortable and safe way.

وزارة الحج والعمرة  
MINISTRY OF HAJJ AND UMRAH

Name

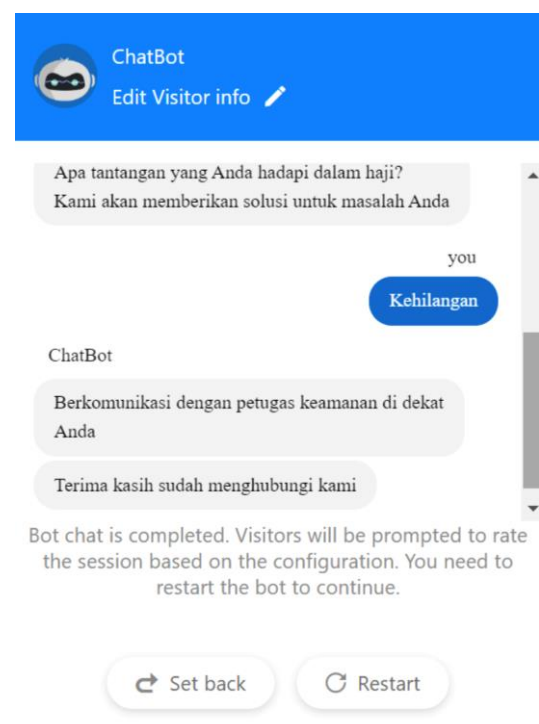
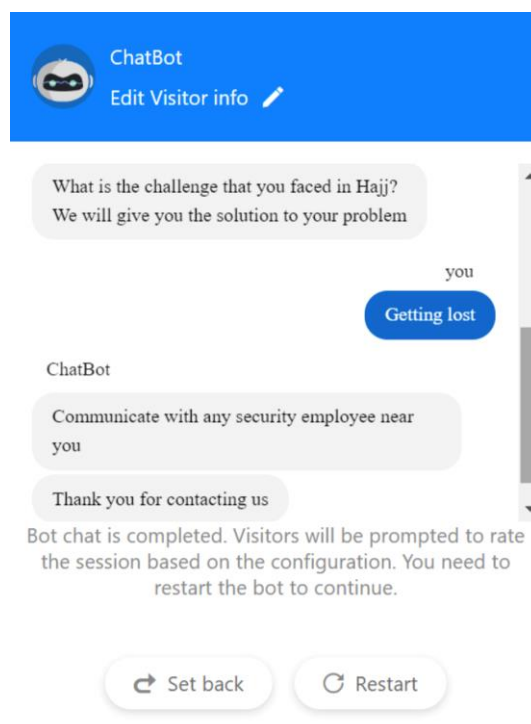
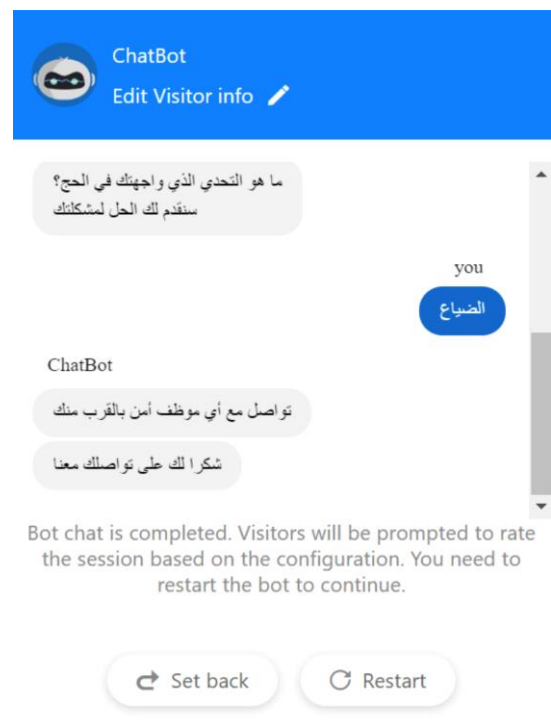
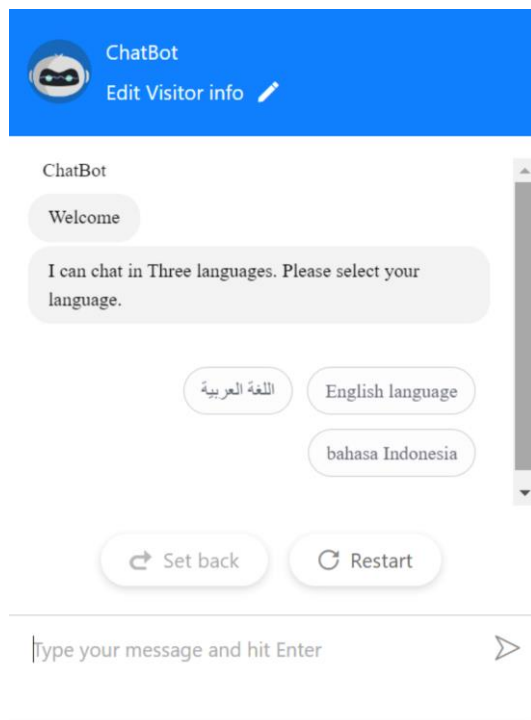
Nationality ☐ inside Saudi Arabia ☐ Outside Saudi Arabia

Hajj year

What do you think of the services provided?

**Figure 12.** Visualization of the site to collect the challenges of Hajj.





**Figure 13.** Chatbot.

## **Chapter 6 – Conclusion and future work**

Our work focuses on classifying the challenges and difficulties faced by pilgrims in previous years. Where they can be used to contribute to supporting the responsible authorities in making the right development decisions to overcome these challenges. Therefore, one of the strategic objectives of the Rahman guests service program will be achieved, which is to provide high-quality services to pilgrims. Where we first reviewed the research's that deals with providing services to pilgrims and compared them in our work. Secondly, data was collected from 4 sources the Haji & Mutamers awareness website, General Authority for Statistics, CNN, and form . which allowed us to analyze 305 opinions of pilgrims, then classify them into 12 categories, and then group them into 4 main categories. Namely Poor services provided, as it represented the biggest challenge for pilgrims, followed by Regulation compared to price, transportation and times, and Campaign team. Then some recommendations were built to overcome these challenges.

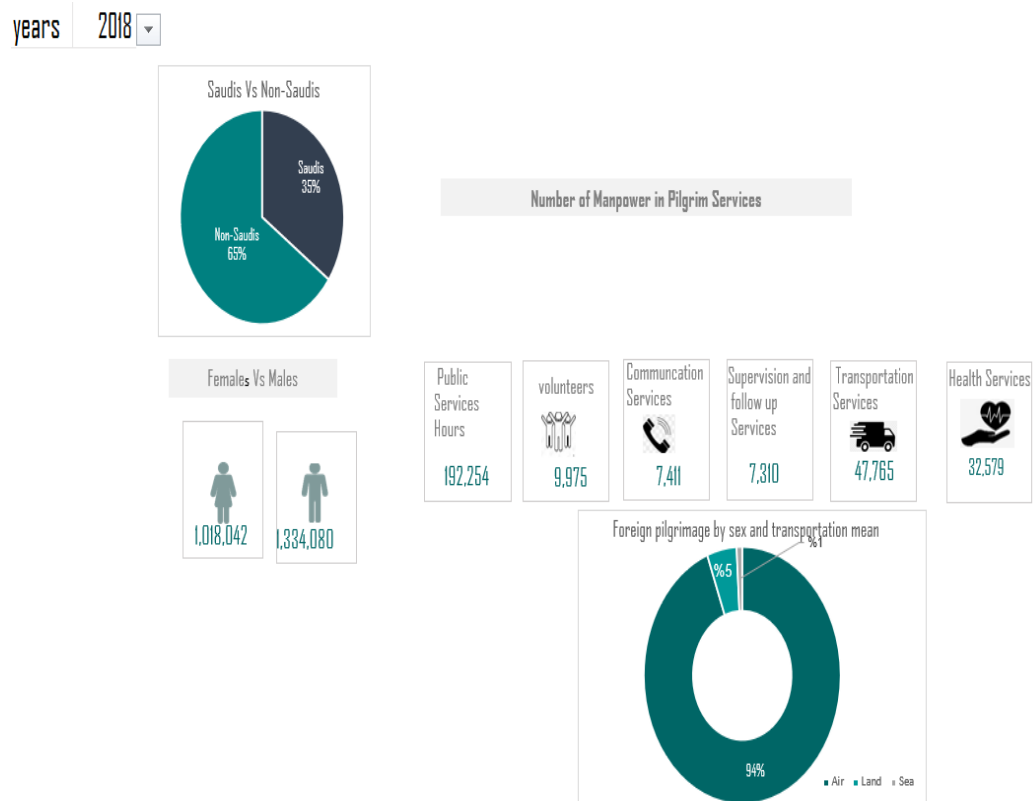
We also plan in the future to develop a site that receives the opinions of pilgrims to know the challenges they face and to be overcome by the responsible authorities. And also the development of the chatbot.

## Chapter 7 - References

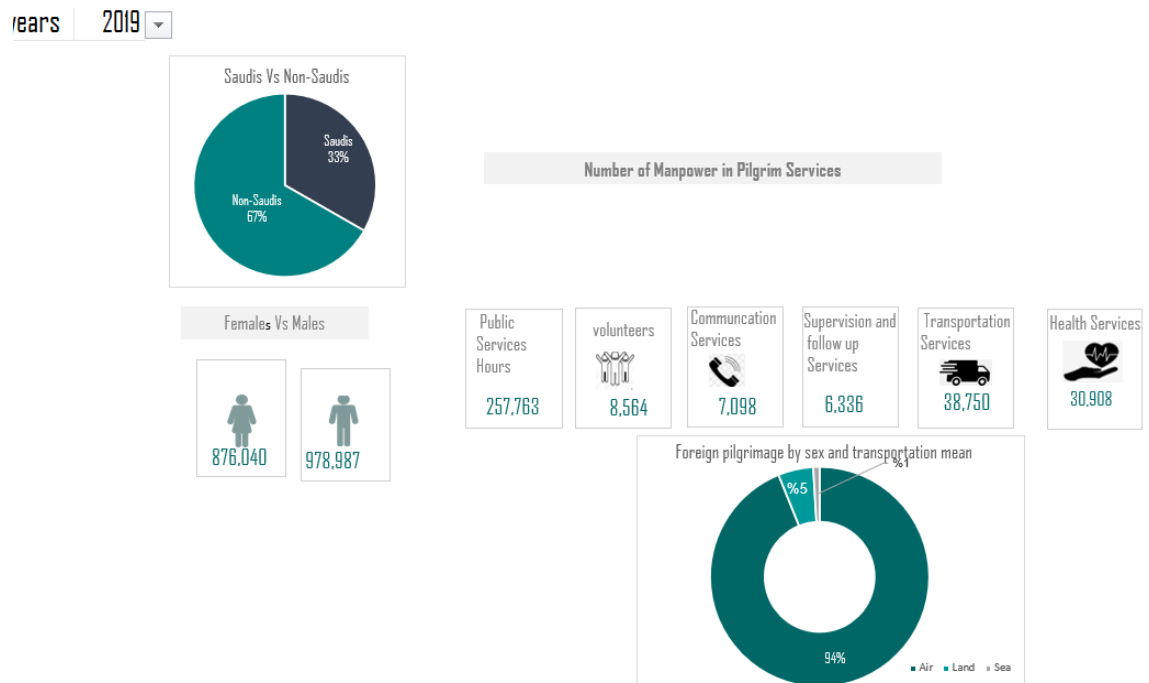
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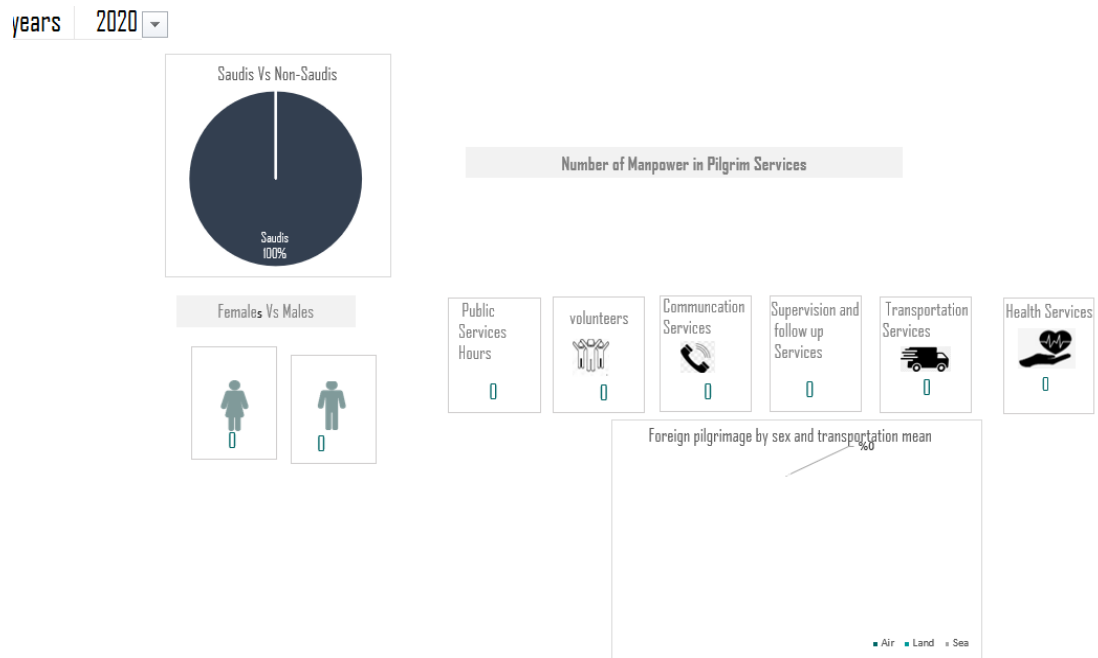
# Dashboard



**Figure 14.** This dashboard shows the number of pilgrims, their genders and nationalities for the year 2018, the number of services provided, and the way to reach Makkah Al-Mukarramah.

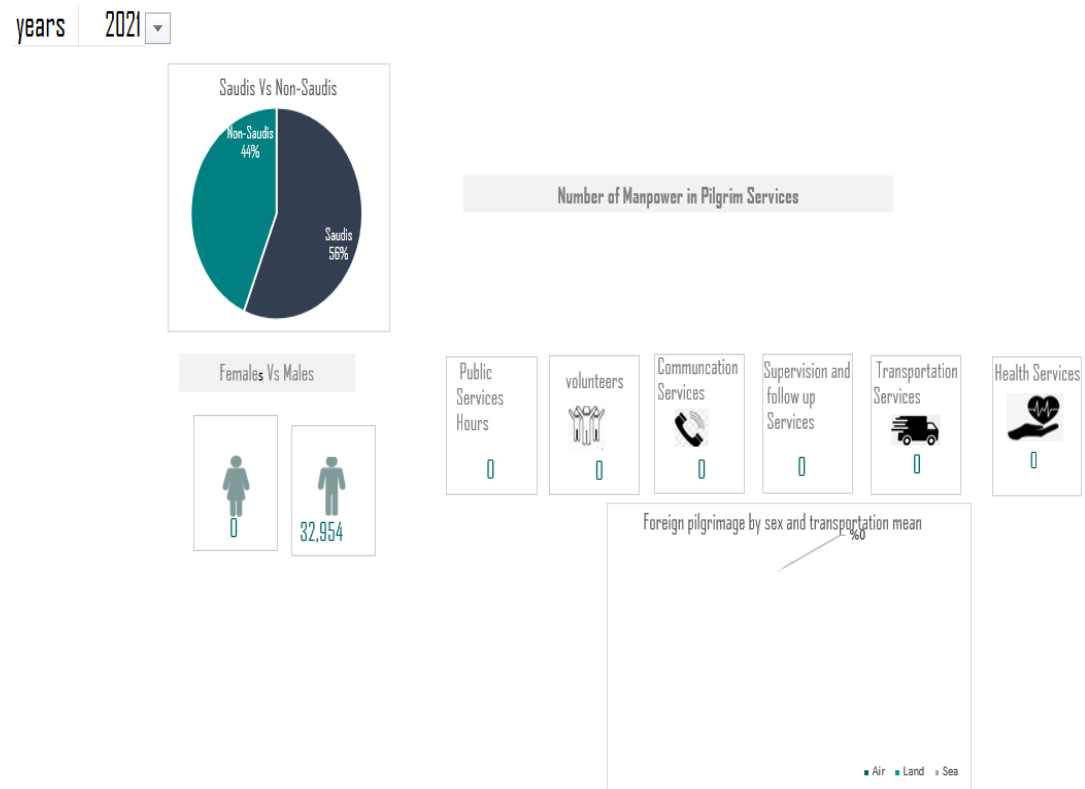


**Figure 15.** This dashboard shows the number of pilgrims, their genders and nationalities for the year 2019, the number of services provided, and the way to reach Makkah Al-Mukarramah.



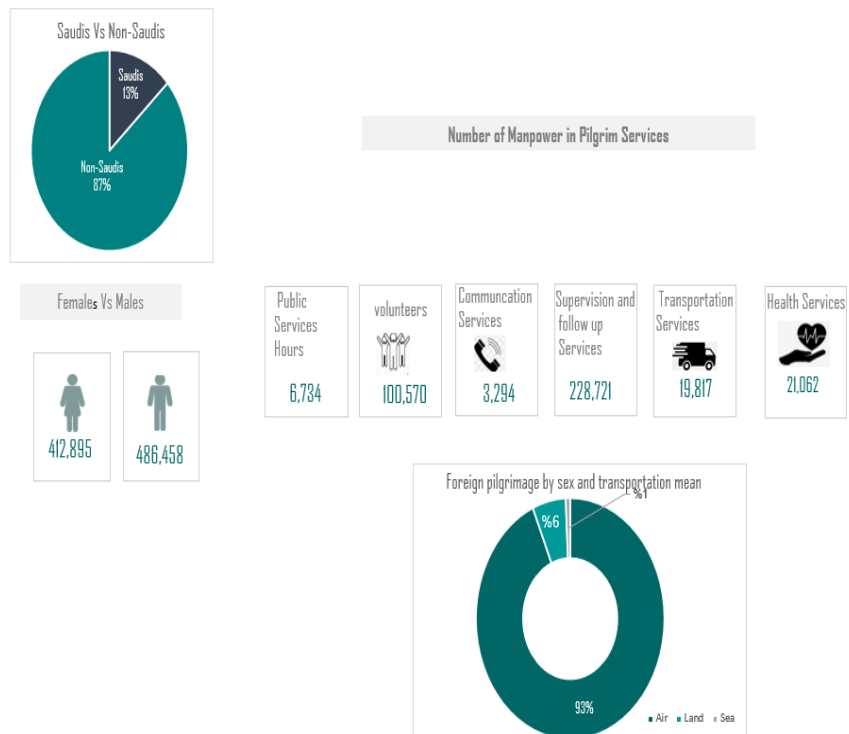
**Figure 16.** This dashboard shows the number of pilgrims, their genders and nationalities for the year 2020, the number of services provided, and the way to reach Makkah Al-Mukarramah.



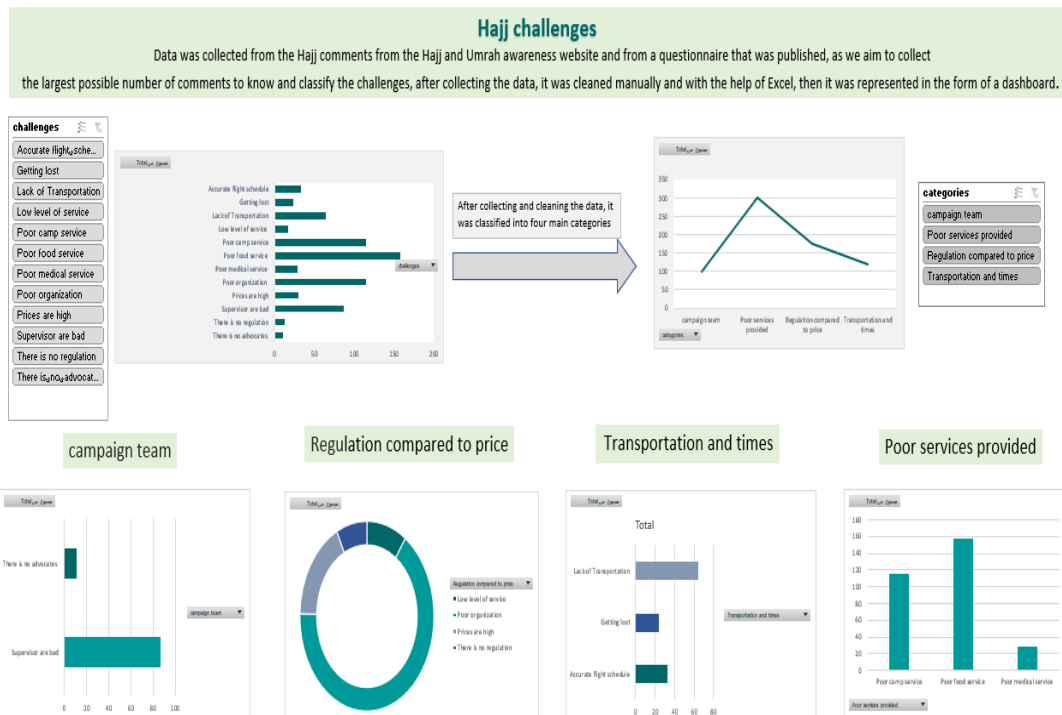


**Figure 17.** This dashboard shows the number of pilgrims, their genders and nationalities for the year 2021, the number of services provided, and the way to reach Makkah Al-Mukarramah.

years | 2022



**Figure 18.** This dashboard shows the number of pilgrims, their genders and nationalities for the year 2022, the number of services provided, and the way to reach Makkah Al-Mukarramah.



**Figure 19.** This dashboard represents challenges and categories.