DESIGN OF VEHICLE INSTRUMENT CLUSTER

FOR INDIAN AND GERMAN AUDIENCES

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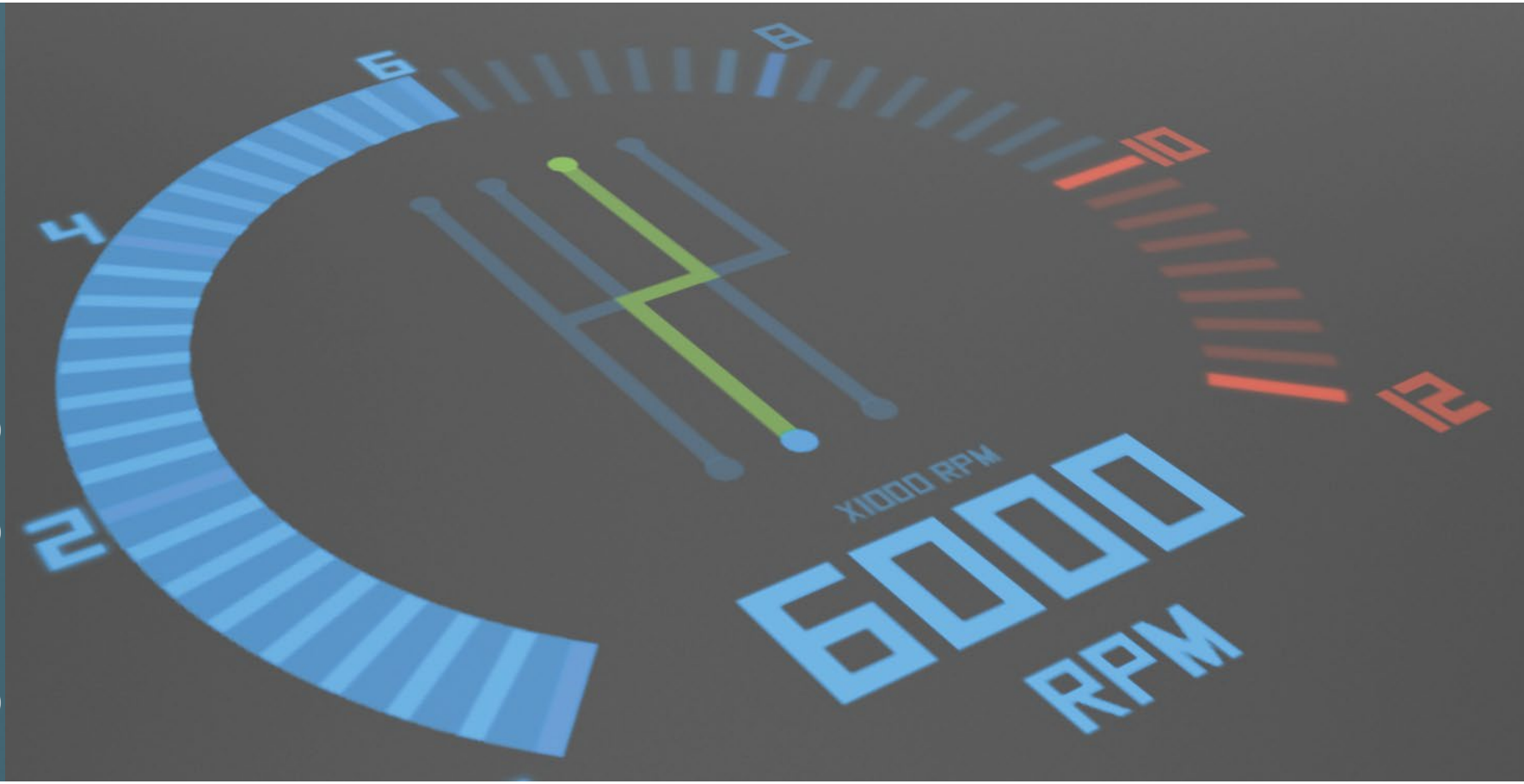

IDC IIT Bombay

IAD Technische Universität Darmstadt
Institut für Arbeitswissenschaft

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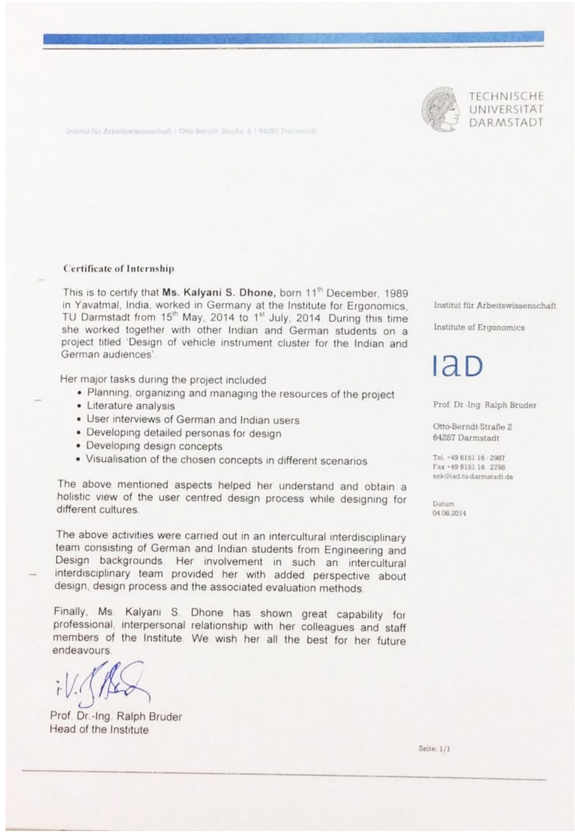

TECHNISCHE UNIVERSITÄT DARMSTADT

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Certificate of Internship

This is to certify that **Ms. Kalyani S. Dhone,** born 11th December, 1989 in Yavatmal, India, worked in Germany at the Institute for Ergonomics, TU Darmstadt from 15th May, 2014 to 1st July, 2014. During this time she worked together with other Indian and German students on a project titled 'Design of vehicle instrument cluster for the Indian and German audiences'.

Her major tasks during the project included:

- Planning, organizing and managing the resources of the project
- Literature analysis
- User interviews of German and Indian users
- Developing detailed personas for design
- Developing design concepts
- Visualisation of the chosen concepts in different scenarios

The above mentioned aspects helped her understand and obtain a holistic view of the user centred design process while designing for different cultures.

The above activities were carried out in an intercultural interdisciplinary team consisting of German and Indian students from Engineering and Design backgrounds. Her involvement in such an intercultural interdisciplinary team provided her with added perspective about design, design process and the associated evaluation methods.

Finally, Ms. Kalyani S. Dhone has shown great capability for professional, interpersonal relationship with her colleagues and staff members of the Institute. We wish her all the best for her future endeavours.

i.V.

Prof. Dr.-Ing. Ralph Bruder
Head of the Institute

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Sajan Pillai for the assistance during the selection process and for keeping up with our pre-departure nagging.

Last, but not the least, we thank our family and friends for their love and co-operation at every step.

About IaD

4 students - Sohini Guin, Baisampayan Saha, kalyani Dhone and Prem Lokesh from IDC, IIT Bombay visited Institute of Ergonomics (IAD), Technical University of Darmstadt, Germany, on a Student Exchange Program during May-June 2014.

IAD specializes and carries out continuous research in the field of ergonomics with focus on vehicle ergonomics, work organization and production ergonomics.

During the 6 weeks, four of us has been divided into 2 teams, each comprising of one product design student and one interaction design student. Two groups had 3 topics to choose from. Both groups had chosen the same topic, so one topic was slightly modified. Each group were paired with 2 German students from IAD for the project.

The projects were completed within four weeks time and one week was spared for the report writing and presentation of the final work in-front of the IAD Jury.

The content in this report has been structured and divided based on the different stages of the project done. They have been ordered according to the duration and amount of work done during each assignment.

Avowal

We asseverate, that the present work has been produced without the help of third party and only with the denoted references. All parts that have been taken from sources are indicated. This work has never been presented to an examination board.

Surname	Dhone	Saha	Sode	Gebauer
Name	Kalyani	Baisampayan	Christian	Tobias
University	IIT Bombay	IIT Bombay	TU Darmstadt	TU Darmstadt
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Date	26.06.2014			
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Abstract

Cultural differences play an important role in the design and development of new products. Many examples of product failures have proven that the culture of a country has huge influence on the success of new product. Against the background of the growing importance of emerging markets it is even more important to understand these cultural differences to take them into account during the product design and development process. Therefore, this Advanced Design Project has the goal to examine these cultural differences between India and Germany regarding the design of a dashboard of a B+-segment car ("Kleinwagen", respectively) and create two instrument clusters, which are based on these results - one for the Indian and one for the German market. To guarantee an efficient and structured approach, a user centered design process considering project management methods is executed. On that account a literature review regarding the user centered design process and the general dashboard design is executed. Based on the insights of that literature review and its insights, a work breakdown structure is developed to structure the project in feasible work packages.

Based on these work packages and the experience of the team members regarding the different tasks, a time schedule or Gantt chart respectively is developed and necessary competencies for the work packages are identified. The responsibilities are distributed according to a competency matrix to guarantee an optimal fit between necessary and existing competencies. The first step during the project is a user study with six Indian and six German users. For that step a questionnaire is generated, which is the basis for following user interviews. After finishing the user interviews, it is the second step to develop an Indian and a German persona and scenarios based on the interview results. These personas are foundation for the third step, the concept generation and evaluation. During that step, an Indian and a German dashboard design is elaborated and rendered virtually, which represents the end result of this ADP. By these two examples it is possible to show how the cultural differences influence the design of a product which prove the importance of the consideration of them in the design process.

Introduction

1.1 Introducing words

A more and more globalized world exacerbates on the one hand the competitive situation of companies but also provides on the other hand opportunities to expand in new markets. Especially the emerging markets or BRIC states Brazil, Russia, India and China provide a large market growth and therefore expansion opportunity for companies. An increasing part of the population of these countries is able to afford technological premium products. Apart from premium products low-cost products for the middle class take on greater significance (Bausenwein & Belz, 2010).

But to pursue these opportunities the cultural aspects and characteristics of the mentioned countries have to be taken into consideration. The importance of the influence of the culture is proven by many examples of product failures, which occurred when new products were introduced in emerging markets without considering the cultural differences.

One of these examples is Gillette. In 2002, the company developed a new razor for the Indian market called "Vector". During the product development process the cultural peculiarities of the Indian market have not been taken into consideration sufficiently. Instead of user studies with inhabitants in India, the users studies were done with Indian MIT students. The result was a product failure (Daily Mail, 2013).

But with a better understanding of the user and the cultural differences Gillette was able to successfully introduce a new razor "Guard" in the Indian, which was a huge success and accounts for two third of new sold razors in India (Daily Mail, 2013).

This example elucidates the importance and relevance of cultural differences in product design. To successfully launch a new product the cultural differences have to be taken into account during the product development process.

Based on that insight an Advanced Design Project was set up between students of TU Darmstadt and IDC, IIT Bombay to examine the relevant cultural differences between India and Germany regarding the design of a dashboard of a B+-segment car ("Kleinwagen", respectively). The goal of the ADP is to transfer these differences into the design of two dashboards - one designed for the Indian and one for the German market. To achieve this goal a user centered design process with Indian and German user studies considering project management methods is performed.

1.2 Project Definition

The project definition contains the general topic of the advanced design project, specific requirements that have to be fulfilled and methods or the way respectively, how the aims shall be achieved. For that, the informations of the task and the interview of the stakeholder are put together.

The definition of this Advanced Design Project ends in "Concept and visualization of vehicle instrument clusters for a B+-segment car ("Kleinwagen", respectively) for German and Indian audiences until the 27th of June, 2014, including the creation of persona and scenarios, the application of project management methods as well as the documentation of project management and design process". In particular, two design concepts are required, one per country. To find the persona, a questionnaire has to be created and after that, six students per country shall be interviewed. The stakeholder expects three dimensional digital visualizations in different scenarios along with visuals of the product in context. Future technologies are not part of the project and shall be neglected.

One of the main aspects of this Advanced Design Project is to learn and exercise project management methods as well as the User-Centered Design process. The individual steps will be reviewed in chapter 7.

Theoretical foundations

2.1 Literature research

In literature review research is done on current reports, literature and design of instrument cluster on car dashboard to get better understanding of elements of instrument clusters and other factors related to it. Before going to instrument cluster, the target segment of the cars is presented for Indian as well as European market.

2.1.1 Target segment

B/B+ segment cars are "known as Supermini in Europe, subcompact in North America. Superminis' have three, four or five doors and are designed to seat four passengers comfortably." The cars of this segment have a length of up to 4.2 meters (Wikipedia, 2014a). These cars are famous for their fuel efficiency and space. In Indian as well as European market these cars are mainly targeted for the users who are buying their first or second cars. These car range mainly from 400000 to 900000 Indian rupee (5000 to 11000 Euro) (Gaadi.com, 2014a). Tata Indica Vista, Volkswagen Polo or Opel Corsa are typical representatives.

image 21: Opel Corsa (Adam Opel AG, 2014)

image 22: Tata Indica Vista (CarsNewsBlog, 2014)

image 23: VW Polo (mobile.de, 2014)

2.1.2 Instrument Cluster

Car dashboard is a control panel placed in front of the driver, which consists of steering and instrument cluster. Mostly the instrument cluster is covered with either a smooth or textured surface to protect the instruments from dust and sun light falling directly on to it, so that driver can read the information on instruments clearly without any difficulty. The main purpose of instrument cluster in car is to give relative information of various parameters and data of the car to the driver and to show current condition of car while traveling.

Generally, instrument clusters consist of:

- speedometer
- odometer (indicator for traveled distance)
- fuel gauge
- tachometer (indicator for the engine's rotations per minute)
- warning symbols like low battery, low oil, parking brake, engine/exhaust problems etc.

2.1.3 Evolution of Dashboards

Designs of dashboards are evolved from 1940 to 2014. Previously the dashboards were rectangular in shape with rounded instrument cluster over it. By the time, dashboard design and fashion trends have also been taken into consideration. "In the 1940s through the 1960s, American car manufacturers and their imitators designed unusually-shaped instruments on a dashboard

image 24: Digital display (Moto-Madness, 2014)

image 25: Analog display (DIY Go Karts, 2014)

laden with chrome and transparent plastic, which could be less readable, but was often thought to be more stylish." (Wikipedia, 2014b)

In current designs, the return to round dials for the speedometer and tachometer can be observed. "Depending on the target driver demographic, these round gauge are either traditional digital control dial & needle gauge or round display screens that project the dial & needle image." (Chatterjee, 2013)

2.1.4 Emotion, aesthetics and dashboard

Automobile is a product which can be defined by its complexity and the emotion attached to it when someone buys one. An automobile can be bifurcated into several small subparts, dashboard being one of them. One of the research paper by Herberth and Blumenthal (Herbeth & Blumenthal, 2013) typically judges various dashboard styles and forms by consumer response towards it. In that paper, the authors mentions that in one of the study involving investigation of the aesthetic appeal of the car interiors based on its complexity, curvature and innovativeness, the customers preferred dashboards with the most round shape and having least innovativeness into it. Apart from the issues related to operational characteristics, emotional and usability issues also plays a major role in customer's product selection.

Research in user experience reveals that aesthetic values like perception of beauty, perception of modernity or friendliness surpass qualities that are marked by characteristics that go beyond task accomplishments.

2.1.5 Dashboard sizes

A document is reviewed to check out the dashboard sizes. One of the manufacturer of car dashboards has a document that sites all the dimensional details of their various dashboards. As an example, the width of BAUSER instrument clusters Type 813.2 (BAUSER GmbH & Co. KG, 2011) is 230 millimeters and the height is 120 millimeters. In addition, the dimensions of the dashboard of one of the group member's car are measured: 400 mm x 120 mm. The dimensions of the dashboards are taken for reference so that a suitable dashboard conforming to the market criteria can be designed.

2.1.6 Symbols

The symbols used in the instrument clusters are very important for the success of the product. In the site of an official SUBARU workshop, there is a document which sites all the possible symbols that they have used in their dashboards ranging from their cheapest to their costliest product (Dennison, 2014) (also see Appendix B). The symbols provided by SUBARU were taken for reference and a new fresh set of symbols were designed. The affordance of the symbols were kept in mind and designed in such a fashion that the symbols do not loose the basic character which conveys the information.

2.1.7 Current trends in market

Mercedes CLS 63 AMG

image 26: Dashboard of Mercedes-Benz CLS 63 AMG (UICloud, 2013)

- Speedometer in the middle
- Tachometer, fuel gauge and coolant indicator at both sides speedometer
- Information like temperature, parking brake at middle dial

BMW M5

image 27: Dashboard of BMW M5 (UICloud, 2013)

- Speedometer at left side
- Tachometer at right side
- Fuel gauge and Coolant indicator at bottom side of speedometer and tachometer respectively
- Information like fuel left, temperature and distance traveled at the bottom center of the instrument cluster

Maruti Suzuki Swift

image 28: Dashboard of Maruti Suzuki Swift (Conway, 2011)

- Speedometer at right side
- Tachometer at left side
- Fuel gauge and coolant indicator at bottom side of Tachometer and speedometer respectively
- Information like distance traveled, temperature, time at the center of the instrument cluster

Tata Vista

image 29: Dashboard of Tata Vista (Gaadi.com, 2014b)

- Speedometer at middle
- Tachometer at right side of main dial (Speedometer)
- Fuel Gauge at left side of main dial (Speedometer)
- Information like coolant temperature shown in middle display in speedometer

2.2 User centred design process

The user centered design process which was used for the Advanced Design Project is based on the DIN EN ISO 9241-210 Ergonomics of human-system-interaction – Part 210: Human-centered design for interactive systems (ISO 9241-210:2010). The general process was modified to fit the context and special requirements of the ADP. In the following chapter a overview of the process is given.

The process has several steps which are shown in image 210. The main steps of the process are the planning of the process, the analysis and definition of the usability context, the specification of the user requirements, the elaboration of a design concept and the evaluation of the design. This process will be repeated until the user requirements are fulfilled.

The first step of the user centered design process is the planning of the whole process. Therefore suitable procedures for the following steps have to be identified and defined. According to the procedures milestones as well as a time schedule have to be fixed. All procedures have then to be integrated in the project plan.

The second step analysis and definition of the usability context has the goal to generate insights concerning the user, user-characteristics, environment conditions, goals and task of the user and existing context problems. The usability context thereby has to be described in a sufficient way to support the design process.

The third step is the specification of the user requirements. Therefore the needs of the users respective to the usability context have to be identified. From that needs the user requirements have to be derived. These requirements have to contain the usability context, user requirements derived from user needs, requirements of ergonomic insights, norms and principles as well as usability and organizational requirements.

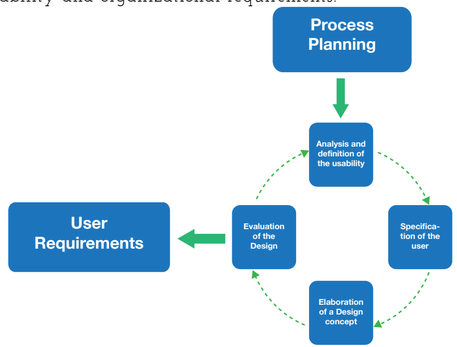


image 210: User Centered Design Process

The fourth step is the elaboration of a design concept which optimizes the user experience. For this step the former generated insights have to be considered. This includes the usability context, user requirements, the state of the art in the according application domain, norms and standards regarding ergonomics and the experience and knowledge of the multi-functional design team. On this basis the user task and the user-system-interaction are designed considering the whole user experience. The design concept thereby is specified by means of scenarios, simulations, prototypes and models and should be changed according the evaluation and feedback of potential users. All in all the design of the user experience is a innovation process, which fulfills efficiency and efficiency aspects and simultaneously satisfies the user in concerns of emotional and aesthetic aspects.

The fifth step is evaluation of the generated design from the perspective of a user. The early evaluation of a concept provides a opportunity to improve and validate the product respective the user requirements. There are mainly two possible ways for the evaluation, the first is testing with users and the second is the evaluation according to standards and requirements regarding usability and accessibility.

If according to the evaluation changes are necessary, the process is repeated until the user requirements are fulfilled.

Methodology

3.1 Project Planning

3.1.1 Work Breakdown Structure

The following abstract provides a overview of the work breakdown structure and the different work packages of the projects. The work breakdown structure was mainly derived from the user centered design process as well as from requirements of the project definition. On that basis the following structure is developed, which is shown in image 31.

In first order eight basic work packages have been defined, which are shown in the first line of the figure. Some basic work packages have been further divided in sub work packages, which are arranged under the respective basic work package. Thereby the basic work packages are organized chronological from left to right and the sub work packages are organized chronological from top to down as indicated by the arrows in the diagram. Therefore the work breakdown structure can also be seen as a flow diagram.

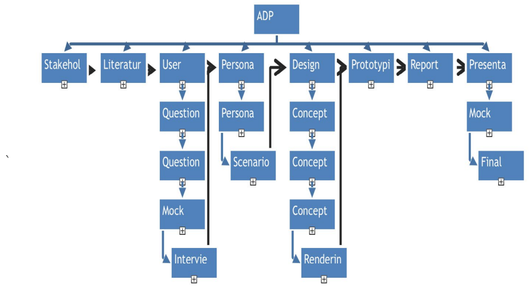


image 31: Project Structure Plan

In the following the single work packages will shortly be describe and the responsibilities will be mentioned. The different responsibilities thereby were decided according to a competency matrix which will be described in a later chapter.

Stakeholder interview

The first work package is the stakeholder interview, which is performed by the complete project team. The goal of the stakeholder interview is the development of a design brief and the clarification and specification of the project definition.

Literature review

The work package literature review has the goal to elaborate a theoretical basis for the further design process. The responsibility for the literature review was divided to all team members.

User study

The user study was separated into the four sub work packages: question formulation, question review, mock interviews and interviews. The subject of the whole work package was to interview six Indian and six German user, which fit into the defined target group. The interviews should generate insights for the generation of one Indian and one German persona. The question formulation and review was done by the whole team. Each team member was responsible to do three interviews, whereas Germans interviewed Indians and vice versa. The interviews were reported in Excel files, which were the basis for the work package persona and scenario development.

Persona and Scenario development

The work package is divided into the parts persona and scenario development. The latter is based on the persona generated in the first part. The Indian and German Persona were developed on base of the user interviews performed in the work package user study. For each of the developed persona three scenarios were developed, to show the dashboards in different situations which represent a typical situation in the life of the persona. The German persona was developed by Christian whereas Kalyani and Baisam were responsible for the Indian persona. The Scenario for the German persona was developed by Tobias, Kalyani and Baisam developed the Indian one.

Design and concept generation

The work package design and concept generation is structured into the sub work packages concept generation, concept evaluation, concept modification and rendering. The whole work package was based on the developed persona of the previous work package. The first step was to generate different concept in matter of creating ideas. All team members created different concepts, which were evaluated together. Modifications were decided together and executed mainly from Baisam and Kalyani. Baisam was responsible for the rendering of the concepts. The rendering includes the design of the dashboard with different graphic programs. The renders should display the different scenarios, which were developed in previous work packages.

Prototyping

The work package prototyping had the goal to produce a model of the developed dashboard designs. Due to the fact that the work package was a "nice to have" feature and insufficient time the work package was not executed. Instead the dashboard was rendered virtually into a car.

Report Preparation

The work package has the goal to guarantee the record of the entire project. Each team member is responsible to protocol his tasks by himself. Christian manages the consolidation of the report. Tobias is responsible for the project planning protocol.

Presentation Preparation

The last part of the project is to present the results to a committee of several members of both the IAD (TU Darmstadt) and IDC (IIT Bombay). Therefore a presentation has to be prepared and practiced. The presentation is prepared jointly by the team.

3.1.2 Time table

The time table is an important project management tool to ensure the delivery of the project according to the deadline. For the time schedule of the ADP we derived a Gantt chart from the work breakdown structure, which contains all necessary steps to fulfill the project requirements. The complete Gantt chart is shown in image 32. On the left side of the Gantt chart the different work packages and sub work packages are shown. According to the experience of the team members the needed time for the different tasks was estimated. Accordingly milestones were specified to mark the finish time of the work packages and a critical path was drawn. The finished Gantt chart enables the team to estimate if the project is on time or delayed respectively steps can be taken.

The Gantt chart is changed lightly after the stakeholder interview, as described in chapter 3.3.

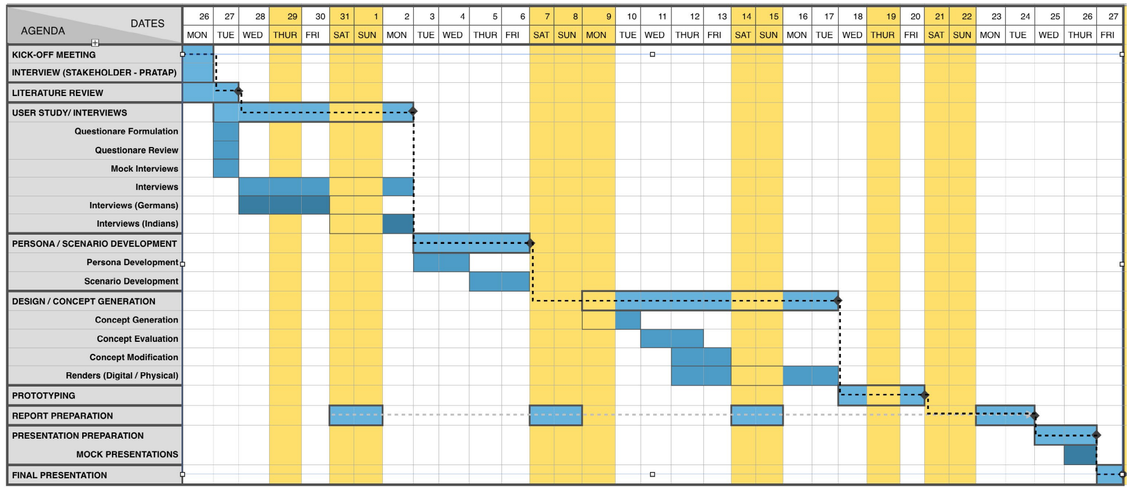


image 32: Gantt chart

3.1.3 Team and Competency Matrix

The project team of the ADP consists of four members. Two Indian design students from IIT Bombay and two German mechanical engineering students from TU Darmstadt . All members are currently doing their Master degree. The team consists of Baisam, a master student in Industrial Design at IIT Bombay, Kalyani a master student in Interaction Design at IIT Bombay, Christian Sode a master student in mechanical engineering at TU Darmstadt and Tobias Gebauer a master student in Mechanical engineering and Business Administration at TU Darmstadt. According to the different backgrounds each team member has different competencies, which are useful for the project. To pursue the individual strengths of each member the work packages are divided according to the characteristics of each team member. To guarantee a optimal fit between task and responsible team member a competency matrix was developed, which displays the requirements of the different work packages and the competencies of the team members. The work was divided in a way that a fit between requirements and competencies was achieved. table 31 shows the developed matrix. On the left side of the matrix the different work packages are listed and according to them the necessary knowledge respectively skills. On the right side is the self-assessment for the listed competencies of each team member. The darker the color the higher the competence in the regarding field. For the literature review and the report preparation no special competencies were identified.

Tasks	Competencies	Kalyani	Tobias	Baisam	Christian
Stakeholder Interview	process and necessary data overview				
Project Management	project management methods				
Literature Review	none				
Questionnaire	necessary persona information				
Interviews	interviewing skills				
Persona Development	persona development process				
Scenario Development	scenario development process				
Concept Generation, Evaluation, Modification	knowledge of dashboard design				
	design skills				
	graphic programs for design				
prototyping	prototyping methods				
report	English academic writing				
presentation	preparation				
	presenting				

table 31: Competency Matrix

3.2 Stakeholder Interview

In the beginning of the project, it is essential to specify the requirements given by the stakeholder. The aim is to figure out the exact design brief and expected end result of the project. Also, you get to see the perspective of the stakeholder and what steps to be followed to meet the expectations.

The following points need to be cleared:

- role of the stakeholder in the project
- purpose of the project
- minimum things to be incorporated in the design
- target user segment of the product
- constraints of the product
- expectation from new design as compared to old design
- estimated budget for the project
- materials and facilities for prototyping

3.3 Design Brief

The task is to design a vehicle instrument cluster (dashboard) for German and Indian B+ segment cars (German: „Kleinwagen") for a car supplier company. For both countries, the target user groups are students who can afford an own car. Considering insights to the different cultures and the needs of both user groups is very important for the stakeholder.

According to the design, no restrictions have been specified, but the concepts shall include instruments or indicators for speed, the engine's rotations (per minute, rpm), fuel, cooling fluid temperature, head lights, seat belts, doors as well as blinker and odometer.

The stakeholder highlights that he is open to new concepts that are not based on given constraints. The concepts shall fit to the needs of persona which have to be created from user interviews. New technologies like touch pad or head-up-display are not intended. Due to insufficient time, no expert consulting is needed and the literature review is concentrated on the minimum requirements. It is expected to have two different designs for the two different cultures.

The presentation of the results is scheduled on June, 27, 2014. The stakeholder expects the final report one day earlier. The budget

for prototyping amounts to 250 Euro, albeit prototyping is not a must. Due to time and logistical constraints, prototyping is later changed to digital prototyping after clearance with stakeholder. Because of that, the Gantt chart is adjusted by discarding the time for prototyping.

3.4 Primary Research

In primary research data from user interviews is gathered by contextual inquiry. "The contextual inquiry is a specific type of interview for gathering field data from users. The aim is to gather as much data as possible from the interviews for later analysis." (Usability Net, 2006) Contextual inquiry mainly focused on gathering the data from users related to context of your project. Therefore, user interviews are conducted to understand the user behavior, driving habits, social aspects related to driving, needs and problems they face while driving.

Before starting the contextual inquiry a questionnaire is formed for gathering the data from the users. The questions are based on the user's day to day life and usage of car dashboard to get the better understanding of his personality and behavior while driving. The questionnaire is attached in Appendix A.

After reviewing the questionnaire, a mock interview is conducted with the guide of the project. It resembles a real user interview to get the experience of the interview process and to help understanding what exactly is required in questionnaires. The feedback is used to learn how to do a one on one conversation for user data gather purposes.

According to the stakeholder's requirements, six Indian and six German users are interviewed. Each interview lasts around 45 minutes. Partly the Indian user interviews are conducted via internet using a video chat software. For the interviews, the editors divide the user interviews that both German and Indian students get exposure to other culture.

User Criteria for both Indian and German users are based on the user group defined by the stakeholder:

- age 18-28
- student
- experienced in driving automobiles
- both male and female (if possible)

An overview of the interviewed students is given in table 32. Insights and observations are drawn after analysis of interview by affinity mapping (see paragraph 3.5).

Country	User No.	Gender	Age
India	1	Male	23
	2	Male	24
	3	Male	23
	4	Male	28
	5	Female	23
	6	Female	25
Germany	1	Male	27
	2	Male	27
	3	Male	20
	4	Male	23
	5	Male	25
	6	Female	24

table 32: Interviewed Users

3.5 Affinity mapping

Affinity mapping is a tool used to organize data and ideas. The group members try to group the data based on natural relationship by brainstorming. The recorded data from user interviews are noted down on cards and linked together. Cards which are grouped together are named under related categories. All these categories are then sorted with bottom up approach by linking different subcategories together to form larger categories, unless top system level is formed. (American Society for Quality; Filev, 2008; leanyourcompany.com)

In image 33 a picture of the affinity mapping in progress is shown.

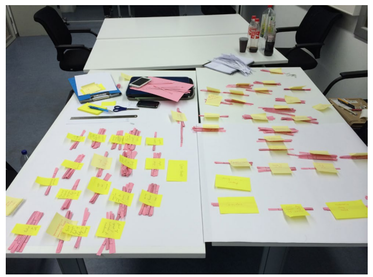


image 33: Affinity mapping

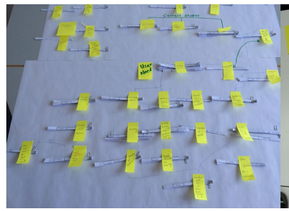


image 33.1: Affinity mapping

image 33.2: Affinity mapping

image 33.3: Affinity mapping

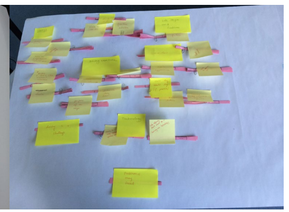


image 33.4: Affinity mapping

Persona, scenarios and concepts

4.1 Insights and observations

Based on affinity mapping, some general insights can be drawn from German as well as Indian interviews. The insights were categorized in two ways:

- information about their lifestyle, free time activities etc.
- insights related to car driving experience and user needs

4.1.1German interviews

General insights and observations

- In day to day life, Germans like to be fit .They work out at a gym and do sports like cycling, swimming etc.
- Normally in college and outside they are social and like to hang out with friends.
- They like technology and they keep themselves updated with new technologies.
- They use their smart-phone and other gadgets to keep them updated with friends and family, but they do not like extensive use of applications like Facebook, Whatsapp etc.
- On holidays or weekends they like to spend time with family and friends and to go outside the city (for that purpose they mostly use a car).
- In day to day life, the interviewed Germans like casual lifestyle. They like brands and quality in fashion.
- They are fine with current schedule in college and work but they prefer slight flexibility in it.

Insights related to car, driving experience and user needs

- While driving, they always keep track of their speed in city and outside the city.
- They always follow all safety rules while driving.
- While buying a car, they consider space and comfort as very important factor. In addition to that, they see to it if the outer design goes with interior of car.

- They like the experience of speed, but they keep safety in mind.
- They like more direct and accurate way of information on dashboard.
- They like driving their own car because it gives them feeling of control over car.
- While driving, they always try to avoid distraction to be more focused on driving.
- Even though they follow a student's life, they prefer luxury and premium feeling in car because it is their status symbol.
- They always try to drive their car in a more economical way to save money and to maintain the car's functionality.
- They like it if design and functionality go hand in hand for dashboard.

4.1.2 Indian interviews

General insights and observation

- In day to day life, they like to be fit but because of hectic schedule in work and office they get very less time to go to gym or to do other sports and activities.
- During free-time, they like to play computer games because it gives feel of thrill and adventure.
- If they get time, they like to travel and go out with friends.
- They keep in touch with friends and family via Facebook, Whatsapp and other social networking application on their smart-phone.
- They follow basic fashion and lifestyle in day to day life.
- They keep themselves updated with new technologies through internet on their mobile or on desktop.
- They buy branded things only if it is affordable.

Insights related to car, driving experience and user needs

- While driving they like speed, but they try to maintain their speed if someone is with them or there is too much of traffic.
- They follow major safety rules while driving in city and outside, especially if they are driving with family and friends.
- They like to drive the car because it gives them feel of speed and control over car.
- When they go for a long journey, they always keep track of distance they traveled to check the mileage of car.
- While driving they keep track of speed and rpm to change the gear of car. If they are experienced in driving, they will change the gear by noticing the sound of car, which works only if there is no traffic sound around.
- Driving in cities can be challenging due to much traffic and noise.
- While buying a car, space, comfort and money are the factors they look upon. In addition to that, even if they like muscular look outside, they prefer smooth and simple design inside.
- They always like to stay connected with their friends and family, even if they are driving.
- They prefer functionality over design of the dashboard

4.2 Persona

Persona is a fictitious characters used to represent the targeting user group of the product. They are created based upon the data gathered from the user research and behavior observed throughout the process. Persona is useful in understanding the user goals, requirements, expectations, skills which are used for taking the decisions in design solutions related to interaction with product. (Assistant Secretary for Public Affairs, 2013)

Based on user studies and contextual inquiry, goals, requirements, problems etc. of both German as well as Indian users are used to develop persona for both cultures. The created persona are shown in image 41 and image 42 on the following pages.

PERSONA:

FELIX SCHMIDT

About Felix

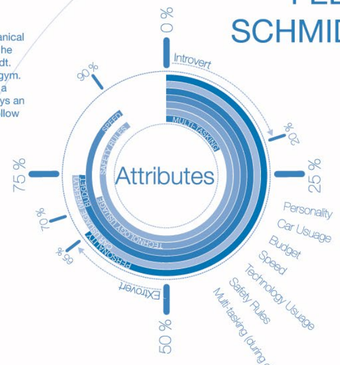
Felix Schmidt is 24 years old and lives in Darmstadt, where he studies Mechanical and Process Engineering to achieve his Master of Science. Before studying, he lived at his parent's house which is about 100 kilometers away from Darmstadt. As he wants to stay fit, Felix likes to do sports, especially working out at the gym. He also likes to go out for climbing, geo-caching and exploring the nature as a counterbalance to sitting in the library. Besides that, he enjoys music and plays an instrument (trombone) in an orchestra. Due to his study, Felix is not able to follow all of these freetime activites very often.

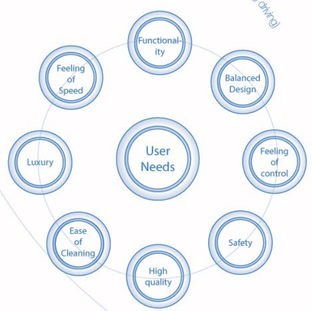
24
YEARS
OLD

Felix has his own car, a VW Polo. He has worked since he was 16 to be able to afford one. He is a fan of high-quality and premium looking things, hence he always wears branded clothes. Felix cares a lot for his car and keeps it clean all the time. He uses his car to meet friends, visit his parents (once a month) and for traveling. He is proud of his car and enjoys to be flexible.

Driving his car is a big joy for Felix. He likes to go fast, but respects the safety rules. He is very safety-conscious and drives more smootly when he is not riding alone.

Felix is interested in new technology, even if he does not follow and use it intensively. He uses social media only to stay connected with friends and is not online the whole day.





GOALS
Wants a stable job after passing out of the college, be with family and wants a settled life

image 41: German persona

PERSONA:

RAHUL SHARMA

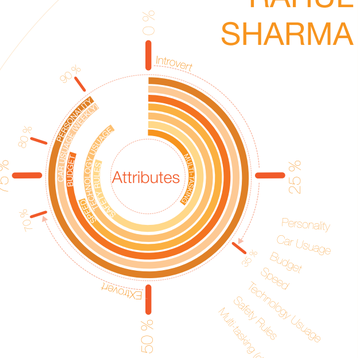
About Rahul

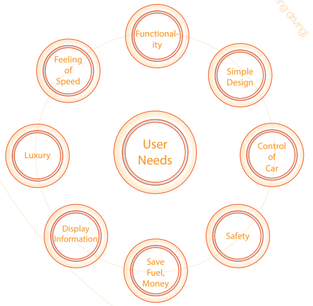
Rahul is 25 years old, lives in Mumbai and is currently studying Master of Design at IIT Bombay. He is living in Mumbai since his childhood. Rahul likes sports like swimming, football and cycling. In his free time he likes to go out with friends to nearby places using his car. He likes new technology and always keep track of new technology and trends in market. He likes branded things. Rahul likes to play computer games. When his car is not available Rahul prefers to go to college by Auto or Taxi because he doesn't like to wait for public transport and wants comfort while travelling.

25
YEARS
OLD

Personality
In class and college Rahul always try to take lead in any activity.
He likes driving, drives mostly on weekends, especially when he goes out with friends on long trips. He checks all essential safety things before going for long journey. Likes to drive safe when he is with friends and family. Picks up call while driving if it is attached to car system.

Pain Points
Doesn't like heavy traffic and pollution while travelling. Doesn't want to wait for public transport.





GOALS
Wants a good earning job after passing out of the college and wants to travel and see different places

image 42: Indian persona

4.3 Revised Design Brief

In addition to the stakeholder's design brief (see chapter 3.3), table 41 gives an overview of user needs that are in focus by the created persona.

It is eye-catching that many user needs fit to both persona, even if the reasons are somehow different. Most of the interviewed Germans state that they are happy with their current dashboard design. They like that the focus is set on the driver and that the instrument cluster shows every information they need, especially concerning safety issues. By contrast, the interviewed Indians wish to have more safety features and a higher convergence in design on the driver.

The differences in design concepts and in final design are described in chapters 4.6, 4.7 and 6, respectively.

User needs	German persona	Indian persona
feel of control	x	x
fuel efficiency and exact amount of kilometers you can drive with fuel left	x	x
direct information about gear shifting	x	x
feel of control	x	x
balance in design	x	
experience of speed	x	x
luxurious/premium feeling	x	x
cleaning should be easy	x	
safety	x	x
easy to see information on heavy traffic		x
comfortable view		x
avoid distraction	x	x
simple design		x
accuracy	x	x
easy to read in every light situation	x	x

table 41: Revised Design Brief

4.4 Scenarios

Scenarios are used to show the product in different situations. On the basis of a storyboard a few model cases are presented.

4.4.1 German Scenario

On a Saturday morning, Felix decides to drive to his home town to see his family. He is a fan of the cruise control that helps him to keep a constant speed. In the evening, he leaves his parent's house to meet friends. While driving, Felix has to make turns and shift the gear. After having met the friends, Felix gets a phone call by his friend who forgot something to tell. During his ride back home later in the night, some warnings pop up.

4.4.2 Indian Scenario

Rahul and his friends decide to go to Goa by his car. They start their journey in the evening. Rahul is safety-conscious and likes to check all car systems before starting the long ride. While driving, Rahul experiences several typical situations like turns, shifting the gear and traffic jam. Also, his brother tries to contact him to ensure that he is alright. In addition, some warnings will pop up.

4.5 Initial concepts

4.5.1 Mind Map

From the insights and observations all team members generate different ideas for initial concepts. Before starting ideation, a brainstorming is done to gather key points which are taken into consideration. The results are combined for both user groups in a mind map that is shown in image 43.

image 43: Mind Map to gather key points

4.5.2 Drawing first concepts

After that, the ideation part follows. Every group member thinks about how the insights and observations can be drawn together in a concept. In the end of this process, everyone presents his ideas and key points to the group. In image 44 to image 411 some of the concepts and ideas are shown.

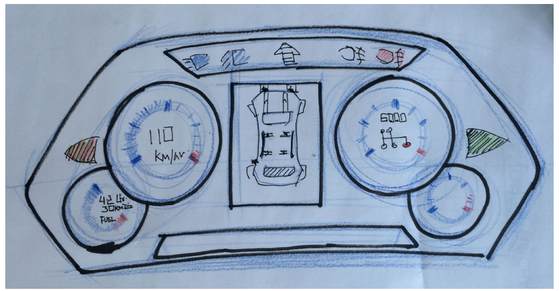


image 44: Initial Idea A

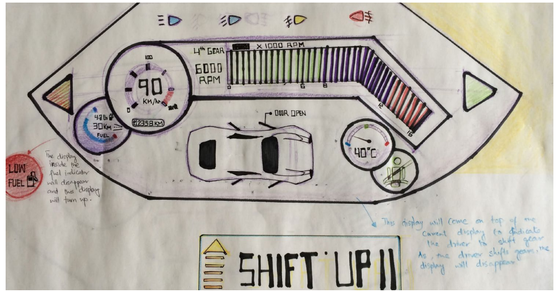


image 45: Initial Idea B

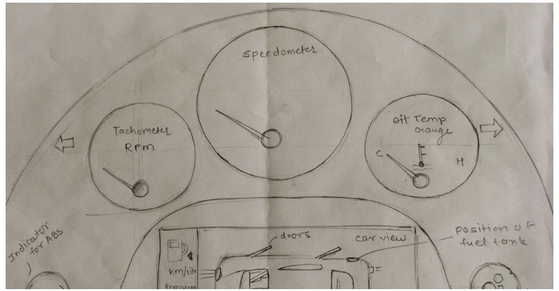


image 46: Initial Idea C

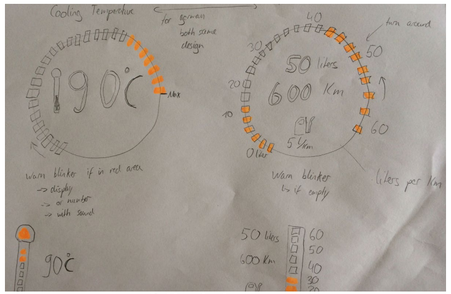


image 48: Ideas for designing instruments

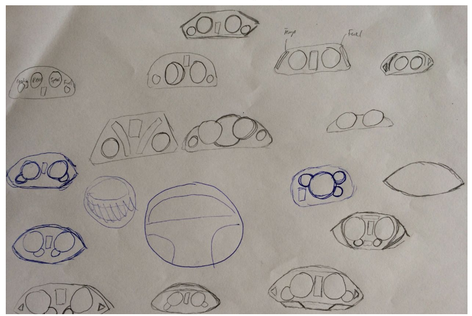


image 49: Creation of different shapes

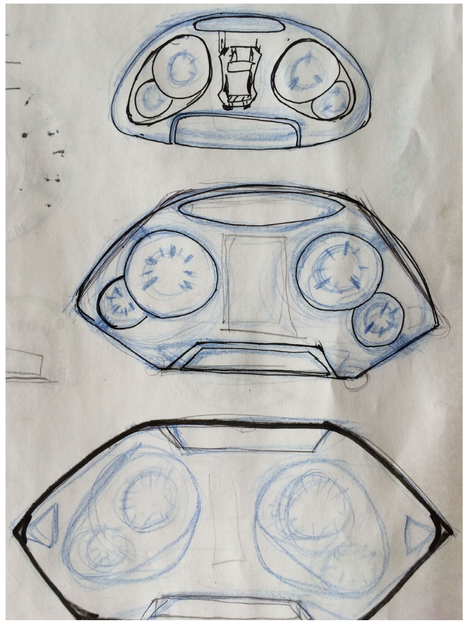


image 410: Variations of some basic shape

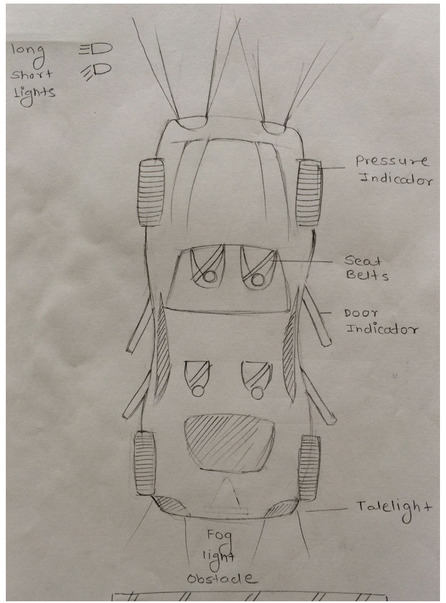


image 411: Concept for main display

4.5.3 Discussion of the ideas

After creating the first concepts, the various ideas are discussed. The following list is an extract of ideas of the attached concepts:

- Combination of Digital and Analog display to give feeling of acceleration/speed and accuracy
- Fuel indicator and coolant indicator as second important instrument
- Speedometer and Tachometer of same size for balanced design
- Weather indicator to show outside weather or the destination if connected with GPS
- Textual information on display to get direct information
- Time and Date
- Obstacle indicator
- ABS/VSC system indicator
- Mileage Indicator
- Nearby fuel Station Indicator on low fuel warning if sync with application on phone and GPS

- Illuminating ring on outer instrument to show economical, non-economical mode
- Trip meter to know the distance covered along with total distance traveled
- Visualization of gear shift
- Display of car to get safety related information at one glance
- Outer shapes – Airplane cockpit, Game pad etc.

Because the target segment are B+ cars, it is supposed that the car has no own internet or GPS connection. The option to connect the user's smart-phone with the car to get information for navigation and weather is discarded as a missing connection would lead to a blank information display. Also, these informations are regarded needless. In the case the driver receives a call, a small additional information on the dashboard will suffice to inform the driver.

The main key points of the final concept are described in chapter 4.6.

4.6 Key points considered for final concept

From the primary research and the revised design brief some key points are identified on which additional effort is spent.

4.6.1 Safety

While driving, it is very important to follow all safety measures before and after starting the journey, especially if you are going for long trips or if you are traveling with family members or friends. From both German as well as Indian interviews it was found out that all users consider safety as the most important factor while driving.

To incorporate safety in the designs, the following ideas come up:

- Warning Symbols: Important warnings at the top of dashboard to grab driver's attention
- Direct Information: Clear text instructions about warning symbols to avoid confusion of signs
- Main display: Main display gives quick overview of safety issues like seat belt, doors and tire pressure
- Remaining fuel: Fuel indicator shows remaining kilometers you can drive plus warning symbol for a critical level
- Less distractions: No extra information added in the design that can distract the user

4.6.2 Clearly Aligned

To support the mentioned safety issues, all instruments shall be clearly aligned and separated so that the driver gets the information clearly at one glance without any difficulty. In addition, balance in design is important for German users. Whereas Indians think more about a simple but new design, Germans like the impression of stability in design as they prefer consistency both in quality and in personal belongings (wish for a settled life with safe income and family).

4.6.3 Feel of Speed/ Acceleration, accuracy

From the German as well as Indian interviews it can be observed that users like the feel of speed or acceleration which gives them excitement and thrill. To incorporate this in design, a combination of digital and analog is part of the concepts. The up and down motion of an analog-looking-needle gives the feel of speed to the user. The digital display gives the accurate information of speed to the driver so that he can see the exact speed and how much he is speeding up.

4.6.4 Economical Driving

It is observed that both German as well as Indian interviews partners always try to drive their car in economical way so that they can save the fuel as well as maintain the car. Therefore, we a mileage indicator is added.

A second focus is set on the gear shifting process. For this point, both user groups have different reasons. Whereas Germans like to go most efficiently to stress the engine as less as possible (taking care of the car), most of the Indians shift by experience of the engine's noise. The problem they reported is that sometimes the surrounding noise is that loud that it is hard to identify the noise level of the own car. To drive most efficiently, several informations about how and when to shift are shown on the dashboard:

A symbol at the top indicator bar shows when to shift the gear up.

The text information at the bottom information bar informs you about gear shifting.

In the tachometer, a visual display shows how to shift to the optimum gear.

4.6.5 Visualization

For the visualization the following likes, dislikes and cultural aspects of the targeting user group are collected to be implemented in final design:

German User:

Likes premium look in design, likes wooden materials and chrome in interior of car

Likes separated instruments on dashboard

- Likes simple design and basic information on display

Indian User:

- Likes new, high technology look in car
- Wants luxurious feeling in interior of car
- Likes digital and sporty look in dashboard

4.7 Comparison of concepts

In table 42 the compendium of differences and coincidences of both design concepts is shown.

Object/Functions	**German**	**Indian**
Position of instrument cluster	Left side of car	Right side of car
Speedometer	Right side of instrument cluster	Left side of instrument cluster
Tachometer	Left side of Instrument cluster	Right side of instrument cluster
Fuel Indicator	Right side of instrument cluster	Left side of instrument cluster
Display of car with related information	At the center of instrument cluster to bring attention of driver on important information	
Calling	Name of the caller will appear on text information line with sound if phone is attached with centralized system of car so that it won't distract the driver but can see if who is calling.	Name of the caller will appear on the main display (instead of showing the car's status) so that driver can see who is calling easily even if he can't hear the sound because of heavy traffic.
VSC(Vehicle stability control)	On the main display to get attention of driver in critical condition like bad weather, slippery roads etc.	
Parking break	On the main display to get the attention of the driver if the parking break is still set	
Cruise control	On the main display to give information whether the car is in auto mode or not	Cruise control is not provided because of heavy traffic it is not affordable to use cruise control
Warning Symbols	On the top of instrument cluster to get attention of driver in failure of system	
Information bar/panel	On the bottom of the instrument cluster to avoid confusion between the warning signs	
Outer Shape	Clean outer lines with classic shape	Game pad shape
Material used on instrument cluster	Wood and chrome to give feel of luxury and premium	Single digital display to give look of technology

table 42: Comparison of designs

Design methodology and Results

5.1 Design Methodology

Golden ratio has been found through out the nature and it has been always related to the aesthetic values it caters to, when used in designing any object. Golden ratio can be found through out nature. The construction of leaves to sunflowers to sea shells, all have one thing in common, the golden ratio.

The symbols used in the instrument clusters were redesigned to give a fresh look to the cluster yet it has been designed keeping in mind that new symbols should not loose the affordance that the old symbols used to portray. While designing the warning symbols that are to be used in the instrument cluster, golden ratio is used. This has been done to make sure that the symbols used are aesthetically pleasing while not loosing its functionality and affordance.

Elements in a particular design are aligned with respective to the golden ratio circle guides. This in turn contributed to overall aesthetic and perceived stability.

Color in a design can be one of the most important factor in its success. It can make a design visually interesting and aesthetic. The color palette has been limited to 3 colors so that it becomes easy for the eye to perceive a design easily. The color of the designs are kept flat, keeping the design flat and elegant.

Horror Vacui as is generally known in the design context is the tendency to fill blank spaces with elements rather then keeping them empty and making the design fill with clutter. As horror vacui increases the perceived value of the design also decreases. In the cluster instrument design, the utmost importance is given to keep the design as minimal as possible. Unnecessary filling up of spaces are avoided to keep the design clean and minimal. (Lidwell, Holden, & Butler, 2010)

The typeface used in the design of the cluster instrument has been chosen carefully. Sans-serif typeface are used to convey information in the instrument cluster. For the dials used in the cluster, SquareFont is used. It has been chosen as it is bold and can attract the attention of driver very easily when highlighted. The information display at the bottom has font Franchise Bold. As a design prerogative, all

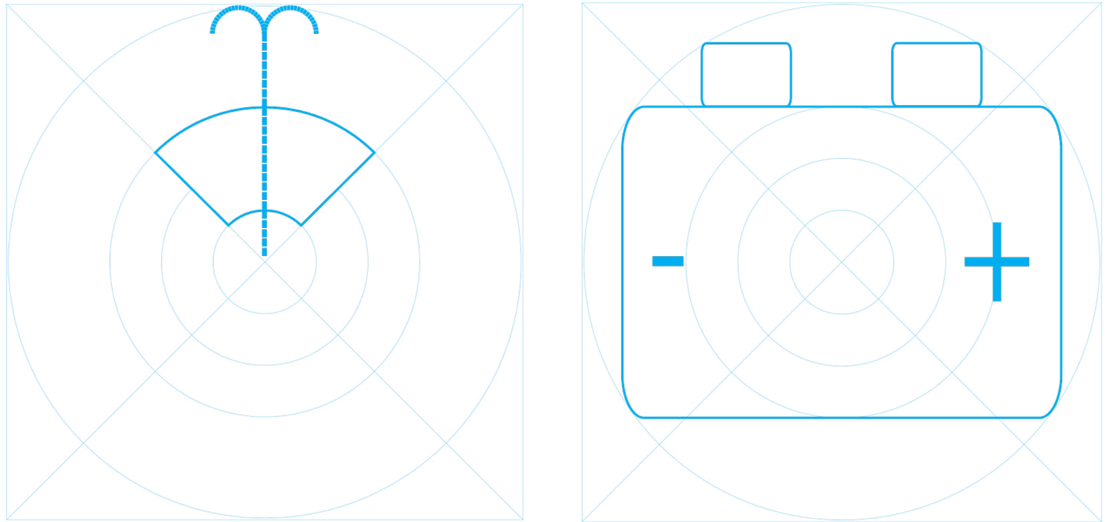


image 34: Creation of warning symbols

5.2 Results

The following results are presented according to the persona and scenarios as described in chapter 4.4.

5.2.1 German Design

Normal Mode: Felix wants to drive to his home town to see his family. He gets into his car at 9 AM in the morning. He starts and his car and is greeted by the dashboard by a "Good Morning" message.

image 51: Welcoming the driver (German)

After the good morning message, the car check all the safety measures and the condition of the car and gives visual feed in the middle display. He completes his safety checks and starts his journey after checking the middle display. There is no problem with the car.

image 52: Car during self-check

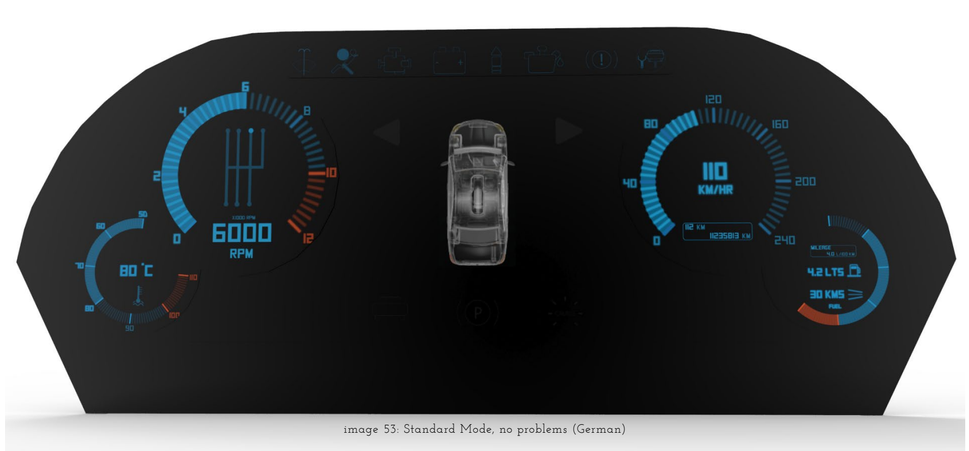


image 53: Standard Mode, no problems (German)

Felix has stopped for a break. He again starts his journey. Its 8 PM in the evening now. He wants to change the lane to the right and turns on the right side indicator and the same is shown in the middle display. He puts his car into Cruise mode for more efficiency of the car.

image 54: Car at night, right blinker set, cruise control and headlights (incl. front fog lights) activated (German)

Felix is speeding his car and therefore has to shift his gear. As he is speeding up, the indicator in the tachometer is showing the proper gear to shift for an economical mode of travel.

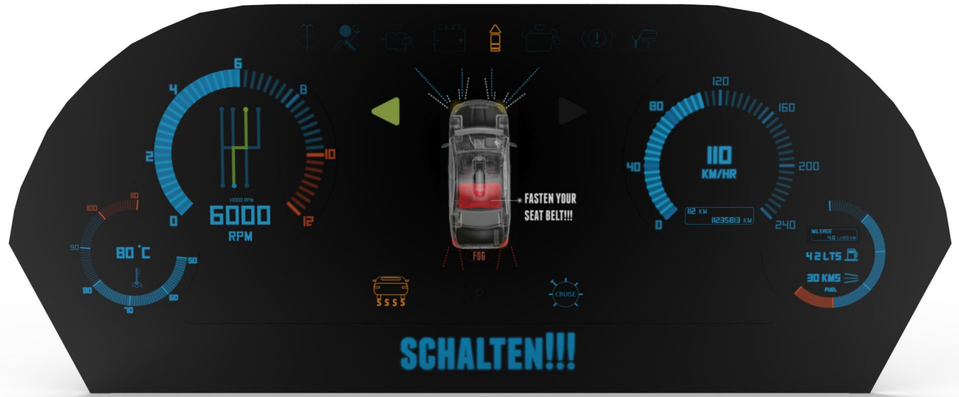


image 55: Gear shift indication (German)

Felix has traveled a long distance. His car dashboard shows that he is having low fuel.

image 56: Low fuel warning (German)

Felix has connected his mobile with the centralized system of the car. Suddenly he gets a call from his friend Chris about when he is reaching.

image 57: Incoming call (German)

As Felix is traveling for a long time, his car dashboard shows that he is having low water for cleaning windshield and at the same time it shows that the car has some problem with the engine and the brake system. Bottom display shows the texts related to the warning signs shown at the top display.

image 58: Several warnings A (German)

image 59: Several warnings B (German)

image 510: Several warnings C (German)

5.2.2 Indian Design

Rahul and his friends decides to go to Goa by his car. They start their journey in the evening. As soon as Rahul starts his car he gets the greeting message "Good evening" on his dashboard display.

image 511: Welcoming the driver (Indian)

As he starts his car, he gets all the safety checks on the dashboard display.

image 512: Self-check of the car (Indian)

Rahul after following all the safety procedures starts his journey. After sometime he has to now take left turn and so he turns on the left side indicator. Meanwhile, VSC is also active. One of his friends who is seating at the backseat open up the seat belt, so the dashboard shows that he has to fasten the seatbelt for safety measures.

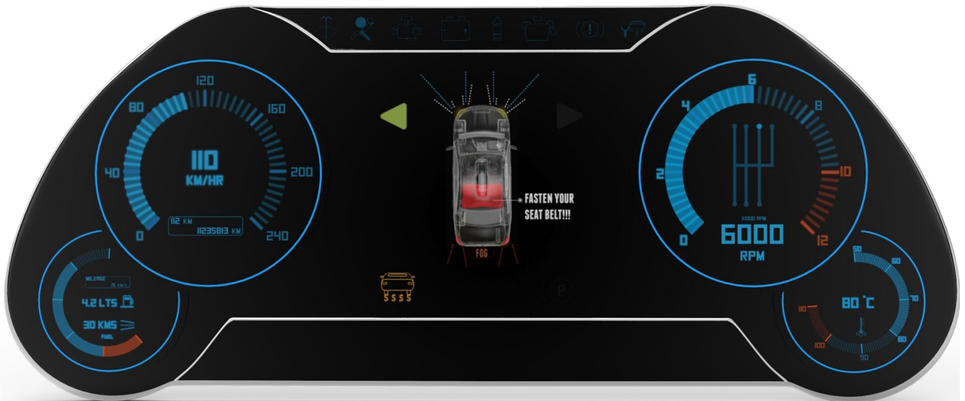


image 513: Left turn, all lights on (incl. fog lights), released seat belt in the rear (Indian)

As Rahul speeds up his car and immediately his dashboard shows message to shift gear for better economy mode of travel. As this is his new car, he always uses the tachometer to shift gears.

image 514: Gear-shifting indicator (Indian)

Rahul is stuck in the traffic. He is moving slowly now. As he goes near another car, his dashboard shows a message that obstacle is ahead, so that he does not hit the other car.

image 515: Obstacle in front of the car (Indian)

Rahul has traveled a long distance. His car dashboard shows that he is having low fuel.

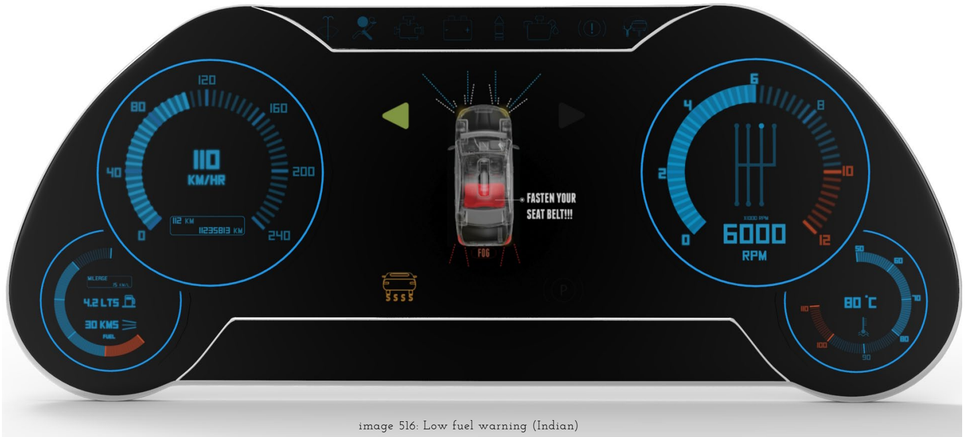


image 516: Low fuel warning (Indian)

Rahul has connected his mobile with the centralized system of the car. Suddenly he gets a call from his brother Amit to know if he is okay or not.

image 517: Incoming call (Indian)

As Rahul is traveling for a long time, his car dashboard shows that the airbag is deactivated and at the same time it shows that the car has some problem with the battery and the engine oil. Bottom display shows the texts related to the warning signs shown at the top display.

image 518: Airbag deactivated (Indian)

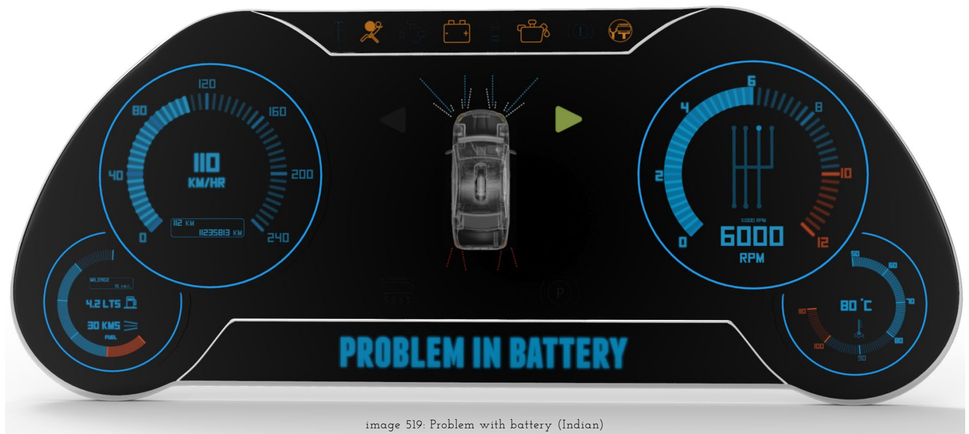


image 519: Problem with battery (Indian)

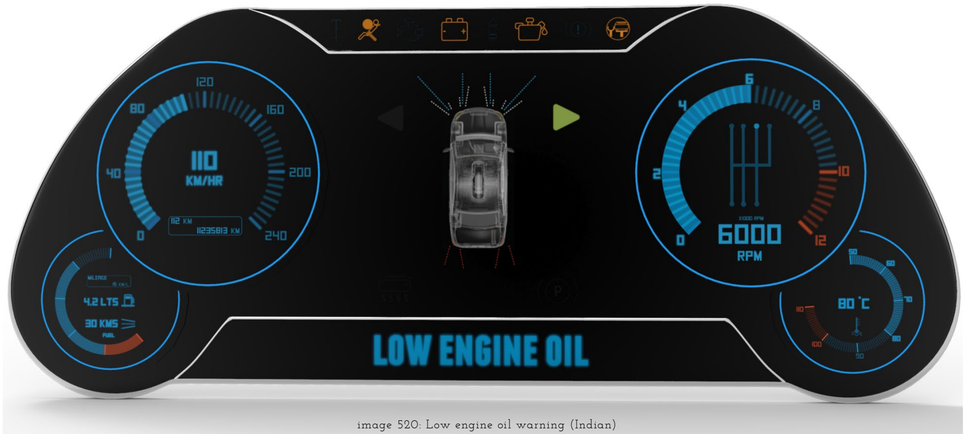


image 520: Low engine oil warning (Indian)

Discussion

6.1 Final Concept

The designs has been finalized for both the Indian and the German concepts. The image in the left is the German design and the image in the right is Indian design. As one can see both the designs have been kept very simple and minimalistic.

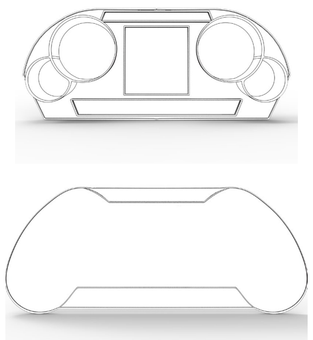


image 61: Comparison of both shapes

In the German design, each element of the cluster element has been separated by a periphery, so that complexity of the system decreases. Each element has been separated physically by either boxes or dials corresponding to its shape and size. As the German persona goes, who likes simple, elegant and balanced designs and also is not a follower of new trends in technology, though likes to use new technology, the interface of the design should be as simple as possible to comprehend when looked into. The material used in the German design is shiny wooden finish material to give the user a classic look as well as a feel of luxury to it. The edges are covered by a chrome ring which adds to the premium feel and the sense of luxury. The display used is a LCD display.

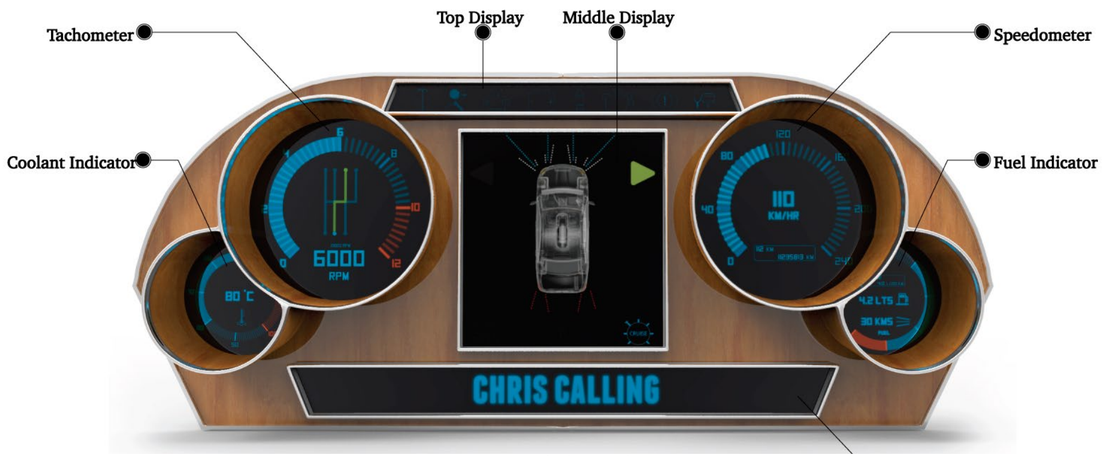


image 62: Details of German design A

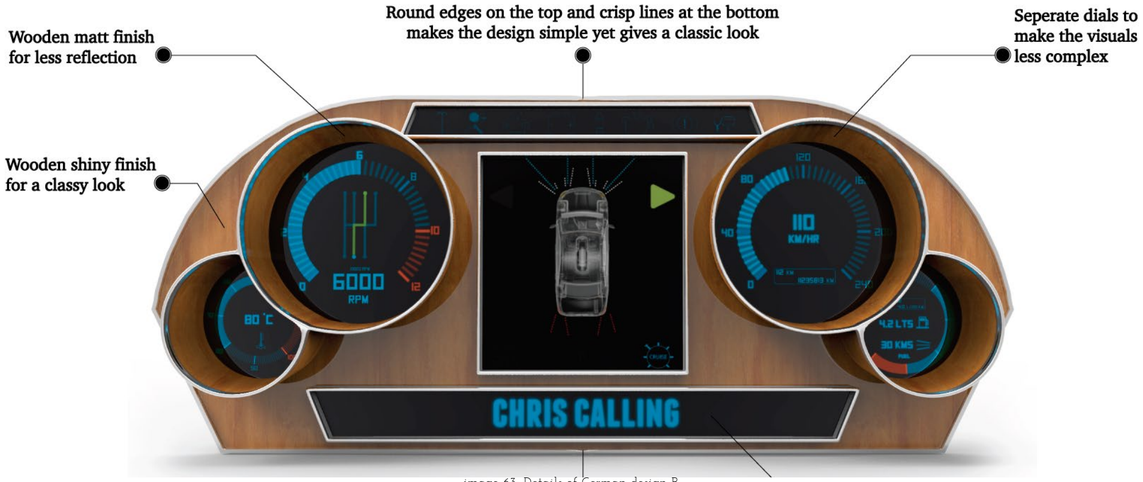


image 63: Details of German design B

In the Indian design, instead of making separate dials and information displays, one unified body is chosen with LCD display. As the design was centered on the persona of our interest, who likes playing computer games, the dashboard's form is heavily influenced by a game-pad's form. Similar to the German design, outer periphery has been covered by a chrome ring which again adds to the premium and luxury quotient of the design.

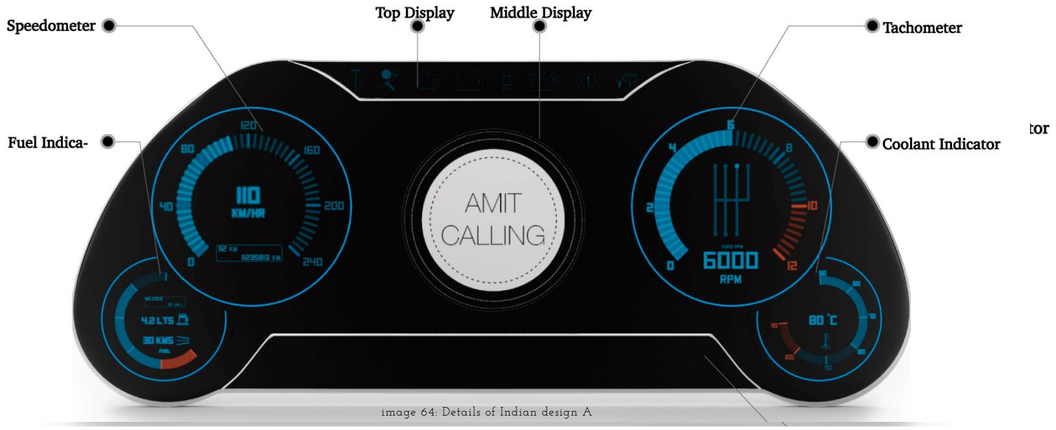


image 64: Details of Indian design A

One interesting thing about both the design is that both are derivative of one form. If the German design is inverted upside down and then the sharp edges are curved, it gets converted into the Indian design. Its interesting to see how culture plays an important role in even fixing a form while designing a product.

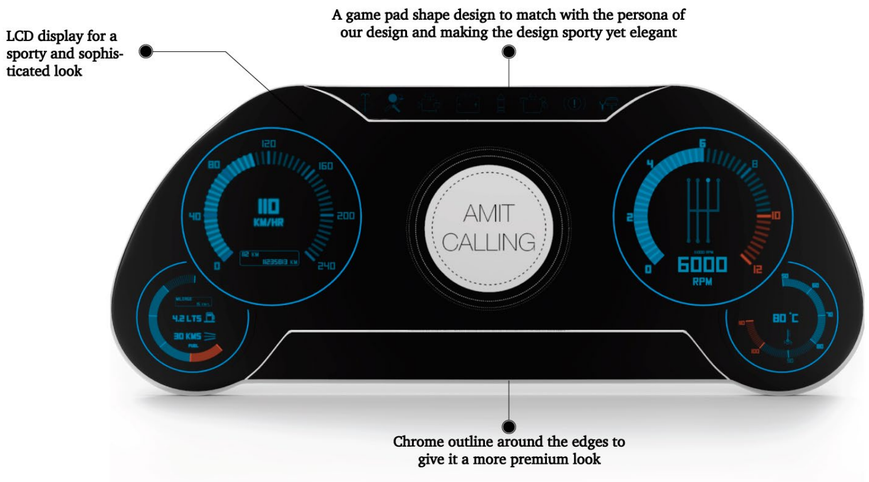


image 65: Details of Indian design B

6.2 Elements of the instrument cluster

Each of the elements of the cluster has been designed keeping in mind various design principles like the Golden ratio, Gestalt's law, Hick's law, color theory, etc. (infoComm) The elements are kept simple yet elegant. Main emphasis is given on the affordance of the elements and also special care has been taken so that cultural stereotypes of symbols and elements are not changed drastically from what is there in the current market. Below, various elements of the clusters are explained.

6.2.1 Speedometer

The speedometer a round dial as the outer shape. The dial is made up of small bars grouped together to give a feeling of continuity as per Gestalt's laws. As speed increases each bar light up more and the area light up would be covered by a transparent blue light to increase the redundancy of the information. Though the display is a digital one, the reason behind the display to mimic analog display is the fact that as the round dial lights up as speed increases, the display gives a feel of the increase or decrease of speed which is sometime missing in the digital displays. The center has a digital display for people who want to know exact speed of their car every time they are behind the steering wheel. At the bottom are two displays, one is a trip meter at the top which tells about the distance traveled in a certain journey and which can be reset to zero after the completion of every journey. The other one is the odometer which tells about the total distance travelled by the car from the start of its journey.

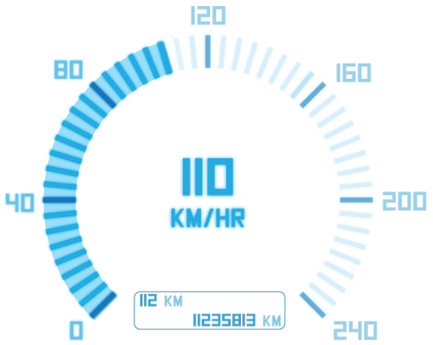


image 66: Designed speedometer

6.2.2 Tachometer (rpm indicator)

Similar concept is applied in designing the tachometer display as it was used for speedometer display. The round dial mimics an analog display and the bottom the exact rpm of the car is shown. The center has a display which gives information about

the gear in which the car is moving. It even suggest gear shifts when required for fuel efficiency of the car.

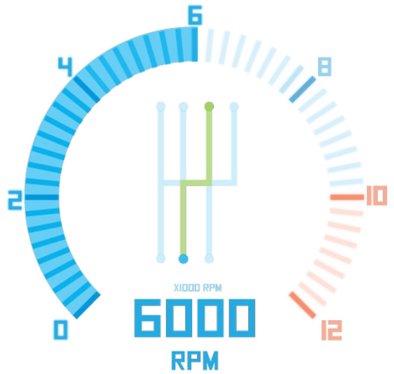


image 67: Designed rpm indicator

6.2.3 Fuel Indicator

The fuel indicator design follows the same design principles as was followed in other displays. The left is for the German design and the right is for the Indian design. The round dial glows blue as the fuel is full in the vehicle. As the fuel gets consumed, the bars in the dials stops glowing and also the blue light covering the dials gets reduced. The center of the dial shows four information. At the top is the mileage of the car, then comes the amount of fuel left in the car, then is the distance that can be traveled with that fuel and lastly it will show a warning that will say "low fuel" when it is comes under the red part of the dial.

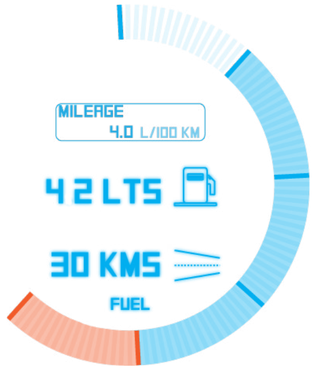


image 68.1: Designed fuel indicators (German)

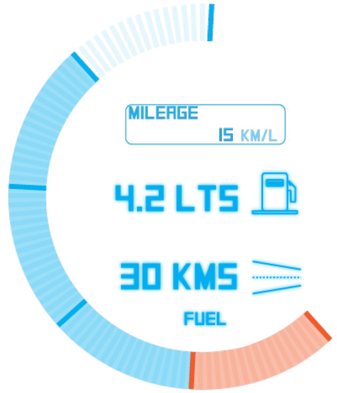


image 68.2: Designed fuel indicators (Indian)

6.2.4 Coolant Indicator

The design here follows the same design philosophy as is followed in the design of other display dials. The left hand side is for the German design and the right hand side is for the Indian design. The bar in the round display lights up as temperature of fluid increases and the blue light covering the round display also increases as the bar lights up. In the middle the temperature of the coolant is shown in the digital format.

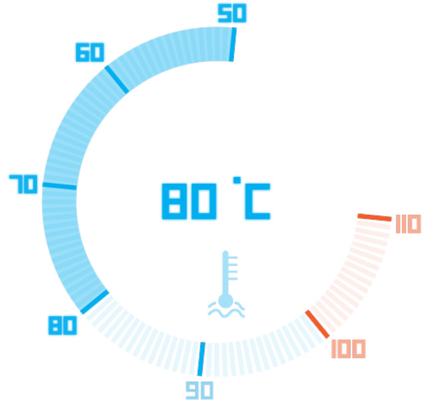


image 69.1: Designed coolant indicators (German)

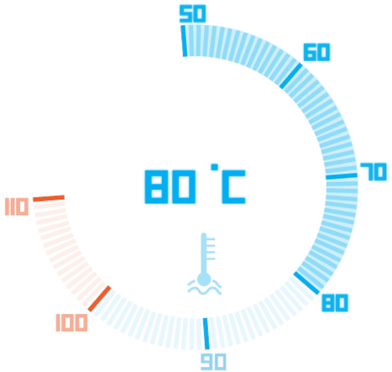


image 69.1: Designed coolant indicators (German)

6.2.5 Centre display

Apart from general warnings , this display would show up additional warnings that is critical for the safety of the user or the passengers traveling in the car. The center display would show information on the condition of the car while traveling and also when it is stopped. As soon as one starts up the car, it would check if all the necessary hardware are okay and gives a visual feedback and also if seat belts are fastened or doors are not closed. This display would again be used to showing up information of persons calling the user while he/ she is driving only if the cellphone is connected with the car dashboard system.

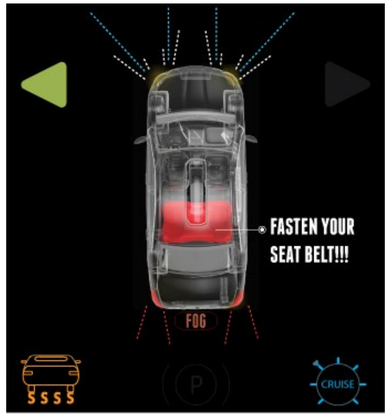


image 610.1: Main display

image 610.2: Main display

6.2.6 Top display

The top display has 8 sets of warnings, starting from low water for washing windshield to take your car for maintenance. The last symbol (maintenance) is added to show if a problem cannot be solved by the driver himself. See chapter 5.1 for details concerning the design of the warning symbols.

image 611: Designed warning symbols

6.2.7 Bottom display

Whatever information has been shown in the top, the bottom display will show a suitable text in the bottom display, so that redundancy of information is increased. Also, user attention always catches the warning signs and thus safety while driving is ensured. The driver does not need to read the manual to look for the meaning of the symbols.

image 612: Text in bottom display

Implementation:

In image 613 and image 614 , the implementation of both the German and the Indian dashboard is presented in three-dimensional views.

image 613: Possible implementation of German dashboard

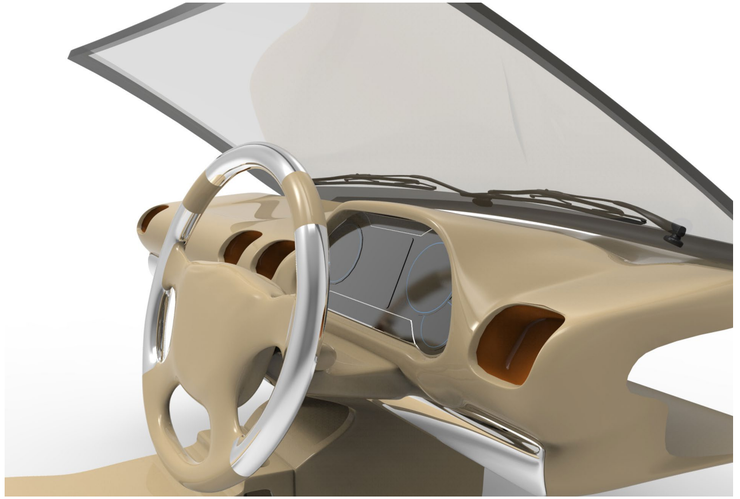


image 614: Possible implementation of Indian dashboard

Review of Design Process and Project Management

7.1 Used project management methods and implementation in design process

In the beginning, the team figures out the competencies and the expertise of each group member. Instead of a competency matrix, a first draft of upcoming stages is drawn. For each stage, one group member is designated as expert. As the German participants have to follow their normal class schedule too, both fixed time slots when they are available for team meetings.

After the stakeholder interview and clearing the task, the project's aims are defined and checked according to the SMART-scheme. Each member acknowledges the definition, which is clear to everyone during the whole project.

After the definition of the project a project structure plan is created. The structure is used to plan the design process and to estimate the work load. Subsequently, a Gantt-chart is constructed to manage the remaining time and steps of the project. The Gantt-chart is used to compare the current and the planned status.

7.2 Critical review

The project definition has been formulated properly, so that all questions concerning the task and the aims of the project had been cleared. The project structure plan has been used as a guideline for the whole project. It helps to ensure that everyone knows the current status and the following steps.

A Gantt-chart was created, but it has not been checked and adjusted during the project. Even though the group recognizes early that it underestimated the time for interviews and creating persona as well as concepts, the time table was kept untouched. In retrospect, the missing election of a project leader has shown disadvantages. It would have been the project leader's part to check the status frequently, especially concerning the time schedule. The outcome was the absence of a project steering unit that helps to stay on track. This led to an increasing delay. Because the team was very short of time for the final report and the presentation, the prototyping was canceled as it has been defined only as nice-to-have.

Outlook

In this Advanced Design Project the cultural differences regarding the dashboard designs of a B+ segment car ("Kleinwagen", respectively) have been elaborated and two dashboards for the Indian and the German market (one each) have been designed. The influences of the cultural differences on the design were shown and discussed.

Even if the target goal for this ADP was achieved, there are still tasks, which can and should be done in further ADPs. Due to time constraints it was not possible to produce a working physical prototype of the designed dashboards, only a virtual version has been elaborated. The goal of further ADPs could be the transfer of virtual to physical prototypes to improve the visualization and experience of the designs.

According to the user centered design process, there are two possible ways to evaluate the designs: either by experts or by the users themselves. Due to the short time period of six weeks it was only possible to evaluate the design by the project group itself. For further research it could be useful to evaluate the designs by Indian and German users of the estimated target group. The evaluation by users will generate further insights of the cultural differences, which could be transferred into the design to improve it. This procedure would represent a second loop in the user centered design process and would be helpful to identify further user requirements, which have not been considered yet. A physical prototype could support this process in giving the studied user group a living product instead of visualizations.

These two future perspectives could improve the comprehension of the cultural differences between India and Germany and enhance the success of new developed and designed products in the future.

References

Adam Opel AG. (2014). Opel ecoFLEX-Spritsparmodelle | Corsa - Opel Deutschland. Retrieved June 26, 2014, from http://www.opel.de/fahrzeuge/ecoflex/modelle/corsa-ecoflex.html.

American Society for Quality. Affinity Diagram. Retrieved June 26, 2014, from http://asq.org/learn-about-quality/idea-creation-tools/overview/affinity.html.

Assistant Secretary for Public Affairs. (2013). Personas. Retrieved June 26, 2014, from Department of Health and Human Services: http://www.usability.gov/how-to-and-tools/methods/personas.html.

Bausenwein, M., & Belz, V. (2010). Produktentwicklung für Emerging Markets - Mit Lean Development zum marktgerechten Produkt. Retrieved from http://www.unity.de/uploads/media/FA_Produktentwicklung_fuer_Emerging_Markets_Mit_Lean_Development_zum_marktgerechten_Produkt.pdf

BAUSER GmbH & Co. KG. (2011). Visualize, Control, Communicate, 7. Retrieved from http://www.bauser-control.de/cd_bed_anl/pdf_files/englisch/bauser_kombi-instrumente_1105_en_v1.1.pdf

CarsNewsBlog. (2014). Tata Indica Vista. Retrieved June 26, 2014, from http://newartcars.com/gallery/2640910-tata-indica-vista.html.

Chatterjee, P. (2013). New dashboard designs reflect the driver's style. Retrieved June 26, 2014, from http://www.edn.com/electronics-blogs/automotive-innovation/4425848/New-dashboard-designs-reflect-the-driver-s-style.

Conway, A. (2011). Maruti Suzuki launches new Swift. Retrieved June 26, 2014, from http://www.auto-types.com/news-gallery-3/maruti-suzuki-launches-new-swift-next-month-7633.html.

Daily Mail. (2013). Gillette won over Indian shavers after totally missing the mark. Retrieved June 26, 2014, from Daily Mail (UK): http://www.dailymail.co.uk/news/article-2443191/Gillette-spent-fortune-Indian-razor-forgetting-countrys-running-water.html.

Dennison, J. (2014). What Does This Light on my Subaru Dashboard Mean? Retrieved June 26, 2014, from Stanley Subaru: http://www.stanleysubaru.com/blog/2012/may/24/what-does-this-light-on-my-subaru-dashboard-mean.htm.

DIY Go Karts. (2014). Can you install a tachometer on a small engine (DIY Go Kart Forum). Retrieved June 26, 2014, from http://www.diygokarts.com/vb/showthread.php?t=8092.

Filev, A. (2008). Top-down and Bottom-up Project Management: Leveraging the Advantages of the Two Approaches. Retrieved June 26, 2014, from http://www.wrike.com/projectmanagement/02/07/2008/Top-down-and-Bottom-up-Project-Management-Leveraging-the-Advantages-of-the-Two-Approaches.

Gaadi.com. (2014a). Latest B Segment Cars in India. Retrieved June 26, 2014, from http://www.gaadi.com/latest-B-segment-cars-in-india/page2.

Gaadi.com. (2014b). Tata Vista Testdrive. Retrieved June 26, 2014, from http://www.gaadi.com/Tata-Vista-TestDrive.

Herbeth, N., & Blumenthal, D. (2013). Product appraisal dimensions impact emotional responses and visual acceptability of instrument panels. Food Quality and Preference, 29(1), 53–64. doi:10.1016/j.foodqual.2013.02.003

infoComm. Dashboard for Controls Design Reference. Retrieved June 26, 2014, from http://www.infocomm.org/fileStore/Dashboard_for_Controls_Design_Reference.pdf.

leanyourcompany.com. Using Affinity Diagrams to make sense from Brainstorming. Retrieved June 26, 2014, from http://www.leanyourcompany.com/methods/Using-Affinity-Diagrams.asp.

Lidwell, W., Holden, K., & Butler, J. (2010). Universal Principles of Design, Revised and Updated. ;: 115 Ways to Enhance Usability, Influence Perception, Increase Appeal, Make Better Design Decisions, and Teach through Design.

mobile.de. (2014). Bild Front - VW Polo GTI 7-Gang-DSG - 132 kW - bei mobile.de. Retrieved June 26, 2014, from http://www.mobile.de/modellverzeichnis/volkswagen/polo-tab-bild-vag_pol_10_gti_1.html.

Moto-Madness. (2014). Motogadget Motoscope Pro Digital Dashboard. Retrieved June 26, 2014, from https://www.moto-madness.com/motogadget-motoscope-pro-digital-dashboard-p-1549.html?cPath=745_746.

Science Buddies. Everything You Need to Know About Fonts for Display Boards. Retrieved June 26, 2014, from http://www.sciencebuddies.org/science-fair-projects/project_display_board_fonts.shtml.

Sweets. Distance Legability Chart. Retrieved June 26, 2014, from http://sweets.construction.com/swts_content_files/1343/512482.pdf.

UICloud. (2013). Super Car Dashboard Designs. Retrieved June 26, 2014, from http://ui-cloud.com/super-car-dashboard-designs/.

Usability Net. (2006). Contextual inquiry. Retrieved June 26, 2014, from http://www.usabilitynet.org/tools/contextualinquiry.htm.

Wikipedia. (2014a). Car classification. Retrieved June 26, 2014, from http://en.wikipedia.org/w/index.php?oldid=613552191.

Wikipedia. (2014b). Dashboard - Wikipedia, the free encyclopedia. Retrieved June 26, 2014, from http://en.wikipedia.org/w/index.php?oldid=613995963.

Appendix

A. Questionnaire for user interviews

Personal

- What is your name?
- What is your age?
- What is your profession?
- What are your life goals?
- How do you spend your free time?
- How do you use social media?
- (Do you have a smart-phone?
- For what purpose do you use your smart-phone?
- How often do you change your phone?)
- Are you comfortable with new, unknown technologies?
- If you buy something new, will you read the manual first?
- How many times do you use your phone for calling?
- … Also while driving?
- Do you call your family/friends when you reach your destination?
- Describe your normal day. (go into dept to find out about his lifestyle)
- fashion sense/style

Driver's experience

- Do you own a car?
- Which cars did you have before?
- Which car do you drive right now?
- Which are your favorite brands?
- For what purpose would you like to buy a car?
- Do you follow new trends in car?
- What is your driving experience?
- … driving level
- What is the normal speed you drive your car?
- in the city (in comparison to speed limit)
- outside the city (in comparison to speed limit)
- Do you like driving?
- Do you feel safe?
- Have you ever had difficulties while driving?
- How do you feel while driving?
- When do you feel mostly concentrated?
- Are there any situations that make you feel happy, frustrated or angry?
- In which situations do you feel stressed?
- How do you feel while driving at night?
- Which safety rules do you follow?
- How do want to improve your driving experience?

Car usage

- How often do you use your car in a week?
- For which purpose do you use your car?
- What kind of experience would you like while driving the car?
- Where do you take your car? (Where are you going with your car?)
- How much do you travel (distance per way)?
- Do you use your car for shorter (how short is short?) or longer distance?
- More inside/outside the city?
- What are your frequent destinations?
- How much time do you drive per day?
- What time do you use your car? (morning, noon, evening)
- Do you do multi-tasking while driving?
- If yes, which are the activities you follow?

Dashboard questions

- How often do you look at your dashboard?
- Describe the interior of your car. (Shape, Color!)
- Describe your dashboard.

- What instruments do you have on your dashboard?
- What instruments do you look at when you see the dashboard while driving?
- How often and for what purpose do you use your dashboard?
- Out of all instruments on the dashboard, which instrument do you see mostly?
- Which is the next most important instrument for you?
- Do you check the fuel efficiency of your car?
- How do you do that?
- Do you prefer an analog or digital display or maybe a combination of both?
- Why?
- Have you faced any problems with your dashboard (in situation: city, highway, day, sunlight, night)?
- Are there things you want to modify at your dashboard?
- Why?

B. Subaru Vehicle Symbols

■ Abbreviation list

You will find several abbreviations in this manual. The meanings of the abbreviations are shown in the following list.

Abbreviation	Meaning
A/C	Air conditioner
A/ELR	Automatic/Emergency locking retractor
ABS	Anti-lock brake system
AKI	Anti knock index
ALR	Automatic locking retractor
AT	Automatic transmission
ATF	Automatic transmission fluid
AWD	All-wheel drive
DCCD	Driver's control center differential
DRL	Daytime running light
EBD	Electronic brake force distribution
ELR	Emergency locking retractor
FWD	Front-wheel drive
GAW	Gross axle weight
GAWR	Gross axle weight rating
GVW	Gross vehicle weight
GVWR	Gross vehicle weight rating
HID	High intensity discharge

Abbreviation	Meaning
INT	Intermittent
LATCH	Lower anchors and tethers for children
LED	Light emitting diode
LSD	Limited slip differential
MIL	Malfunction indicator light
MMT	Methylcyclopentadienyl manganese tricarbonyl
MT	Manual transmission
OBD	On-board diagnostics
RON	Research octane number
SI-DRIVE	SUBARU Intelligent Drive
SRS	Supplemental restraint system
TIN	Tire identification number
TPMS	Tire pressure monitoring system
VDC	Vehicle dynamics control

Vehicle symbols

There are some of the symbols you may see on your vehicle.
For warning and indicator lights, refer to "Warning and indicator lights" ☞22.

Mark	Name
	WARNING
	CAUTION
	Power door lock
	Power door unlock
	Power window with automatic open and close function
	Passengers' windows lock and unlock
	Fuel
	Front fog lights

Mark	Name
	Hazard warning flasher
	Engine hood
	Trunk lid (4-door)
	Seat heater
	Child restraint top tether anchorages
	Child restraint lower anchorages
	Horn
	Wiper intermittent
	Windshield washer
	Windshield wiper mist (for single wipe)
	Rear window wiper

Mark	Name
	Rear window washer
	Lights
	Tail lights, license plate light and instrument panel illumination
	Headlights
	Turn signal
	Illumination brightness
	Fan speed
	Instrument panel outlets
	Instrument panel outlets and foot outlets
	Foot outlets
	Windshield defroster and foot outlets

Mark	Name
	Windshield defroster
	Rear window defogger/Outside mirror defogger/Windshield wiper deicer
	Air recirculation
	Engine oil
	Washer
	Door lock (transmitter)
	Door unlock (transmitter)
	Trunk lid open (4-door) or rear gate unlock (5-door) (transmitter)