

## Study of Form, Color, and Activity Mapping for Fully Autonomous Passenger Drone Interiors

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### Abstract

Passenger drones are currently being developed in some countries to solve the purpose of point-to-point commute. Even though passenger drones have been developed and are developing in some countries, the studies done on designing the interiors have focused on the western audience. Therefore, an in-depth study is required to create cabin interiors for passenger drones, which can suit the country's varied aspects like India. This paper focuses on the user requirements based on a survey of the color, form, and possible future inflight activities conducted for interior design and development for passenger drones. The methodology used was a survey among the potential users. To understand the interaction, color, and form, and map the needs and activities of the passengers in a fully autonomous passenger drone, literature review on proposed activities, future trends of color and form forecast of the transportation industry was studied and used as an input for questionnaire design. An online survey was conducted to gain insights on capturing the futuristic travel experience and activities when inside a fully autonomous cabin. Questions related to the future prediction of automotive trends and possible activities within the cabin were asked. Quantitative data analysis was done after converting the data to a pivot chart. The paper explores and discusses an overview of the future form and color trends and mapping future possible inflight activities in a fully autonomous passenger drone. It also discusses the various possibilities that can be explored to design and develop a passenger drone interior cabin.

**Keywords:** Transportation, color and form for autonomous passenger drones, interaction design, futuristic vehicle design

### 1 Introduction

The evolution of flying vehicles started in 1980's with Skycar, developed by Moller International. With technological advancement, several companies have launched different prototypes that are capable of Vertical Take Off and Landing (VTOL). As VTOL vehicles do not require a runway and can accommodate one or more passengers, thereby being more efficient than a helicopter (*Changing the Future of Mobility with Passenger Drones - FutureBridge*, 2020).

Drone development has come a long way from being developed as a weapon to now being emerged as a transportation mode. Understanding the new problems and user needs before designing the drone specially for a country like India, will drastically improve the passenger drones' public acceptance and system-level working (Rautray et al., 2020). Research shows that safety is a critical factor that plays an important role (Aydin, 2019). "User diversity strongly influences both acceptance and perceived barriers" (Lidynia et al., 2017).

The luxury segment air travel interior space emphasizes giving the passenger the highest level of comfort. The compact cabin sometimes can lead to one of the stress factors. The futuristic aircraft cabin design is to give a real-time adaptive environment experience to the passenger and can adapt to the needs and moods of the passenger (David, 2004).

Interior space plays a vital role while purchasing any vehicle. The exterior aesthetics define the form of the brand, whereas the vehicle's interior design makes the purchase. According to the article (Moore, 2020), nearly 54.8% of people decide to purchase a vehicle looking at the interiors. The three primary psychological criteria for interior design are economic, spiritual, and social hierarchy. The safety and practicality of the design are also essential. The Interior of the vehicle should be able to define the passenger's personality and thus raise their self-esteem.

The main factors that need to be highlighted while designing the vehicle interiors are Functional storage, spatial aesthetics, digital device, comfort, safety, and cleanliness (Tu et al., 2018).

This research paper focuses on the user requirements based on a survey of the color, form, and possible future inflight activities conducted for interior design and development for passenger drones. The purpose of this paper is to study the existing literature on interior design aspects of a fully autonomous passenger vehicle which is then used as inputs for developing an online survey to gain insights on capturing the futuristic travel experience and activities when inside a fully autonomous cabin. The paper explores and discusses an overview of the future form and color trends and mapping future possible inflight activities in a fully autonomous passenger drone. It also discusses the various possibilities that can be explored to design and develop a passenger drone interior cabin.

## 2 Literature Review

Literature review plays a critical role as it distinguishes what has been already done and what needs to be done, helps in discovering variables related to the topic, acquiring a new perspective, identifying various practices and identifying the methodology used for the research, establishing a context for the statement of problem, rationalizing the significance of the problem, historically placing the research to show familiarity with the state of the art developments (Boote & Beile, 2005).

### 2.1 Literature review on study of futuristic fully autonomous interior trends

Is it predicted that the futuristic concepts would be only passenger-centric, offering various seamless experiences to the user. (Moore, 2020) states the importance of interior design in a fully autonomous passenger vehicle.

Volvo 360c, a futuristic, fully autonomous car concept, has identified four potential activities that people will prefer on the go. These are the sleeping environment, mobile office, living room, and entertainment space (Korosec, 2018).

Renault designers state that a car is a place where you can isolate yourself or be more connected. Therefore, the future concept cars should have various themes designed for passengers on the go. The design for the future vehicle should follow "One design, several functions" (Lambrichts, 2019).

The interior design should follow form follows function, making it look modular and a complete smart product (Simmonds et al., 2019). The vehicles should focus on seamless interactions and minimal design solutions. The article predicts that facial recognition will play a huge role while confirming the ride. It also lays down various scenarios where once the ride for the passenger is booked, the interior adapts according to the passenger's trip.

The three factors to gain trust and social acceptance of passenger drones are: (1) The vehicle should know the journey details and show the immediate surroundings to make the passenger feel safe. (2) Interaction with the vehicle should be seamless. (3) The premium feel of the interior makes the passenger safe and comfortable (Kahl, 2020).

### 2.2 Literature review on future color trends

Vehicle color plays a major role during purchasing. Each year a global research team conducts and uncovers the color trends for that particular region. This determines the customer's vehicle color preferences for the next five years. Chiharu Matsuhara, head of design, Asia Pacific, states that the people of Asia Pacific have become more realistic and positive." Asia Pacific's key colors reflect a positive, flexible attitude for change, action, and the future. They are warm and emotional colors. They are not black or white, but more blurred and floating, like human emotion" (BASF's 2020-2021 Automotive Color Trends, n.d.).

It is evident from the literature that there is minimal research on interior design aspects, user experience needs, and activity mapping for fully autonomous cars. The color trends specified are for the entire Asia Pacific region, which may differ country wise. Hence, there is a need to do in-depth research on the interior design aspects and user's requirements in the fully autonomous passenger drone in flight. Therefore, these are the starting points of the present study where this paper aims to bring out the travel experiences and behaviour of the user needs to be designed for fully autonomous passenger drone cabin interiors.

## 3 Methodology

The methodology used in this research paper is survey design to gain better insights of the prospective users to enhance their travel experience. A questionnaire was developed and circulated to understand the futuristic color and form trends which could be used in developing the interior cabin space of fully autonomous passenger drones. The questionnaire also aimed to capture the various user activities which could be later used for designing various themes for better user experience.

### 3.1 Survey design

An online user survey was conducted to gain insights into the travel experience of the future prospective users of the passenger drone. The questionnaire consisted of 3 parts. Part one dealt with the demographic data and travel experience, the second part dealt with the activity mapping, and the last part aimed to collect the choice of interior design trends. Since participants have never seen or experienced passenger drones in India, direct questions related

to the drone cabin were avoided. Questions were made to map the travel experiences and get details of the choices of designs preferred in the current everyday commute to the workplace.

**3.1.1 Demography and travel experience:** The questionnaire collected demographic details like age, gender, location, profession, annual income, the time required to commute to the workplace, mode of transportation, and the average weight of the luggage carried every day to the workplace.

**3.1.2 Activity mapping:** The questionnaire was designed to gain insights into the activities while commuting to the workplace. Multiple choice questions acquired the various current activities of the participants on the go. The questions were mainly based on three aspects, i.e. work, spend time with family/friends, and relax.

**3.1.3 Interior design trend analysis:** The questionnaire also collected the participant's preferred interior design trends. Three choices were given to participants. Each choice had a collage of pictures. The three choices were based on the following design forms and colors which were sporty, minimal, and posh as shown in Fig 2. These design trend keywords were not mentioned in the questionnaire so that it does not influence the participants.

The questionnaire was circulated through email to get a maximum number of participants. The focus was on urban city residents of India, where traffic congestion plays a vital role in everyday commute, and on higher salaried people who will be able to afford this drone.

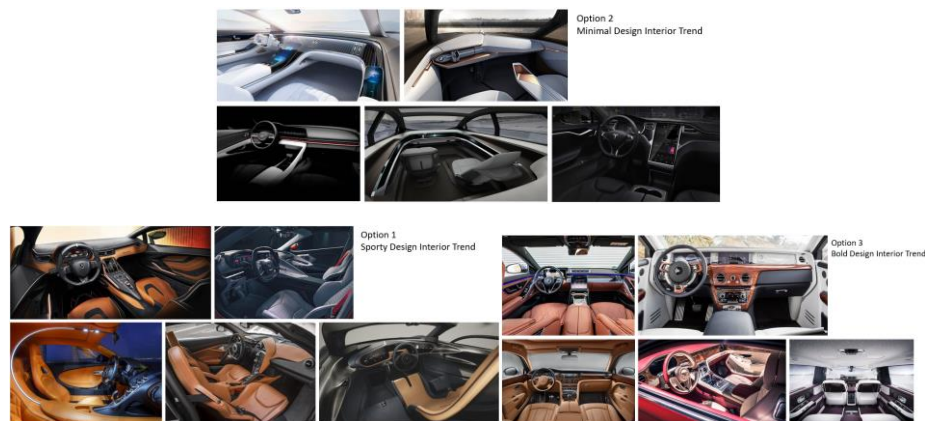


Fig 1: Interior Forms and Color options in the survey

#### 4 Data representation

An online survey was conducted at pan India level. A total of 126 valid responses were received. Convenient sampling was done, and the questionnaire was given to the working class, which excluded students. 95 participants (75.4%) were male, 28 participants (22.2%) were female, 2 participants (1.6%) were LGBTQ community and 1 participant (0.8%) chose not to disclose the gender. The age in the sample ranged between 24 years to 74 years. 5.6% of the participants had their annual income in the range of 0-6Lakhs (L), 37.3% of participants had an annual income between 6-15L, 34.1% of the participants had an annual income between 15-30L, 8.7% of the participants had an annual income between 30-50L, and 14.3% of participants had an annual income between 30-50L.

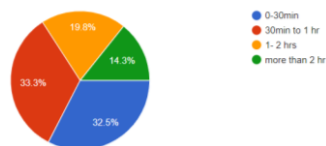


Chart 1: Time Spent on Everyday Commute

According to chart 1, 32.5% of participants spend 0-30min, 33.3% of participants spend 30min – 1hour, 19.8% of participants spend 1-2 hours, and 14.3% of participants spend more than 2 hours commuting daily to their workplace.

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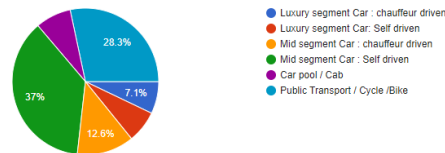


Chart 2: Everyday Commute to Workplace

According to the chart 2, 7.1% of the participants travel in chauffeur-driven luxury segment car, 7.1% travel in self-driven luxury segment car, 11.9% travel in a mid-segment chauffeur-driven car, 37.3% of the participants travel in mid-segment self-driven cars. 7.9% travel via carpool or cabs, and 28.6% travel in public transport and bikes for their everyday work commute.

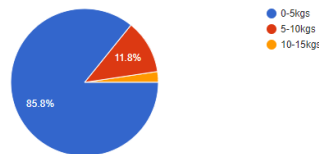


Chart 3: Average weight of luggage carrying while commuting

According to Chart 3, 85.7% of the participants carry 0-5kgs hand baggage, 11.9% carry 5-10kgs of hand baggage, and 2.4% carry 10-15kgs of hand baggage to their workplace daily.



Table 1: Activities on the Go

While capturing the responses of the participant's activities on the go, the majority of participants like to attend calls, listen to music, view outside, and plan for the day, according to Table 1.

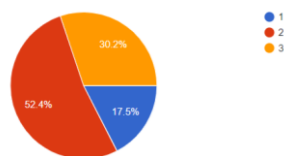


Chart 4: Interior Design Trends

According to Chart 4, the maximum preferred choice of the interior design trend was option 2, which was minimal.

## 5 Data Analysis

The data from the first segment (*Demographic and Travel Experience*) was analysed by taking the highest frequency to different multiple-choice questions. Design attributes suitable for business class working people were investigated and prescribed in luggage space and ergonomic capacity parameters. For the second segment (*Quantitative data*) data analysis was done taking the frequency range to the multiple-choice question. Possible activity mapping was prescribed. For the last segment (*Quantitative data*) the responses with the highest mean were considered to form the design parameters.

From the demographic and travel experience data, we found that a large part of working-class people spend an average travel time of 60 minutes to their workplace. They carry average luggage of 0-5kgs every day. This gives

the design attributes to be considered while designing the interiors considering interior space layout, ergonomics and comfort.

The activities on the go data give the researcher a range and preference of themes that can be designed inside a fully autonomous passenger drone to enhance the travel experience. The user data was converted to a pivot chart and analysed. The maximum design trend chosen among men and women is option 2, a minimal design trend. Filtering out salary-wise, and metro city wise, the most chosen design trend was option 2 across participants of all income ranges.



*Fig2. Minimal Design Trend and Color Swatch Analysis*

Fig 2 shows the colour swatch analysis done for the minimal design trend shown in option 2 of Fig 1.

Following are a few of the design insights for the drone cabin interior derived from the user's survey:

- Passengers feel more comfortable in a minimal design interior space during commuting, as per the pivot chart.
- The design should follow minimal clean aesthetics and form.
- The cabin design colour trend should be of subtle colour tones and not contrasting. The color preferences of the luxury car segment presents today's color preferences. This may or may not represent the color trend for the future passenger drone cabin interiors.
- The hierarchy of activities chosen by the participants' during commute was:
  - a) Work,
  - b) Family Connect,
  - c) Relax.
- Hence, the cabin interiors should be designed for the above three themes. To enhance the user experience, the user should be able to seamlessly switch between the themes.
- The cabin interiors should be designed to carry a luggage space of up to 5kgs for the everyday commute as chosen by maximum participants.

## **6 Discussion and Conclusion**

This paper explores the various possible color, form and activity mapping for designing the fully autonomous passenger drone interior cabin. The collection of relevant literature review highlights that the interior of a fully autonomous passenger drone should follow form follows function. There should be seamless interaction within various themes to switch for the passenger. The color trends for futuristic vehicle interiors should be warm and emotional colors. The survey carried out among the prospective users suggests that the interior should be designed with a minimum of three themes for the passenger to switch from: work, social connect, and relax themes. The color forecast for interior cabin space according to the survey predicts subtle tones and not contrasting. However, the color preferences of the luxury car segment present today's color preferences. This may or may not represent the color trend for the future passenger drone cabin interiors. One of the limitations was the sample size of the survey, which was limited to 126 participants only. The survey was conducted at the prospective users, as passenger drones are yet to be launched in India.

In the future, to understand the drone interior design, a more detailed survey, one to one interviews and focused group discussions need to be conducted with a larger audience. Insights can be gathered once the passenger drones are available for commercial use. This study can be taken as base for conducting further research on the interior cabin space design of a fully autonomous passenger drone.

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