

How the use of colour with other visual design elements can help to design better mobile application interface for colour blind people

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The goal of this paper is to analyse how the mobile interface design can be made accessible for the colour blind people. The focus will be on how the use of colours with other visual elements such as point, line, shape, typography, texture, and patterns can improve to designing a more reliable mobile application interface.

Executive Summary

Color blindness affects approximately one in twelve men and one in two hundred women i.e. approximately 5-6% of the entire population (Probability of color blindness, 2008). It is indeed necessary to consider this group of people while designing any application. According to the survey and story blogs, there is twice the percentage of people who think colour blindness as a disability moreover many people keep themselves anomalous. The difficulties they face in distinguishing the colours in day to day life are numerous. Of all the recognised issues, problems associated with interaction of mobile interface are prominent. With the rapid evolution of technology and dramatic usage of applications in daily task, it is essential to design convenient for colour blind. This paper is a research made on the hypothesis - colour in isolation does not have significant impact on conveying the right message and it should be combined with any other visual design elements. The conclusion is made based on the information collected from various resources, the verification of the visual outcome is done using the colour-blindness simulator. Chapter 1 discusses in detail about the colour-blindness, obstacles standing in everyday life, the treatment and technology invitations, and the significance in considering the colour blind people while designing the mobile interface. Chapter 2 is understanding of the fundamentals in designing for the accessibility and interpreting today's designers' attention while designing for colour blind. Chapter 3 explores the colour theory and colours to be picked for designing. Chapter 4 concludes with the present initiatives/applications designed for colour-blind as well as the visual outcome of this research.

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Defining the problem

With day to day increase of colour usage in visual communication to communicating vast information and the rapidly evolving technology, design plays a major role in conveying the idea and, surprisingly, the designers are rarely considering to design for the accessibility. There are numerous problems faced by people around the world who are affected with colour blind. As there is no treatment for this yet, it is the designer's responsibility to make the design accessible for the colour blind. Of all the problems faced by colour-blind people, the focus of this research is to design a better mobile interface. The major problem identified is that colour in isolation can't help in conveying the information, rather combining colour with any other visual elements would make the design better. This research is focused on how the use of colour with other elements like point, line, shape, form, patterns and texture can help the visually colour deficiency people to identify colour with easy.

As a consequence, and based on the above mentioned details, a mobile application UI kit and working mobile applications which are user friendly for normal vision and as well as colour blind people are proposed.

Based on the problem statement mentioned, the following queries are constructed.

- a) What are the problems faced by colour blind while using the mobile application interface.
- b) Are today's designers considering to design user friendly interface for colour blind, and what is the significance of designing for colour blind?
- c) What design changes should be made for existing interface to make it accessible?

Scope of the Problem

This research will focus on designing a mobile application interface that is user friendly for colour blind. And it will let them to use the mobile applications with ease. The proposed is mobile UI kit that can be used in any mobile application further. The prototype is based on the problems faced by colour blind while interacting with the mobile application. Focusing the design to be friendly interface for colour blind, here in the group of colour blind people are mentioned as users.

Chapter 1

Colour blind and types of colour blind

The term colour-blind is misleading as 99% of colour-blind people can see colours, thus it is preferable known as 'colour vision deficiency (CVD)'. Colour perception in the human eye is built up by three different types of cones. Each type is sensitive to a certain wavelength of light (red, green, and blue) and every perceived colour is therefore a mixture of stimuli of those three cone types. Now, if one of those peaks of sensitivity is shifted towards another one or if one is missing at all, you perceive a narrower colour spectrum (Daniel).

Thus people can see less number of hues than that of the normal people.

This is mostly inherited by the child from women chromosomes or can be caused later due to physical or chemical damage of the eye, with age, damage on brain etc.

There are different types of colour blindness based on photo pigment defects in the three different kinds of cones that respond to blue, green, and red light and out of these the focus is on the following major types of colour blindness.

- Protanopia – Red/Green colour blindness due to anomalous red cones.
- Deutanopia – Red/ Green colour blindness due to anomalous green cones.
- Tritanopia – Blue/Yellow colour blindness due to anomalous blue cones.
- Monochromacy/ Greyscale



Image created with <https://www.color-blindness.com/coblis-color-blindness-simulator/>

Red-green colour blindness is the most common, followed by blue-yellow colour blindness.

A complete absence of colour vision —total colour blindness – is rare. (nei.nih.gov, 2015)

Problems faced by colour blind people

People with colour blindness aren't aware of differences among colours that are obvious to the rest of us. They face many problems in day-to-day life, for example in identifying the colours on the traffic light, difficulty in understanding the route on the route map with colours, LED lights on the electronic appliances – confusing if the machine is on or off due to the colours red and green and while interacting with mobile and web applications. In today's world with the evolution of technology mobile applications have become a part of life and it can be considered that 80% of our day-to-day task are with mobile phones. Thus it is necessary as a designer to consider this users in Interface design and Visual design.

Treatment and cure to correct colour blindness

Regrettably, there is no treatment for the colour blind, till date the use of the colour tinted lenses and EnChroma glasses could not help all the people affected with colour blindness as it fails to differentiate the colour. Though the EnChroma glasses corrects the colour to certain

extent, they are pricey which most of them aren't able to afford. The only helpful tool for the colour blind is the Seekey which helps few colour blind effected to identify the colour.

Therefore there is no accurate cure for the people affected with colour blindness.

Chapter 2

Design and Design empathy

Design is about communicating the idea, making the product useable to delightful and beyond that, and also helping in solving the problems. A quotation of Joshua Brewer says

“Socrates said, “Know thyself.” I say, “Know thy users.” And guess what? They don’t think like you do.”

Design empathy is designing a product from the perspective of the user and understanding their feelings. The users don’t think or see like the designer. A Design is termed as ‘good design’ when every user can use it same way. The main aim of today’s designers should be to make a user friendly interface for all kinds of users.

Importance of designers to consider people effected with colour-blindness while designing

According to the surveys and blogs¹ of stories written by colour blind people, there are twice the percentage of people who think colour blindness as a disability and many people keep themselves anomalous. However, people effected with colour blind are not the only one to pay attention but also to consider the old aged people who find it difficult in differentiating the colours. As a designer it is our responsibility to contribute while designing any product/interface that is user friendly and makes the life easy for all the users. The question is are today’s designers considering the colour-blind people while designing. There are very few applications which are designed considering the accessibility. To be more specific let’s consider mobile user interface, according to the research proposal - the mobile application interface can be designed better for colour-blind people when colours are combined with other visual elements such as point, line, shape, form, typography, space, textures and

¹ Retrieved August 18,2019, from <https://www.color-blindness.com>

patterns. Thus this research is carried to understand '**How the use of colour with other visual design elements can help to design better mobile application interface for colour blind people**'.

Chapter 3

Understanding colour and the significance of colour in communicating

Color is a visual design elements used to create emphasis, impact and to communicate information effectively. Hue, Saturation and value are the characteristics that describe color. It is broadly divide into Primary, Secondary and intermediate colours and the primary colours being red, blue and yellow which future form the color schemes – Analogous, monochromatic, complementary, triad and compound.

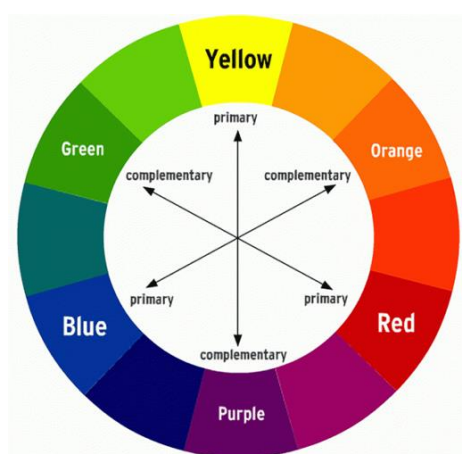
Colour plays a major role in visual communication, color jumps out to give an impression even before the viewer reads the information. There are many things communicated with the help of colour alone, the colour red is an indication of turned off, stop, danger and etc. Similarly every colour can be related unconsciously to something or the other. When colour is used to communicate such strong message to create an impact, it's challenge that all the users should able to understand the same message.

The colour palettes in designing for colour blindness

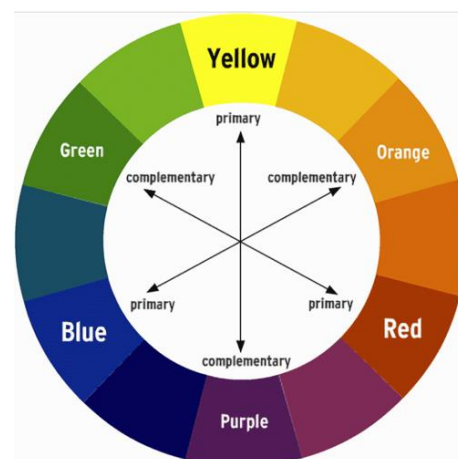
The colour-blind people find it difficulty in indenting the colours, thus there should be more understanding of which colours to be used while deigning. Colour is the most used element to communicate the message example- colours used in navigation/maps, colour used to emphasise on something that needs attention/notice, colour in displaying the information graphically through charts, to understand the action to be taken, to convey emotions and many more. Taking this into consideration it is the need for the designers to create a colour-blindness friendly interface. The following are some interesting facts gathered to pick colours while designing colour-blind friendly.

- Pick a colour scheme that is user friendly for not just colour blind but all the other users too.
- Avoid the bad combination of colour such as red & green, green & brown, green & blue, blue & grey, blue & purple, green & grey and green & black.
- Make use of monochromatic colours and limit the usage of colour to 2-3.
- Usage of colour based on the value, most of the colour blind people can identify the colours based on the value.

The following is the colour wheel for normal vision and red-green colour blindness. (Jager, 2018)

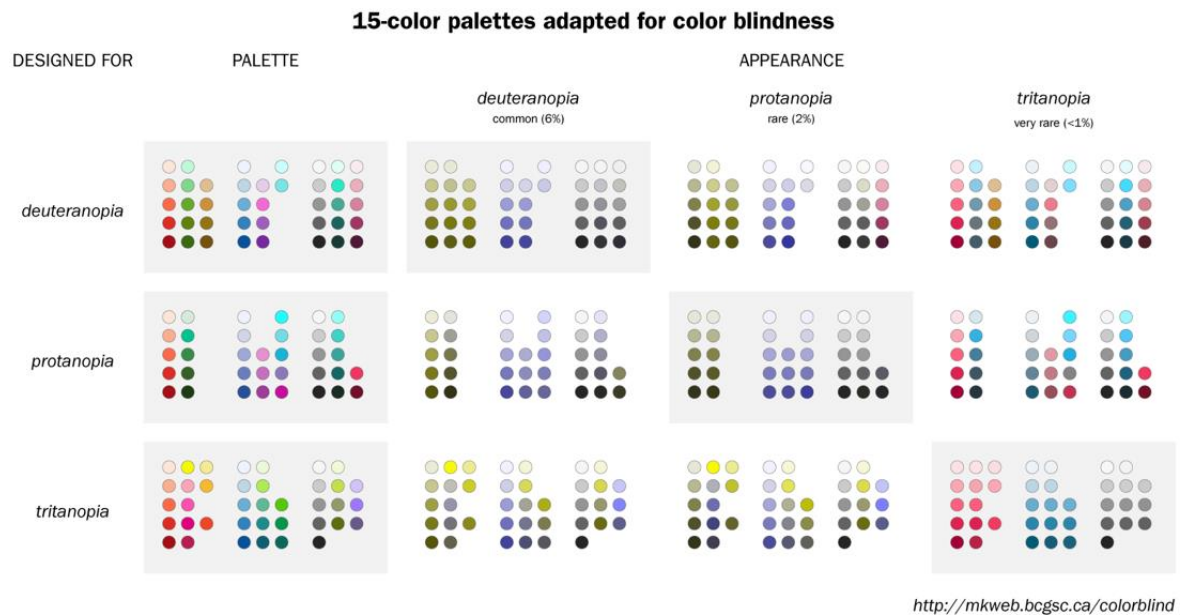


Normal vision



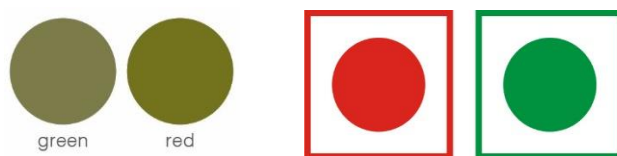
Red green colour blindness

The colour blind friendly palette supports colour combinations such as blue & orange, blue & red or blue & brown. In these cases, colour blind people can distinguish between the two, which eventually leads to optimized data visualization. (Jager, 2018)



Usage of these colours in the design can make a colour blind friendly interface.

It is necessary to note that the combination of red and green can be problematic for people having colour blindness.



Non veg and Veg indication

Taking this minute example, how do you think the colour deficiency people can identify if the product is veg or non veg. However designing something in minimal might be in trend but it doesn't help all the users. Eventually the question arises if the design emphasising on color alone is communicating the right message or not.

Thus, I hypothesize that color in isolation does not have a significant impact on conveying the right message for the colour blind people.

Chapter 4

Existing initiatives/applications for colour-blind people

An initiative to make the maps readable for the people with red-green colour blindness has been taken by the Japan's local government². Also, it is known that the most used communication platform 'Facebook' is designed with blue and white colours as the CEO Mark Zuckerberg is colour-blind. There are simulators that help you to view and design as per the colour different colour blindness³. The Adobe Photoshop has also taken an initiative by adding an option that tests the work according to the colour blindness and Google has an extension for Chrome to help the colour blind people to distinguish the colours and there are many websites that have multiple theme options which are colour-blind friendly, also the mobile applications that allow you to capture the image and know the colours and lists go on for a few more applications.

The interesting fact is that there are designers who themselves are colour blind and it's appalling to know how they design based on the colour value and software's that read out the colour names. Nevertheless, every application/ interface should be accessible to any kind of users. To make this happen, this research has identified a few problems in mobile applications and the ways to solve them.

² <https://www.color-blindness.com/2006/04/04/japans-public-facilities-making-life-easier-for-colorblind/>

³ <https://www.color-blindness.com/coblis-color-blindness-simulator/>

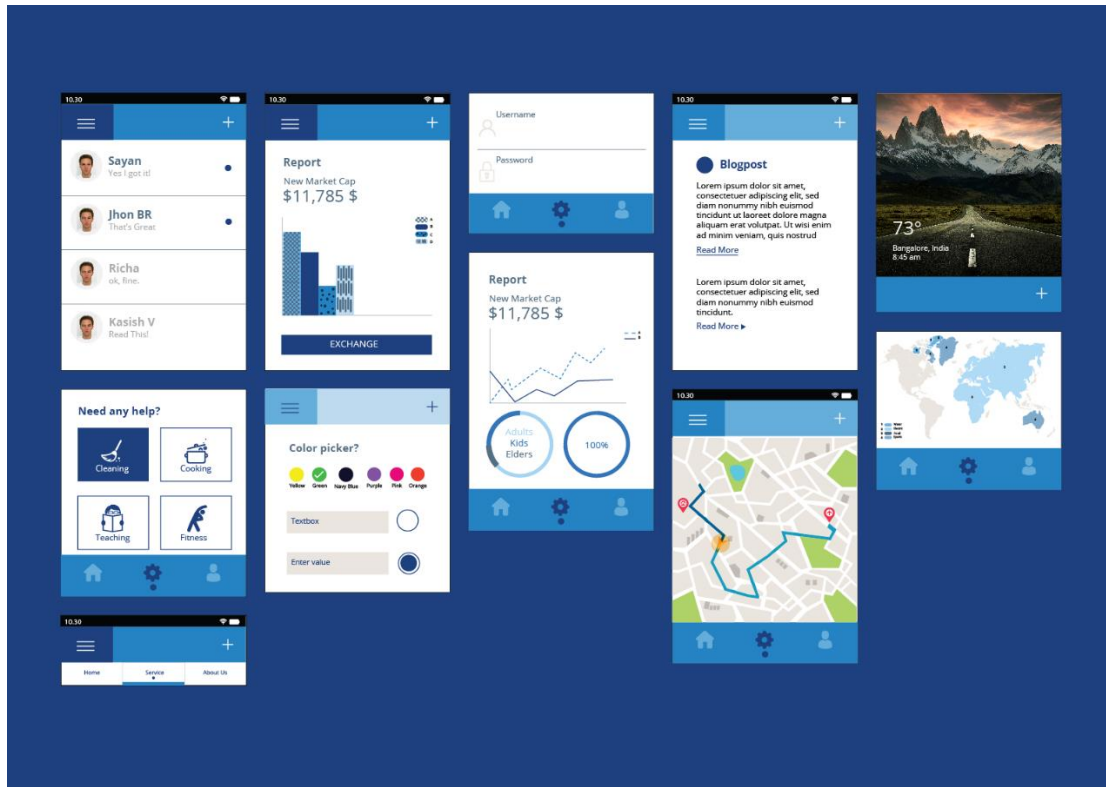
Design description overview

The research has a visual outcome of a mobile application UI kit and application screens designed which is aesthetic and is user friendly for both the normal vision and the color blind people. This mobile UI kit has essentials that communicates the right message to the colour blind people. This kit consist of:

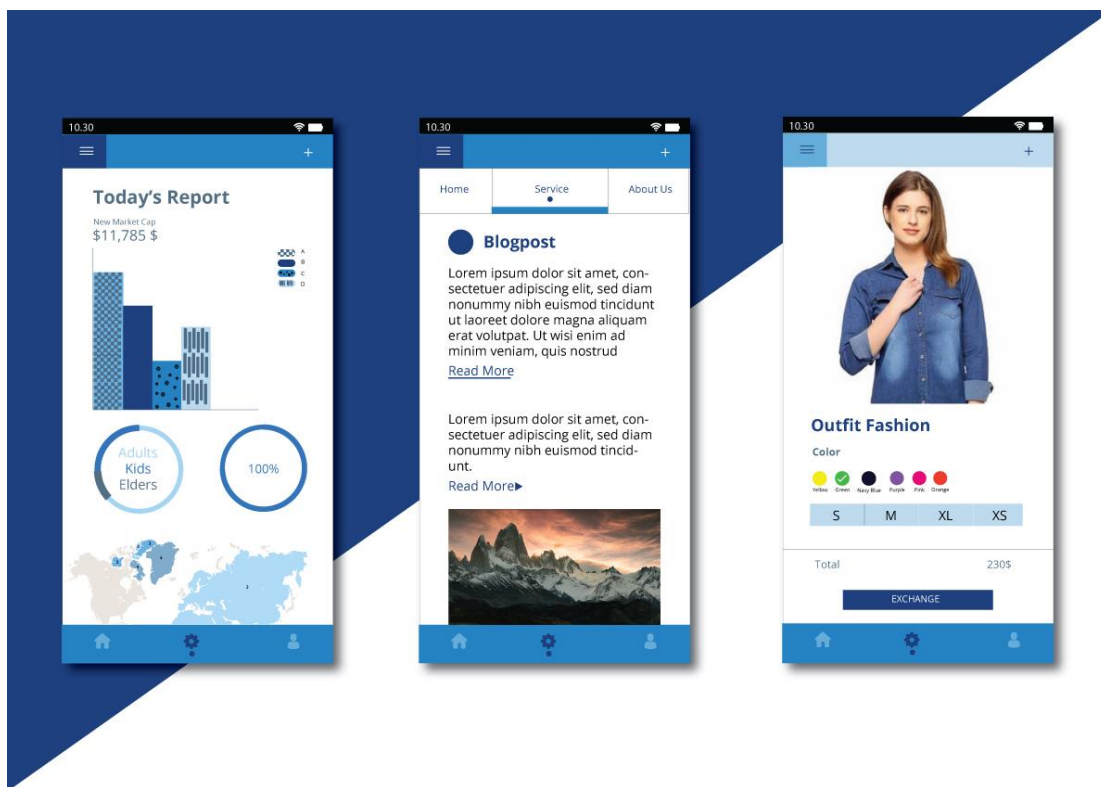
- Notification of messages (colour + dot)
- Contrast to be used (limiting the colours)
- Active button indication (Colour + dot/line)
- Charts like bar graph, line graph, and etc. (Colour + Patterns)
- Colour Picker (Colour + Typography)
- Form elements: Textboxes, radio buttons
- Login page
- Readable buttons (Colour + Line/Shape)
- Maps (Colour + Symbols)
- Text on the Image (Right usage of the colours)

To understand the UI elements created, it is necessary to examine the problems faced by the colour blind people in detail while interacting with the mobile application.

Visual outcome



The mobile UI kit designed for colour blind friendly

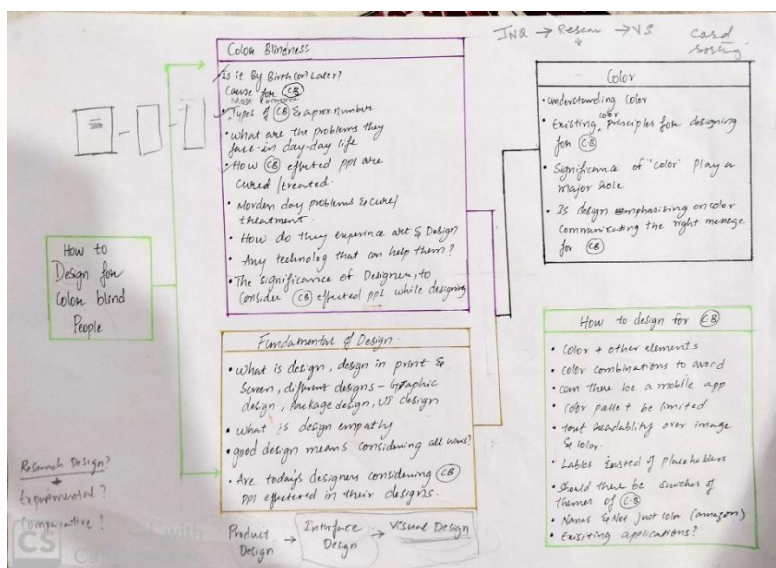
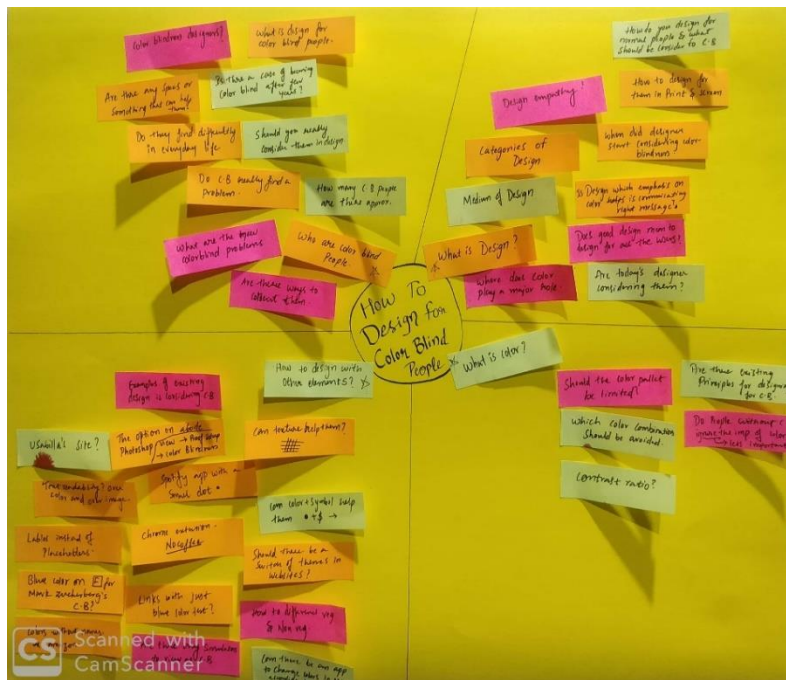


The mobile application interface designed for colour blind friendly

Design objectives and approaches

The main design objective is about design empathy, to design a mobile application interface considering the emotions and perceptions in the views of a color blind person.

The design process started with a mind map and then organizing the mind map to approach it systematically. Below is the mind map and the organized thought process:



The main objective of the research is to prove that colour alone can't communicate the right message. Thus, the element colour should be combines with any of the other visual elements, to understand this there is a need to examine the problems faced by colour blind people while interacting with the mobile user interface which has emphasis on colour alone. The below are the cases:

i. Colour used to notify the new message

Most applications use colour to notify the message but it becomes difficult for a colour blind person to understand this, Henceforth there should a dot or shape used along with the colour.

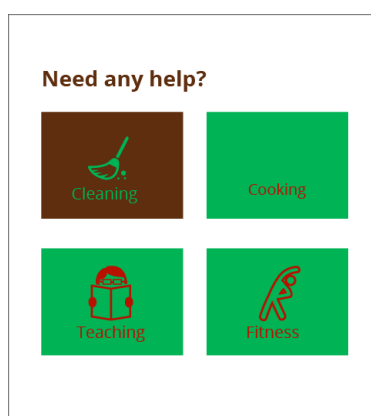


Colour used to notify message

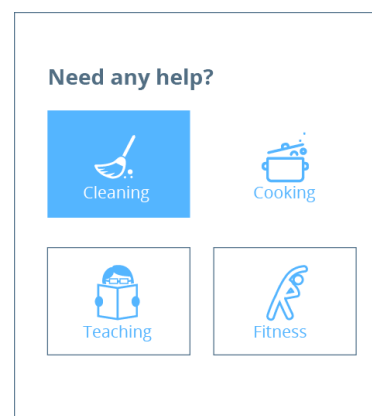
Colour used with a dot

ii. The colour combination used should be accessible friendly

It is must to limit the usage of colour in a application to 2-3, thus it creates an impactful effect on the users, the bad colour combinations should be avoided.

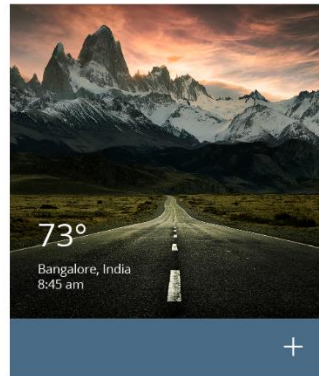
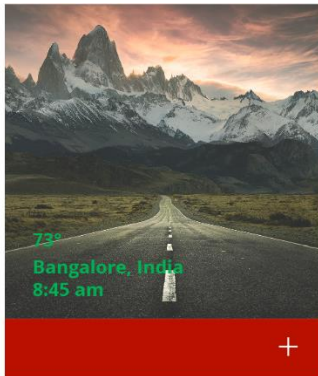


The text is hard to read



Usage of colours should be minimal

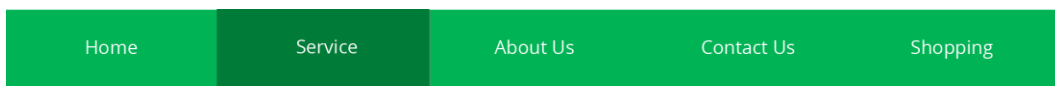
- iii. The colours used on the images of bright colours should be readable.



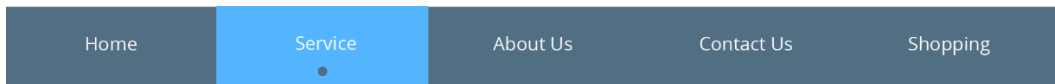
Dark colours should be avoided on the image

Use colours that are readable

- iv. The colour used to indicate the active button is not always prominent for the colour blind people

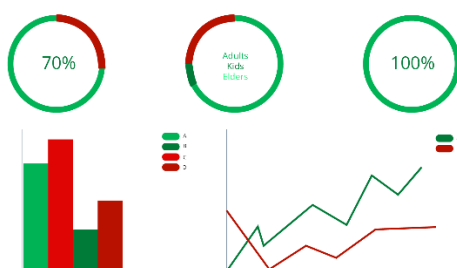


Colour used to indicate the active button

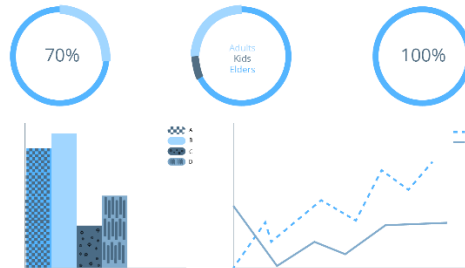


Colour used in combination with a dot to indicate the active button

- v. The use of colours alone in data representing in the charts is difficult to distinguish.
The use of patterns can solve this problem.

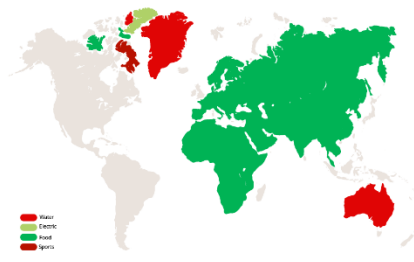
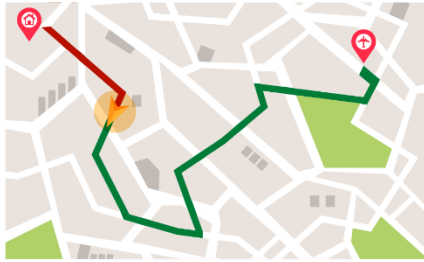


Colours alone used in charts

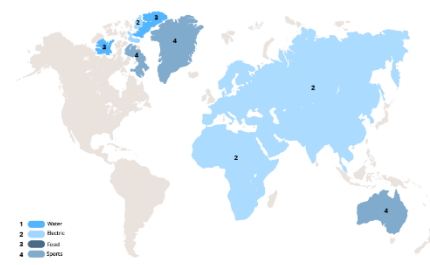
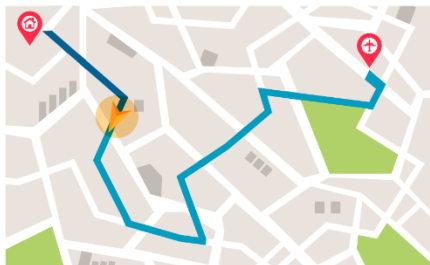


Colours used with patterns

- vi. The colours in maps for navigation and information can alone be confusing, Thus added numbers or type can help the users.



Bright colours used in representing data.



The use of colours in combination with symbols, type and etc.

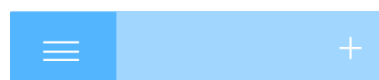
- vii. There are many e-commerce sites that use the colours without the naming this might be difficult for the colour blind people identify the colour.



Color picker?



Colour picker without names



Color picker?



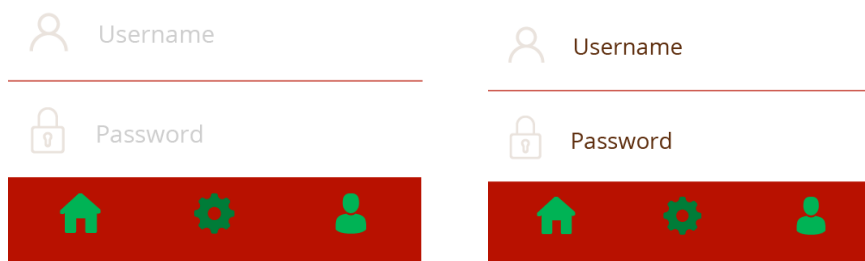
Colour picker with names

- viii. One of the observed bad design is, when there is no border given for a radio button it is very difficult to identify it. Thus there should be border defined



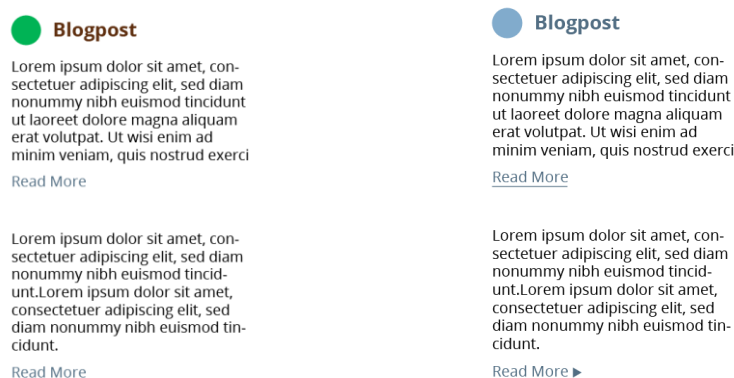
Use of border around the radio button

- ix. The placeholder in the textbox should be avoided as it is not seen usually



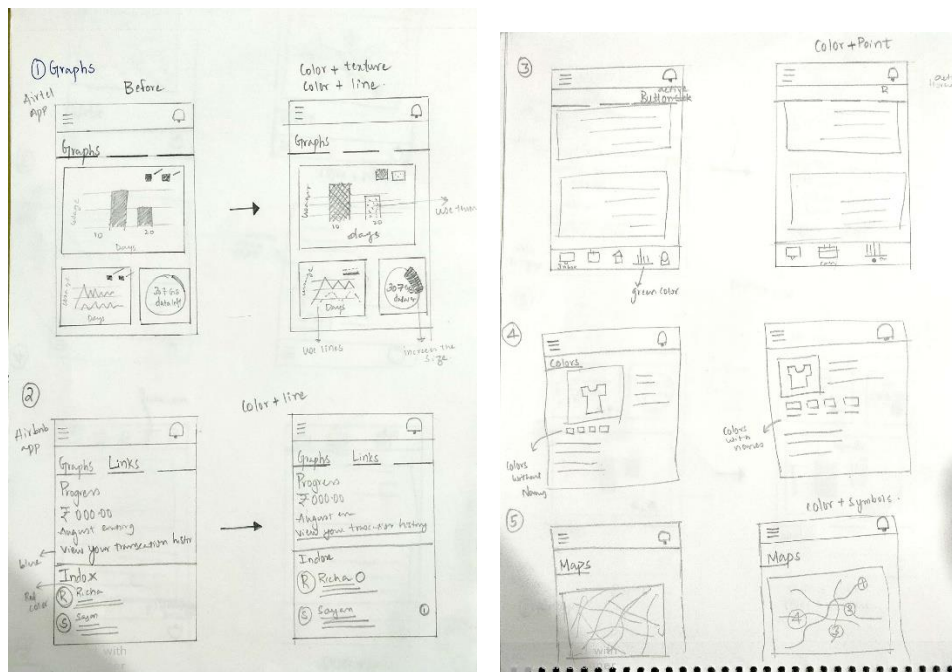
Avoid using the place holder as it is not visible

- x. The most important of all, there are many applications which use just colour to indicate the link but it is hardly visible and understandable for a colour blind person to identify it. A link should be combined with other visual element like line or shape.



To use a line of shape beside a link to identify it.

I have considered the following cases and designed wireframes for designing a color blind friendly applications. Below are the wireframes, left indicating the existing application screen and right indicating the design solution proposed.



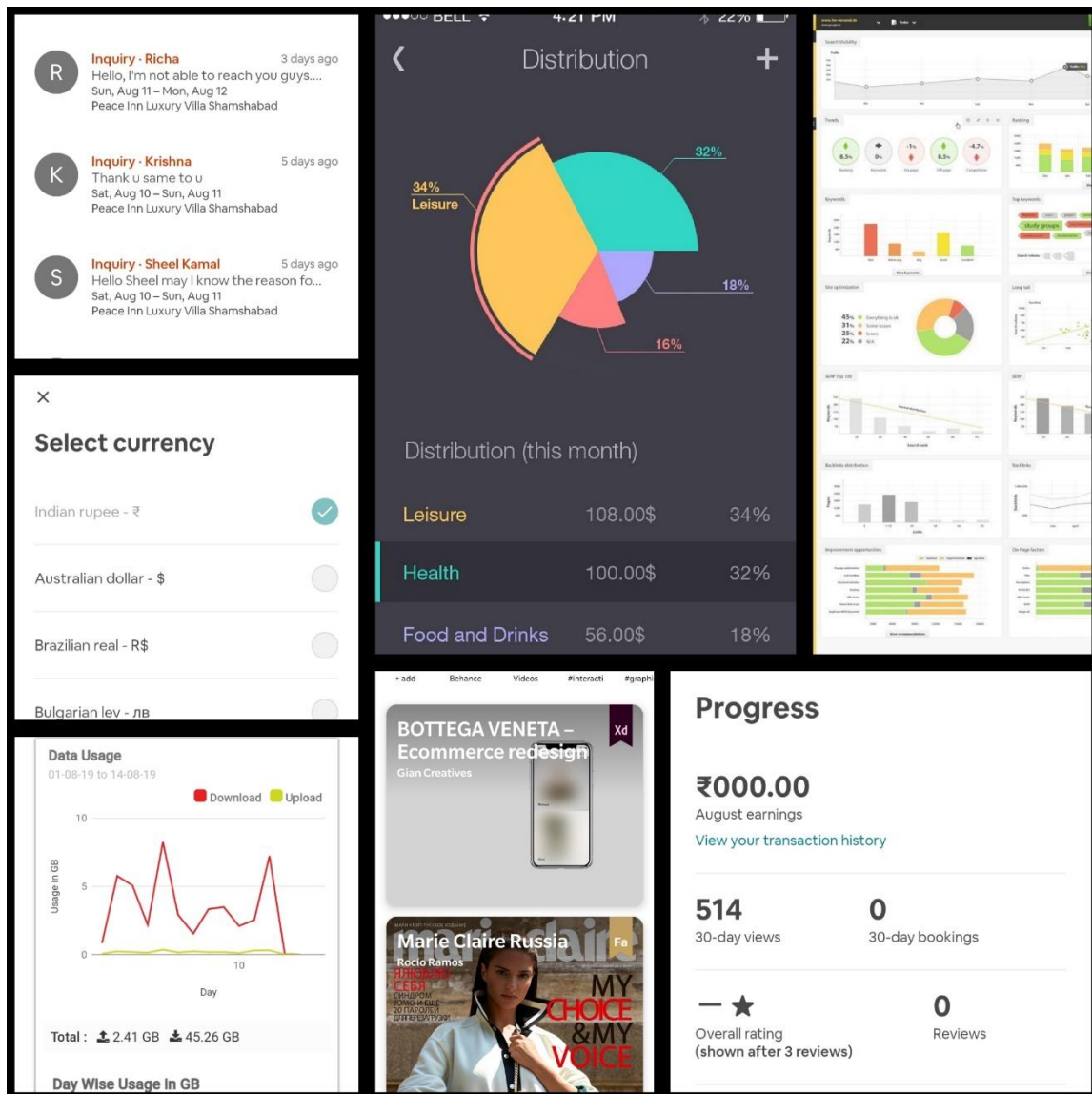
Wireframes for the application design interface

Type: The type used in the visual outcome is a simple open sans to let the user to easily read.

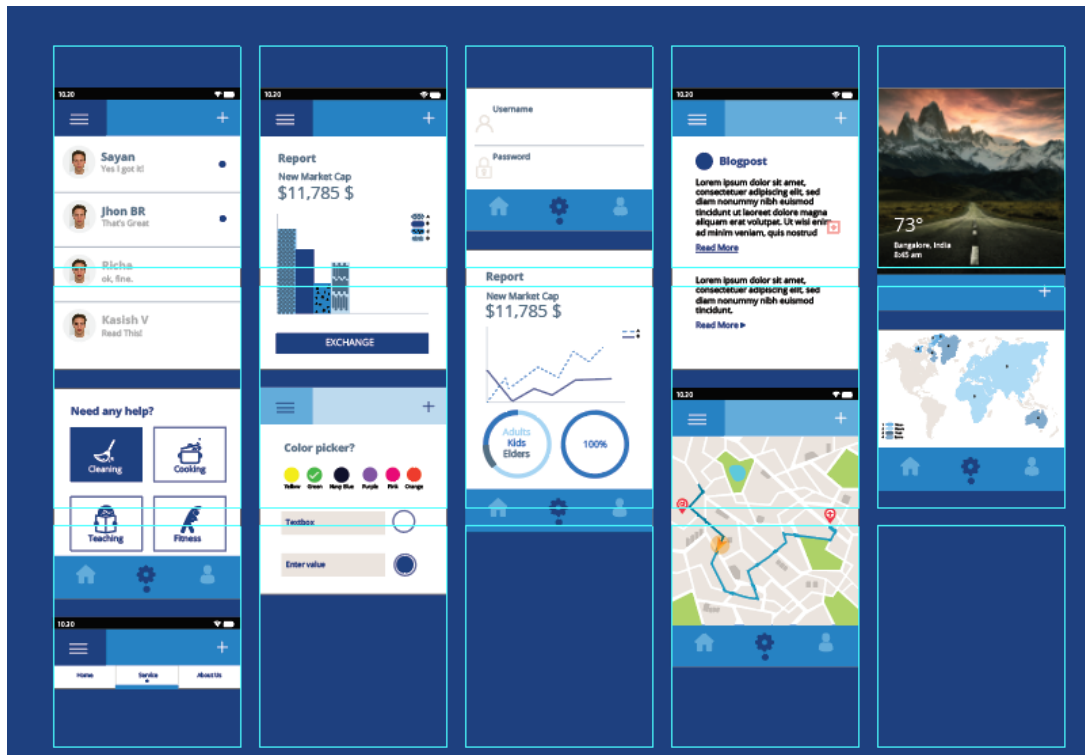
Colour pallet used: The monochrome colours of Blue share are considered as they are user friendly for colour blind people.



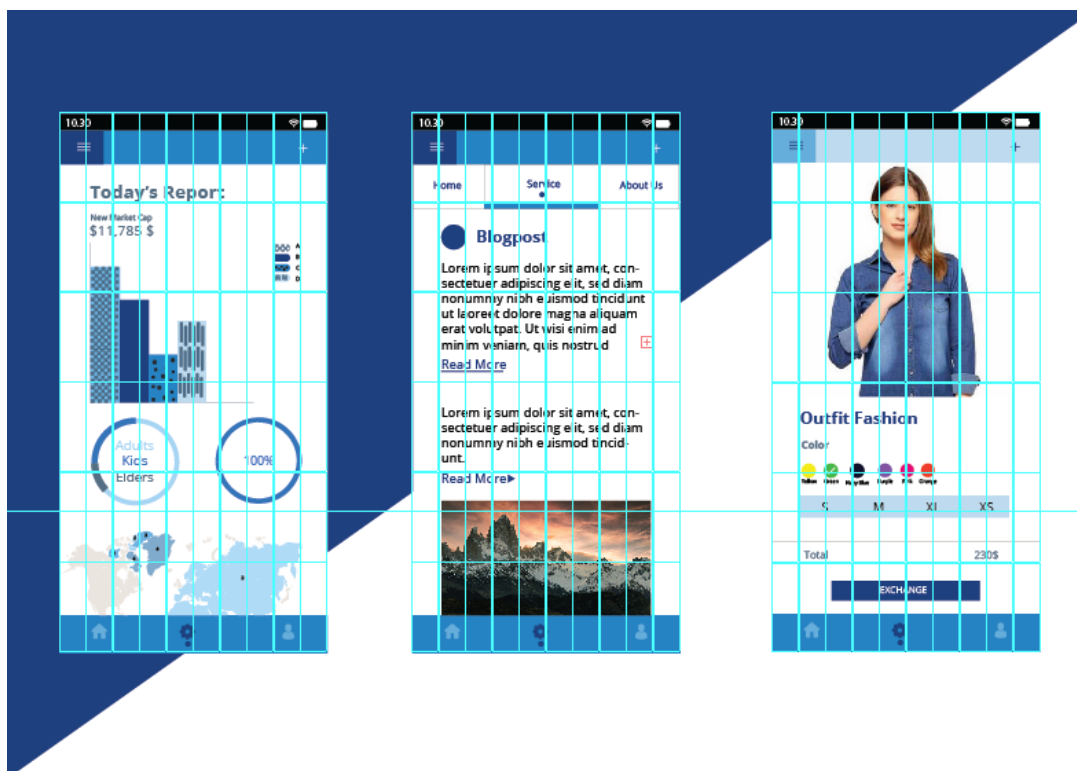
Mood Board: The existing application interfaces are considered to evoke the idea, to solve the problem faced by colour blind people while using them.



Grid: The grids used in designing the mobile UI kit and the application is 5X3.



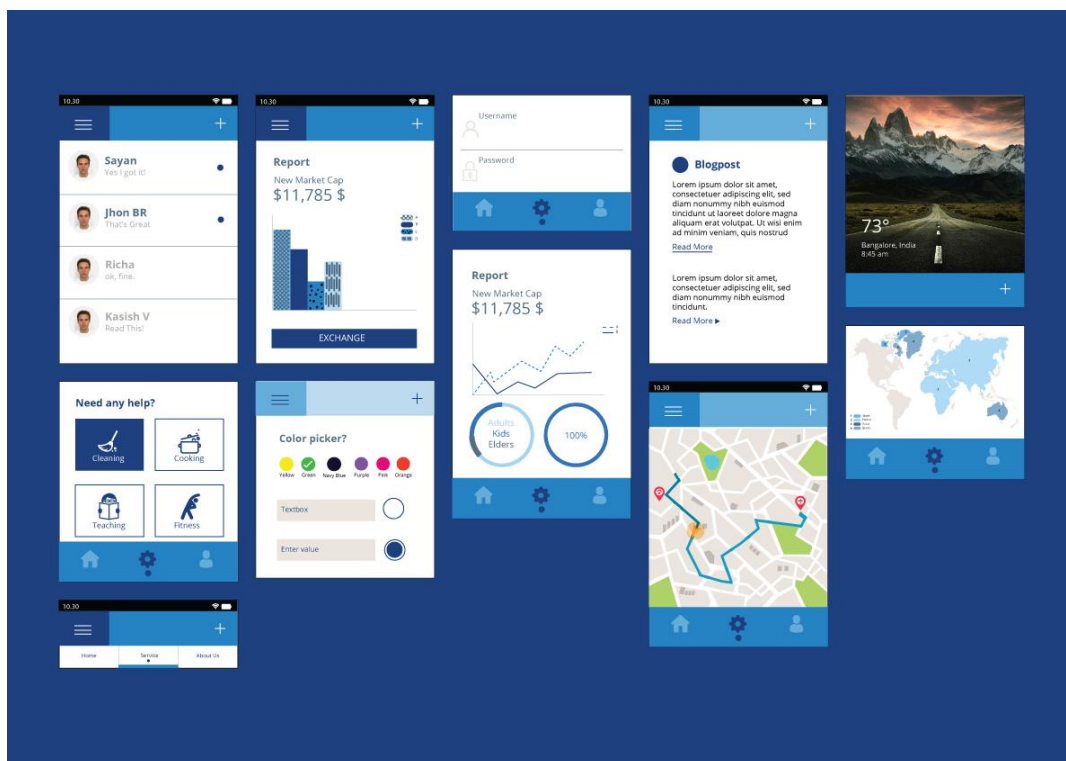
The grid used in designing the mobile application screens 10X6



Evaluation overview

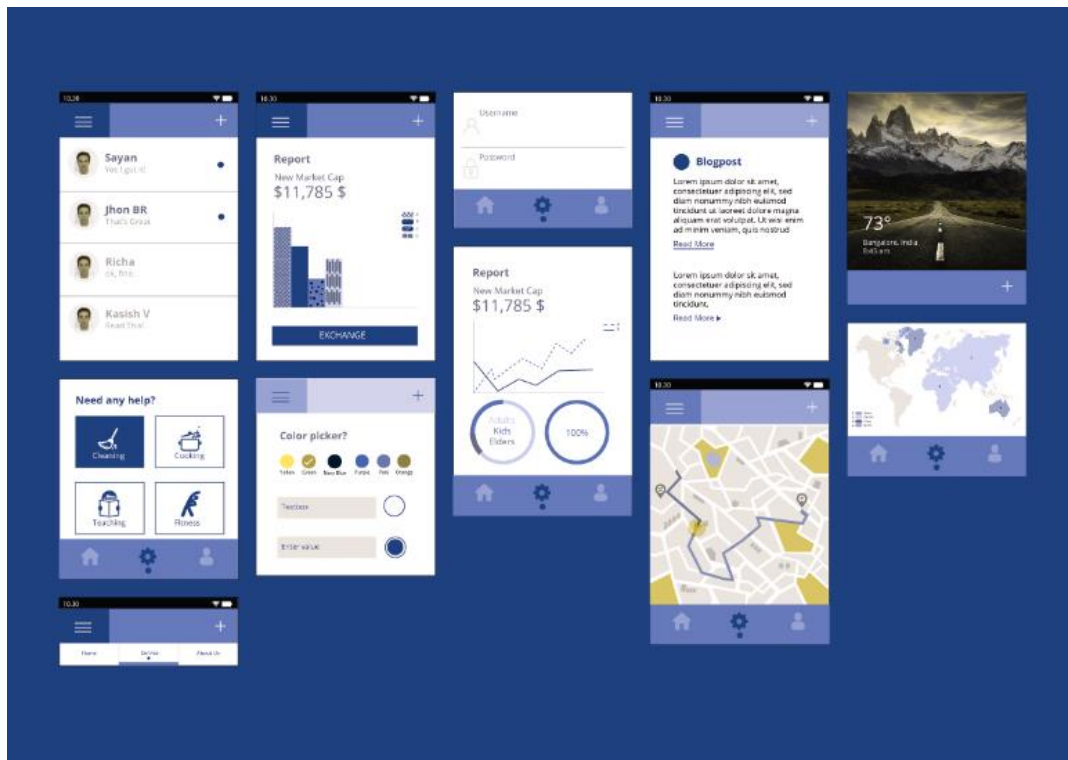
The designed Mobile UI is tested using the colour blind simulator⁴. Summing it up, it is to be noted that colour alone shouldn't be used to communicate any kind of information and also the use of high and low value colours can make the user identify the colours easily. Colours in combination with other visual design elements like dot, line, shape, space, form, patterns and texture can help the user to understand the message in right way.

Normal Colour Vision:

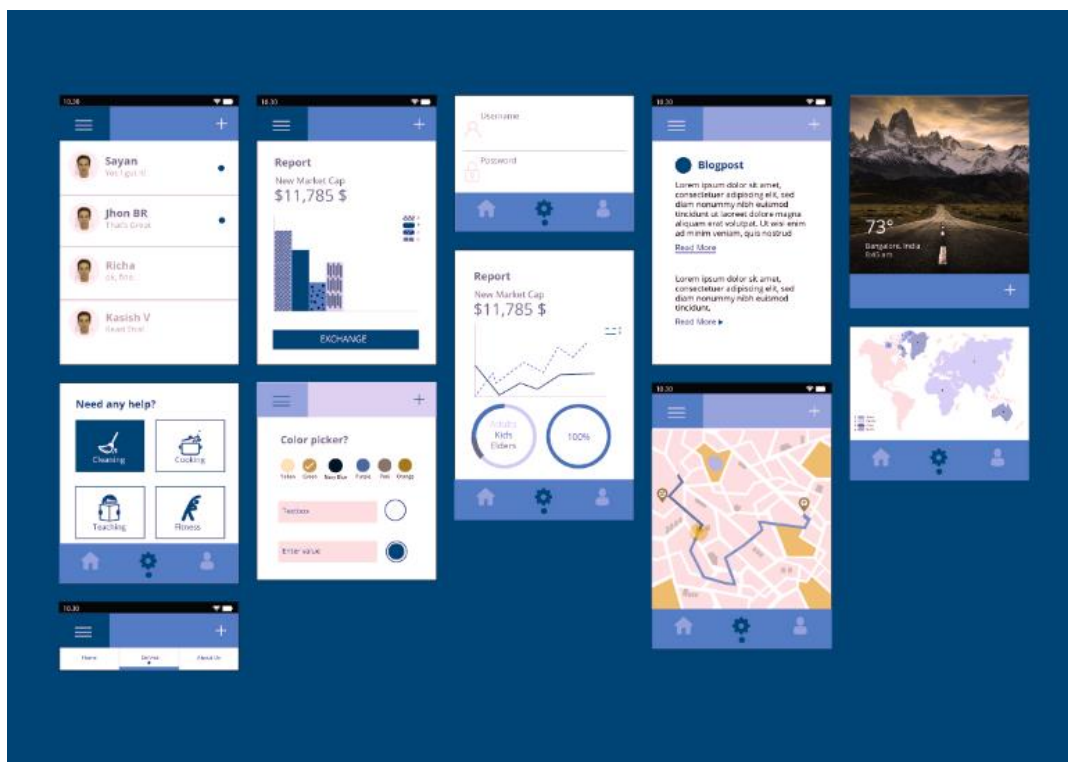


⁴ <https://www.color-blindness.com/coblis-color-blindness-simulator/>

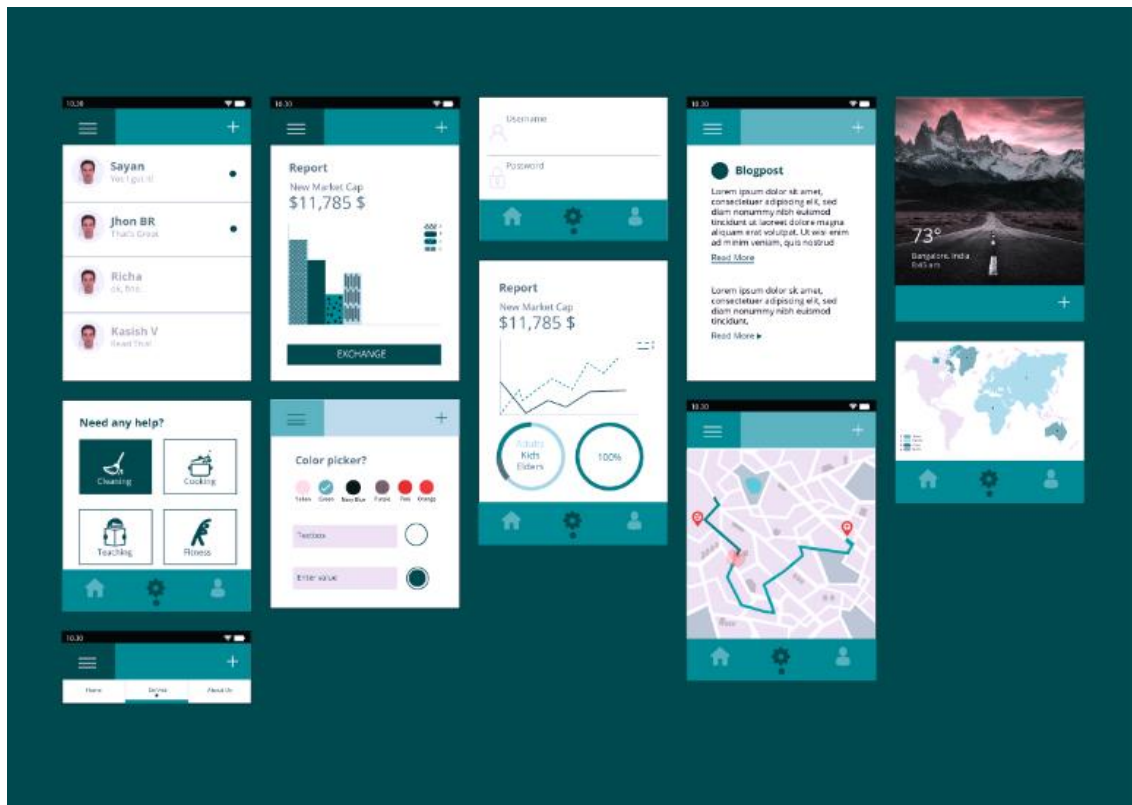
Protanopia – Red/Green colour blindness due to anomalous red cones



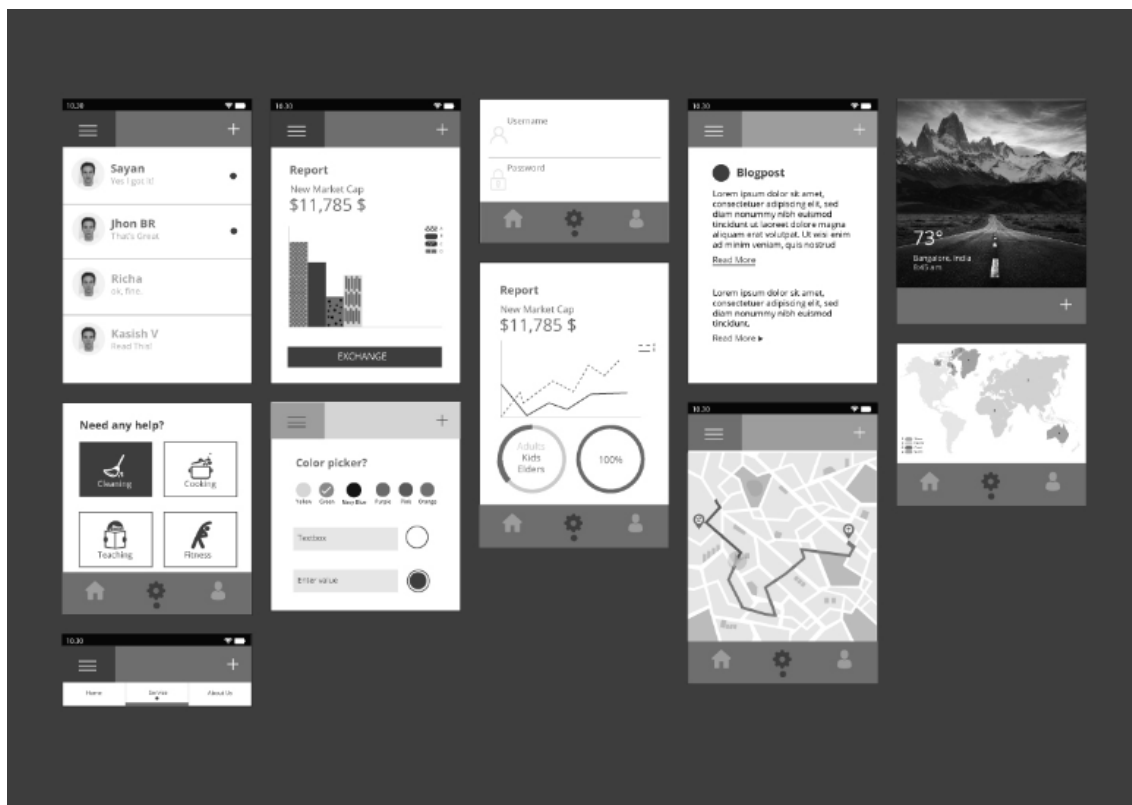
Deutanopia – Red/ Green colour blindness due to anomalous green cones



Tritanopia – Blue/Yellow colour blindness due to anomalous blue cones



Monochromacy/ Greyscale



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