Contents

Introduction

Each year brings with it some new and exciting trends that impact how we keep fit; from the rise of yoga and spin classes, to combat sports and boxercise. Year on year, we seem to savour finding new ways to push our bodies to the limits but hiking, trekking and camping have been existent for past many years! This interest is being driven by the millennial generation.

As a kid, I've always wanted to go on an adventure such as camping or trekking but I got very few opportunities. Each time I went to such trips, I was always pumped up to plan and go for the next one. I'm the kind of person who likes to prepare for a thing instead of diving in blindfold and learning the hard way with experience. This inquisitive nature of mine made me keep note of famous trekking spots in India as well as other countries and understand what kind of preparation is required to take up such activities.

I had found out that two of the most important aspects to consider for trekking/hiking are climbing and weather statistics. Climbing statistics help us to know how many attempts were made, how many of those were successful, how many were the failed attempts, what were the routes taken, what is the success percentage etc. whereas weather statistics help us to know the average temperature, average precipitation, average length of day, number of days with precipitation, average snowfall etc.

I found how much these statistics matter irrespective of which place you wish to go for trekking/hiking. For this project, I picked on the Mountain Rainier, also known as Mount Tahoma and Mount Tacoma, located at Washington, U.S.A. It stands 14,411 feet tall and is a volcano type peak. It is an active volcanic peak but it has been few years since last eruption which took place in Nov-Dec 1894.

Through the interactive and narrative visualisation, I've made few bar and line charts which plot the statistics mentioned above and allow the user to explore a bit about Mt. Rainier and fuel his/her desire for trekking/hiking – if not to Mt. Rainier, someplace that's feasible to him/her.

While doing this project, I came across four significant segments which I believe form the complete layout and the base of my project. They are:

- Total number of attempts over a year or month
- Popular routes used by people
- Total number of attempts per route per month
- Weather stats

The intended audience for this project is trekking/hiking enthusiast, general public who are interested in gaining information or people who are in for simply entertainment purpose.

Design

I've chosen R shiny to work upon this project. I had to go drill down the details of my dataset to make sense of the structure, what and how to get the information that I needed. I've divided into 4 segments as below after the basic introduction:

1. Attempts – Total number of attempts at yearly, monthly and daily granularity levels.
2. Popular routes – Top five most common routes taken by people.
3. Attempts per routes – Taking a look at the attempts and success percentage based on routes.
4. Weather trends – Checking out weather parameters such as temperature, snowfall, precipitation etc.

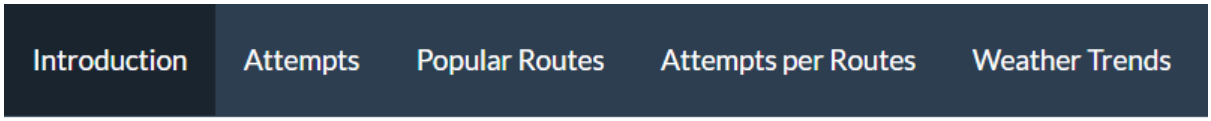


Figure 1: Navigation tabs

Since I had a layout and the topics I'm to cover on my mind, as a part of this project, I did the brainstorming and visualised few types of charts and interactive elements in sheet one from the five-sheet design. From here, I filtered out some of the relevant charts that I could use to visualise my data and combined and refined few of those charts to form a proper layout.

Sheet two focuses on the introduction and attempts. My idea was to introduce the user to Mount Rainier and some interesting pointers about it on first page. For the attempts, I had planned to display a combination of bar and line chart where the bar plot shows the number of attempts while the line chart shows the success percentage per the granularity chosen by the user. This selection was based on radio box initially but I changed that to drop down as shown below. I felt that dropdown would enhance visual effect compared to the radio box in this case. There is also a display of relevant text based on user's choice.

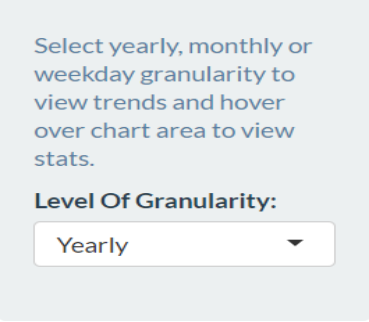


Figure 2: User can select the level of granularity and view trend in terms of total number of attempts

Sheet three focuses on popular routes and attempts per routes. User would be exposed to the top five most common routes taken by people to climb up Mt. Rainier. This is basically a horizontal bar chart with shows the total number of attempts per route. Upon hover, user can see the stats related to that particular route. For the attempts per routes, I initially thought of displaying a drop down from where user can select a route and see it's monthly and weekly trend (total number of attempts and success percentage – monthly or weekly) but with the kind of data I've and for representation purpose, it would make sense to observe monthly pattern compared to the daily pattern. Hence, I dropped the daily granularity for this design step.

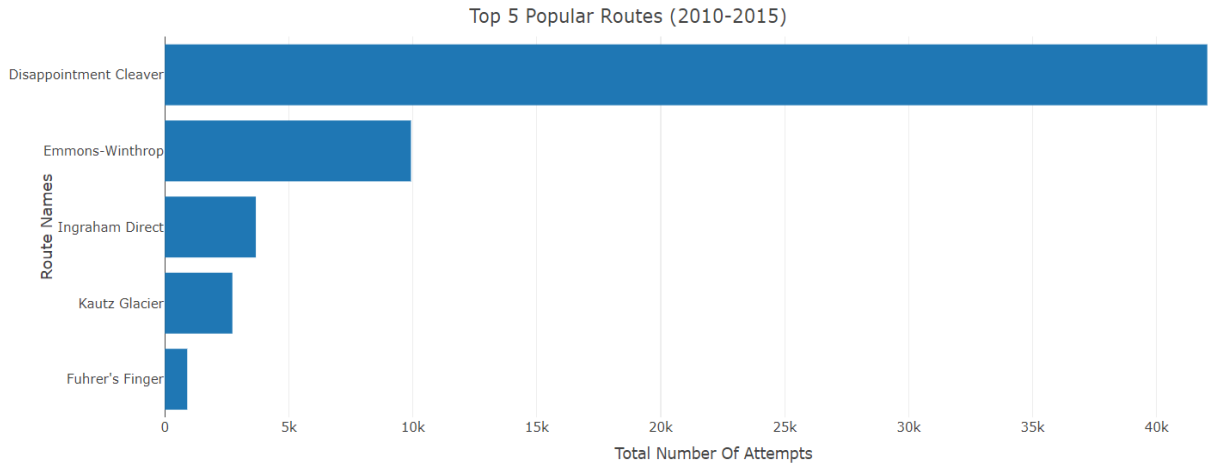


Figure 3: Top five popular routes in terms of total number of attempts

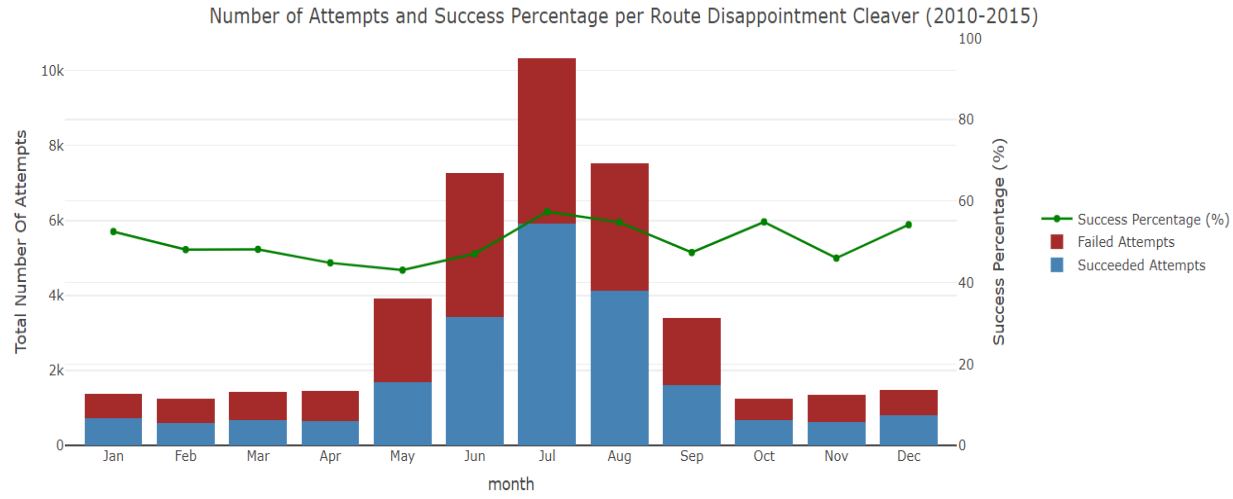


Figure 4: Monthly trend for the route Disappointment Cleaver

Sheet four focuses on weather parameters such as temperature, precipitation etc. User can select any weather parameter from a drop down and relevant bar/line chart is displayed along with observational text. However, as the user has had drop down experience earlier and instead of displaying each parameter by itself, I felt that it would be better to combine similar parameters and display in form of tabs. For instance, I've combined monthly average temperature, high temperature and low temperature into a single line graph. This helped me to visualise better, allows the user to gain more information from one graph only instead of three and even compare the stats.

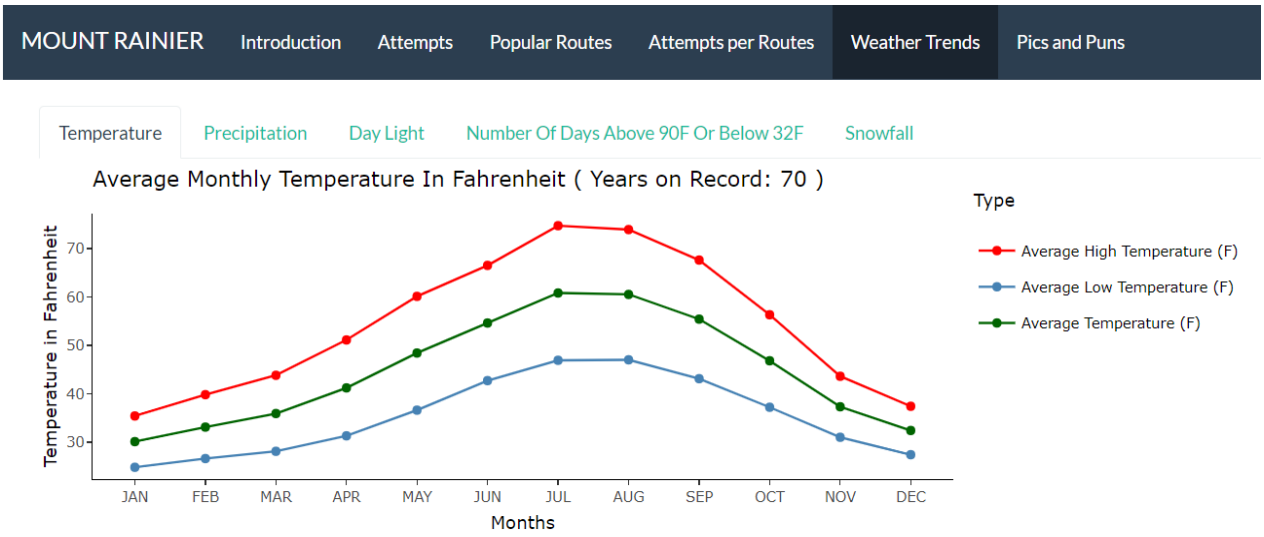


Figure 5: Weather parameters visualised in separate tabs instead of dropdown feature

I've also included another tab of 'Pics and Puns' which consists of some breath-taking pictures and few mountain puns which will serve as a purpose to engage the user.

The fifth sheet basically culminates the five-design sheets – it combines all the independent designs on sheets 2,3 and 4 which employs all the functionalities in terms of tabs.

Implementation

I've used two data sources – climbing and weather statistics.

1. Climbing statistics for Mt. Rainier is in a form of csv format which consists of date, route, attempted and succeeded. I've downloaded the dataset from the mount rainier climbing website. It has about 12.5k rows and 4 columns.

date	route	attempted	succeeded
4/01/2010	Disappointment Cleaver	9	7
4/02/2010	Gibralter Ledges	3	0
6/02/2010	Gibralter Ledges	5	0
7/02/2010	Gibralter Ledges	2	0
7/02/2010	Gibralter Ledges	3	0
8/02/2010	Wilson Headwall	2	2
12/02/2010	Gibralter Ledges	2	0
12/02/2010	Gibralter Ledges	4	0
02/13/2010	glacier only - no summit attempt	2	0

Figure 6: Climbing statistics

There were few empty fields in this dataset and some data entry errors such as the value for succeeded was greater than the attempted which is not possible and one of the routes was duplicated with a difference of apostrophe. Hence, I had to make some corrections and filter out few rows to keep useful and relevant information.

2. I picked up weather statistics for Mt. Rainier from a weather base website. I did web scraping to extract relevant information and broke them into different data frames. Then I used these data frames to visualise the weather stats.

MONTHLY - WEATHER AVERAGES SUMMARY [Show All Data] [°C] °F

Average Temperature Years on Record: 70

	ANNUAL	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
F	44.7	30.1	33.1	35.9	41.2	48.4	54.6	60.8	60.5	55.4	46.8	37.3	32.4

Average High Temperature Years on Record: 70

	ANNUAL	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
F	54.2	35.4	39.8	43.8	51.1	60.1	66.5	74.7	73.9	67.6	56.3	43.6	37.4

Average Low Temperature Years on Record: 70

	ANNUAL	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
F	35.2	24.8	26.6	28.1	31.3	36.6	42.7	46.9	47	43.1	37.2	31	27.4

Average Precipitation Years on Record: 48

	ANNUAL	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
in.	82.8	12.5	8.9	8.1	5.2	4	3.6	1.4	2.2	4.1	7.9	11.4	13.7

Figure 7: Some of the weather statistics from where I did web scraping

Under weather parameters, I've collected below information from the above site:

1. Average Temperature
2. Average High Temperature
3. Average Low Temperature
4. Average Precipitation
5. Average Number of Days with Precipitation
6. Highest Recorded Temperature
7. Lowest Recorded Temperature
8. Average Length of Day
9. Average Number of Days above 90F/32C
10. Average Number of Days below 32F/0C
11. Average Snowfall

I wanted to develop a narrative in a sequential manner such that the user is first introduced about Mt. Rainier, know some interesting facts, know how many attempts were made at yearly, monthly or daily granularity level, popular routes, know attempts per route information, checkout weather pattern and finally end with seeing some pictures and enjoying the mountain puns. Below are the set of libraries I used to achieve this.

```
# Loading required packages
library('shiny')
library('shinydashboard')
library('leaflet')
library('plotly')
library('shinythemes')
library('ggplot2')
library('reshape')
library('rvest')
library('xml2')
```

Figure 8: Libraries used in the code

After the data extraction, processing and filtering, I've aggregated the data based on year, month, day or route and made few basic plots before incorporating them to interactive space. There are two segments in this code. One is UI which has information about the user interface on the shiny dashboard. This includes the presentation and placement of the elements used for visualisation. The placement of the elements in a page is important because one the user enters the page, there has to be a flow otherwise the user will be confused and disengaged.

```
# Shiny UI
ui <- fluidPage(
  titlePanel(img(src = "mount rainier title.png", width=1500), windowTitle = 'Mount Rainier'),
  navbarPage(
    "MOUNT RAINIER",
    theme = shinytheme(theme = 'flatly'),
    tabPanel(
      # First tab
      "Introduction",
      fluidPage(
        # Basic introdution
        p("THINKING ABOUT HEADING TO MOUNT RAINIER OR WANT TO KNOW SOME INTERESTING FACTS ABOUT MOUNT RAINI
        p("WELL, GO READ ON THE INFO AND CHECKOUT DETAILS ABOUT THE CLIMBING STATS, ROUTES AND WEATHER ON (
        h3('Mount Rainier, Washington', align='center'),br(),
        column(
          6,
          p("Mount Rainier is perhaps the single most impressive mountain in the 48 contiguous United State
```

Figure 9: Shiny UI segment

As soon as the user enters the page, they'll see a panoramic view of the Mt. Rainier followed by a guided tab sets under navigation bar page. The second tab, Attempts, is combination of sidebar and main panel. Sidebar has a dropdown for the user to select granularity whereas main panel has a plot and observational text. It also has some help text to guide user. Third tab, popular routes, has a plot followed by observation text. It gives user an idea about the most popular routes and how many attempts were made using that route.

```
tabPanel(
  # Second tab
  "Attempts",
  fluidPage(
    # Sidebar from where user can choose the level of granularity
    sidebarLayout(
      sidebarPanel(

        helpText("Select yearly, monthly or weekday granularity to view tr

        selectInput("granularity", "Level Of Granularity:",
                    list("Yearly"="year",
                         "Monthly"="month",
                         "Weekday"="day"
                    )
        ), width = 2
      ),
      # Main panel where graph is displayed based on user selection
      mainPanel(
        plotlyOutput("routesPerGranularity", width = 1200), br(),
        htmlOutput('routesGranularity')
      )
    )
  )
),

tabPanel(
  # Third tab
  "Popular Routes",
  fluidPage(
        plotlyOutput("attemptsPerRoute", width = 1200,height=400), br(),
        htmlOutput('attempts.route.text')
```

Figure 10: Second and third tab set code

After knowing the attempts and popular routes, the next step would be to know how many attempts were made using a particular route and what's the success percentage per month. It is to give user an idea about the route trends. It employs a side bar panel and main panel similar to the third tab structure.

```
tabPanel(
  # Fourth tab
  "Attempts per Routes",
  fluidPage(
    # Sidebar from where user can select route name and checkout it's monthly trend
    sidebarLayout(
      sidebarPanel(

        helpText("Select a route to view trends over year and hover over chart area to view stats."),

        selectInput("route.name", "Routes:",
                    unique(routes$route)
        ), width = 2,
        helpText("Find out the routes which were taken during odd times of the year and how did that end up
      ),
      # Main panel where graph is displayed based on user selection
      mainPanel(
        plotlyOutput("routesPerMonth", width = 1200),
        htmlOutput('route.text')
      )
    )
  )
),
```

Figure 11: Fourth tab set

The fifth tab, weather trends, has multiple tab panels which display each parameter plots and observational text.

```
tabPanel(
  # Fifth tab
  "Weather Trends",
  fluidPage(
    # Sub tab panel which consists of weather stats
    tabsetPanel(
      tabPanel("Temperature",
               plotlyOutput("temp.plot",height = 300, width=1000), br(),
               span('The red line shows the average monthly high temperature, blue l
               span(strong('The best time to visit Mt. Rainier is when the temperatu
               plotlyOutput("temp.plot2",height = 300, width=1000), br(),
               span('The above graph shows the lowest and the highest monthly temper
      tabPanel("Precipitation",
               plotlyOutput("precipitation.plot",height = 300, width=1000), br(),
               span('The wettest month is December with average monthly precipitatio
               plotlyOutput("precipitation.days.plot",height = 300, width=1000), br(
               span('It generally rains throughout the year at Mt. Rainier. As menti
      tabPanel("Day Light",
               plotlyOutput("average.length.day.plot",height = 300, width=1000), br(
               span('The average monthly legnth of the day is generally shorter duri
      tabPanel("Number Of Days Above 90F Or Below 32F",
               plotlyOutput("days.temp.plot",height = 300, width=1000), br(),
               span('It is a rare occurrence to have number of days above 90F at Mt.
      tabPanel("Snowfall",
               plotlyOutput("snow.plot",height = 300, width=1000), br(),
               span('Mt. Rainier has experiences heavy snowfall during the winter se
               p('<--- CHECKOUT SOME PICS AND PUNS ON THE NEXT NAVIGATION TAB! --->'
```

Figure 12: Fifth tab set

The final tab, Pics and Puns, has few images and jokes to lighten up the mood of the user.

Another integral part of this code is the server segment. This serves as a backend to the UI segment. All the calculations, filtering and plot development in done in this segment. The first tab of introduction has a leaflet design which shows Mt. Rainier on a map with a label on it. The user can explore the location.

```
# Shiny server
server <- function(input, output) {

  # Generating a leaflet map to show Mt. Rainier
  output$leaflet <- renderLeaflet({
    leaflet() %>%
      addTiles() %>%
      addMarkers(lng=-121.760424, lat=46.852947, popup="Mount Rainier") %>%
      setView(lng=-121.760424, lat=46.852947, zoom = 13)
  })
```

Figure 13: Leaflet map to show Mt. Rainier

In the second tab, the user has to select the level of granularity to view total number of attempts. Based on the user's selection, there has to be some observational text to guide the user about these trends.

```
  # Generate relevant text based on user's selection on routes granularity
  output$routesGranularity <- renderUI({
    if(input$granularity == 'year')
      HTML(paste("Crowd has been always excited to go hiking and camping at Mt
                 "The brown segment indicates the number of failed attempts, b
                 "The maximum success percentage was seen in the year 2014 wit
                 "The success percentage has been around 50% for past many yea
                 "<b><--- Checkout other granularities and then goto next tab
    else if(input$granularity == 'month')
      HTML(paste("As mentioned earlier, most people visit Mt. Rainier from May
                 "The brown segment indicates the number of failed attempts, b
                 "The maximum number of attempts and success percentage was se
                 "January and December are two of the coldest months at Mt. Ra
                 "<b><--- Checkout other granularities and then goto next tab
    else if(input$granularity == 'day')
      HTML(paste("It is expected that people go out when they're free! Based o
                 "The brown segment indicates the number of failed attempts, b
                 "Success Percentage is pretty much the same (around 50%) no m
                 "<b><--- Checkout other granularities and then goto next tab
  })
```

Figure 14: Text based on user selection

The third tab is pretty much basic which has plot and supportive text. The fourth tab is similar to the second tab in terms of format – just that the data displayed is different. Second tab is focused on total number of attempts per year/month/day where as fourth tab is focused on the total number of attempts per month for the route selected by the user. Also, this plot has a secondary y-axis which represents success percentage.

```
# Rounding off success percentage
plot.data[,6] <- round(plot.data[,6],2)

# Creating a dummy dataframe to display all the months in case some are missing from original dataset
month.df <- data.frame('month'=factor(unique(routesPerMonth$month), levels = unique(routesPerMonth$mont

# Merging both into a data frame, setting 0 where months have NA values
plot.data<- merge(month.df,plot.data,by="month", all.x=TRUE)
plot.data$route <- input$route.name
plot.data[is.na(plot.data)] <- 0

# Reorder the data based on levels of month
plot.data <- plot.data[order(plot.data$month),]

route.plot <- plot_ly(plot.data, x = ~month, y = ~succeeded, type = 'bar', name="Succeeded Attempts",
                marker = list(color=c('steelblue')),
                hovertemplate = paste('<i>Month</i>: %{x}',
                                      '<br><i>Value</i>: %{y}<br>'))
route.plot <- route.plot %>% add_trace(y = ~failed, name="Failed Attempts", marker = list(color=c('brow
                           hovertemplate = paste('<i>Month</i>: %{x}',
                                                 '<br><i>Value</i>: %{y}<br>'))
route.plot <- route.plot %>% add_trace(y = ~successPercentage, type = 'scatter', mode='lines+markers',
                           name = "Success Percentage (%)", marker = list(color='green'), line=list(col
                           yaxis = "y2",
                           hovertemplate = paste('<i>Month</i>: %{x}',
                                                 '<br><i>Success Percentage</i>: %{y}<br>'))
route.plot <- route.plot %>% layout(title = paste('Number of Attempts and Success Percentage per Route'
  yaxis = list(title='Total Number Of Attempts'), barmode = 'stack', yaxis2 = double.y,
  legend = list(orientation = "v",
                xanchor = "center",
                y = 0.5, x = 1.2)
)
```

Figure 15: Total number of attempts per month based on the route selected by the user

I've used rvest and xml to read the data from the webpage, ggplot and plotly to add interactive features to my visualisations and ultimately used shiny to design the whole layout. I found these packages useful and simple to implement. Although I deviated a bit from my initial five-sheet design, I think this way of implementation is more user-friendly and allows user to explore different tabs with short and crisp content. Also, the visualisations and the dataset aren't heavily loaded, so, it runs pretty fast and shows labels when hovered on chart area.

User Guide

This section contains instructions for viewing and exploring this narrative visualisation. For best results, please view on web browser with font settings to windows recommended size.

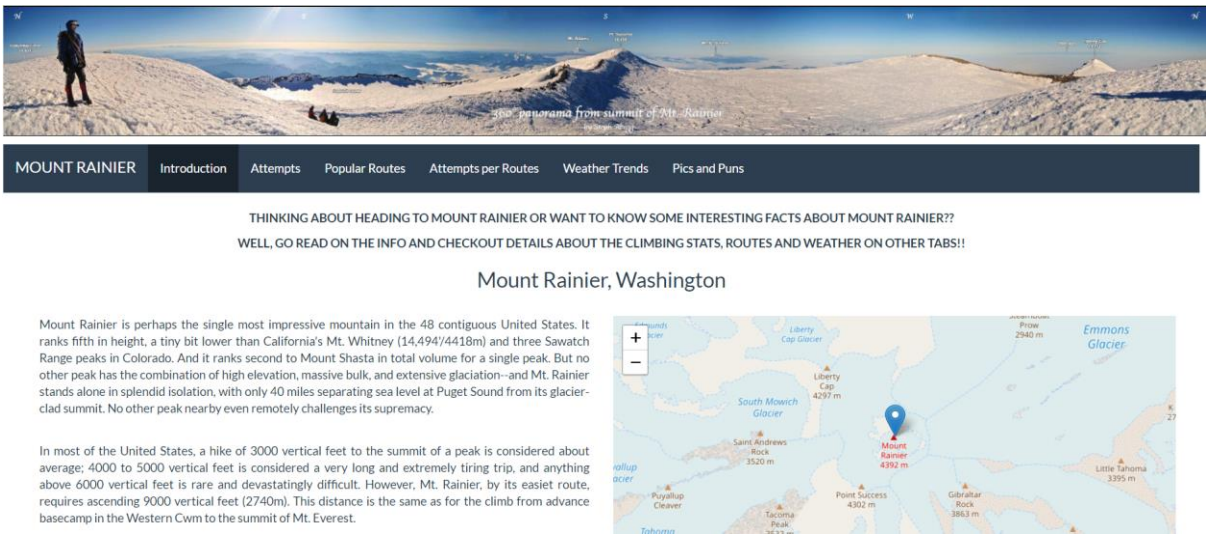


Figure 16: First page of the app : Introduction

The above figure shows the front page of this app which has a panoramic view of Mt. Rainier and main navigation bar made of the attempts, popular routes, attempts per routes, weather trends and lastly pics and puns. This is the introduction tab which has basic information about Mt. Rainier, a map and some interesting facts. The user can skim through or checkout the overview to get an idea about Mt. Rainier.

Below is the figure of the second tab of the app: Attempts. Here, the user can select the level of granularity (yearly/monthly/daily) on the left to view the total number of succeeded attempts, failed attempts and success percentage from year 2010 to 2015 – chart displayed on the right. It is followed by some additional observation text based on the user selection. User can hover over chart area to view corresponding stats.

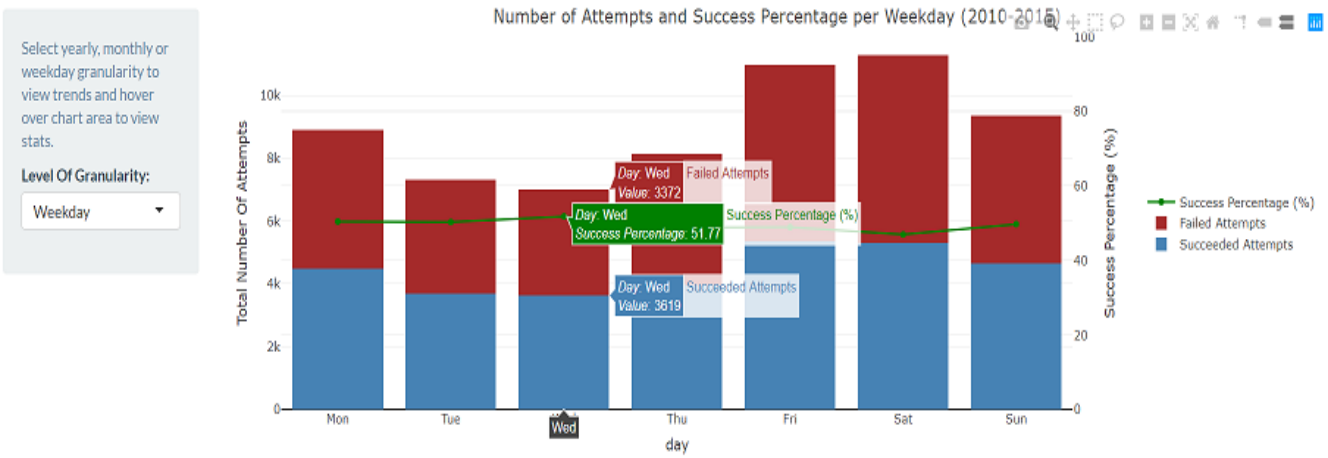
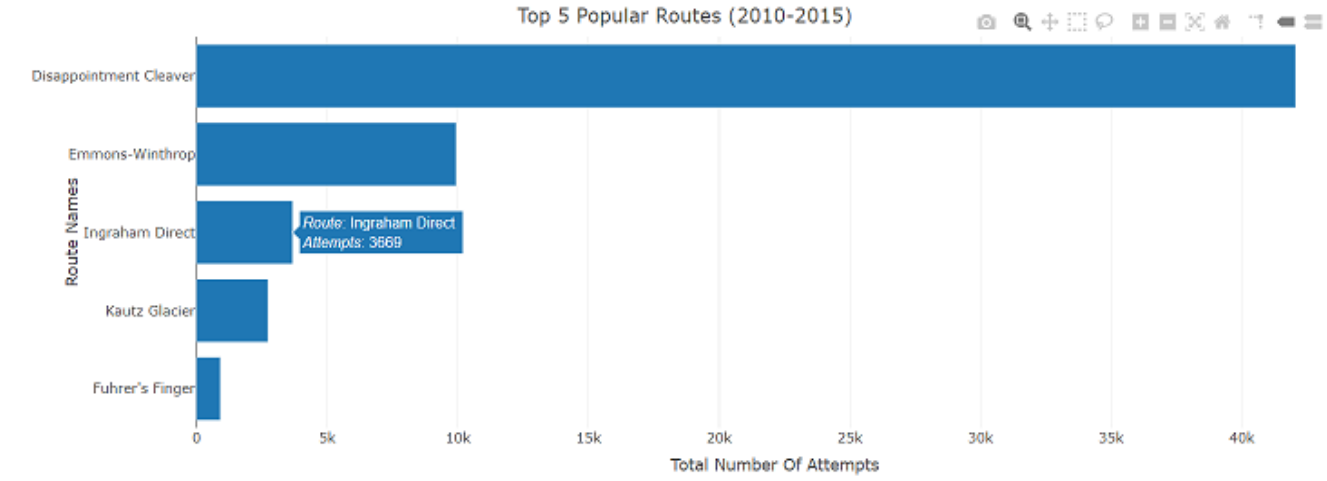


Figure 17: Second page of the app : Attempts

Below figure shows the popular routes in terms of total number of attempts from year 2010 to 2015. It is for the user to know which are the most common routes taken by people. User can hover over chart area to view stats.



There about 30 routes that can be taken. Among those, *Disappointment Cleaver* is the most common route taken. Followed by *Emmons-Winthrop* and *Ingraham Direct*

Figure 18: Third page of the app : Popular Routes

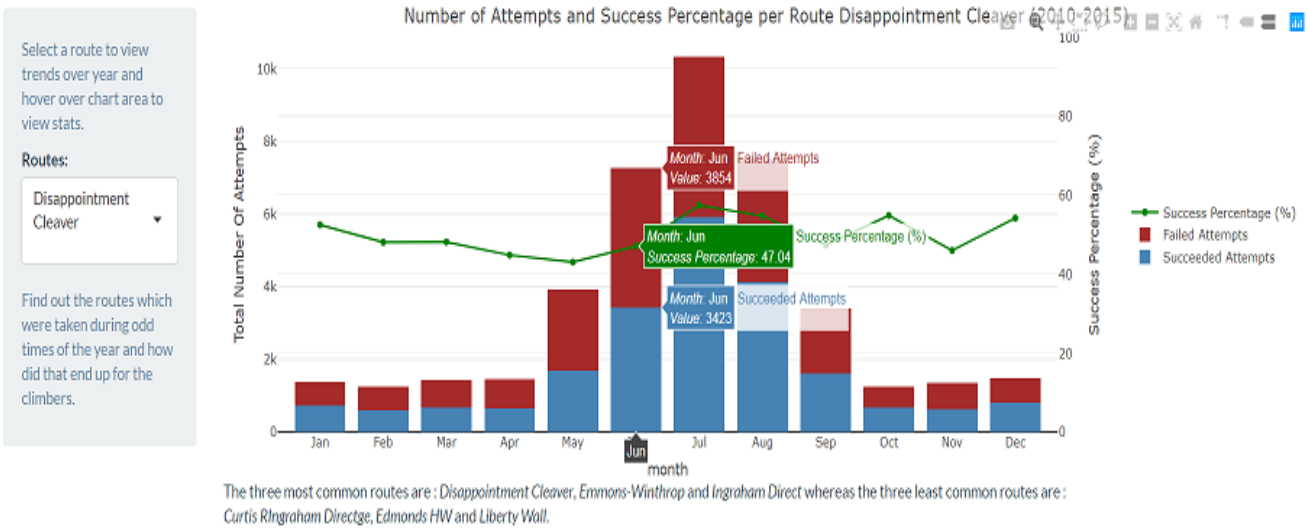


Figure 19: Fourth page of the app : Attempts per Routes

The above figure shows the tab for attempts per routes. User can select whichever route he/she has to view (there is help text at on either sides of the drop down bar to guide the user) on the side bar and the corresponding monthly graph will show up which has the total number of succeeded attempts, failed attempts and success percentage for the selected route on the right. The top 3 and bottom 3 routes are displayed in the text giving an idea to the user for experimentation.

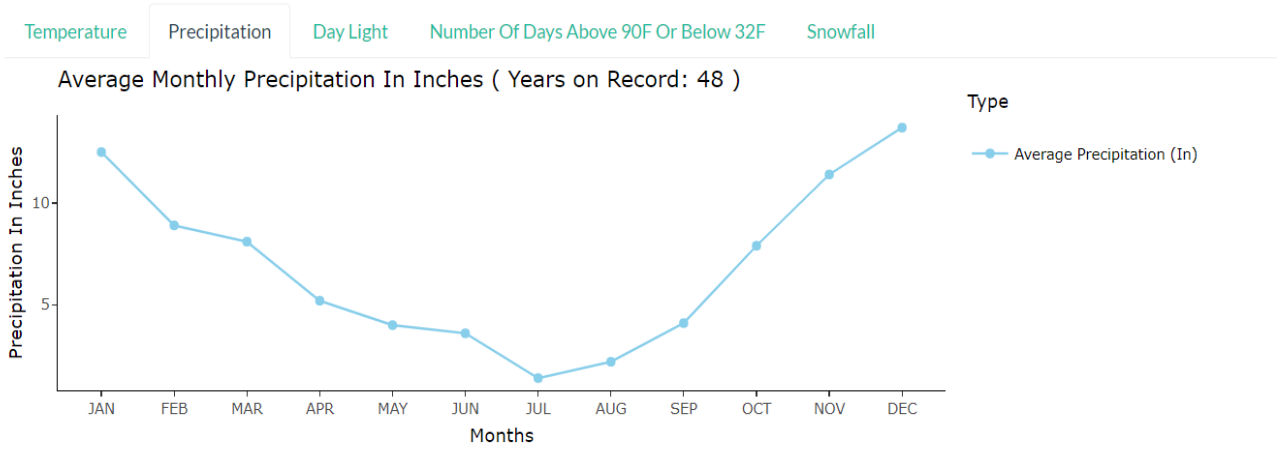


Figure 20: Fifth page of the app : Weather trends

The above figure shows the weather trends. The user has the option to select any of the weather statistics from the tabset. Upon selection, user can view the monthly trend and associated observation text below the plot of that particular weather parameter. The user can also view the stats just by hovering over chart area.

The last tab, pics and pun, is just for fun to engage the user to view some of the breath-taking pics and mountain puns!

Conclusion

Climbing data was structured and csv format file. It was amusing to dig in the day on day climbing stats and find out the total number of attempts to climb summit, successful attempts, failed attempts, success percentage and different kinds of routes to transform the data into appropriate visualisation in the form of a narrative story. Also, I did web scraping to extract the relevant weather statistics as mentioned above. This helped me in gaining knowledge about web scraping. I was successful in extracting the data and putting them into data frame in R to produce visualisations and arrange them on shiny dashboard to present a narrative visualisation.

The five-sheet design really helped me put a layout I intended to present whereas when it came to implementation, I realised I can improve my design by adding some extra elements or come up with some simpler yet effective way to visualise the same thing. For instance, I had planned of presenting the weather trends based on user selection but during the course of implementation, I grouped common parameters and set them in tabs so that user can get a clear picture and information.

It was amusing to know that how a route is considered as successful route or not based on the number of attempts. For example, *Disappointment Cleaver* has the greatest number of attempts, successful attempts and unsuccessful attempts. But the same, when the success percentage is considered, it was seen that *Tahoma Cleaver* is the route with highest success rate. Hence, it is important to know not just the total number of attempts of made choosing a route but also the success or failure rate. General tendency of a human is to relate with huge numbers but that should change and people should relate with the ratio and percentages to be able to make better decisions.

As I was implementing, I found that most attempts were made during mid-year (Jun to Aug) when there is sufficient heat, temperature and less precipitation and snowfall. Although this varies from place to place but it is good to keep a track of such things.

I had to explore, analyse and find out few errors in the climbing dataset. It was tough to find proper dataset for climbing and weather stats but I handled them to my satisfaction with the work arounds I found. Although it would have been more interesting to have more hiking and weather data not just with respect to existing dataset but in general covering more area which would have geographical sites, extensive weather parameters and climbing statistics. Basically, a complete overlap of both the climbing and weather stats would have been great! It would be fun to analyse and may be perform predictive analysis on such data.

Reference and Bibliography

1. Mount Rainier – Peakbagger.com. Retrieved June 17, 2020, from https://www.peakbagger.com/Peak.aspx?pid=2296

2. Mount Rainier Statistics. Retrieved June 17, 2020, from http://www.stephabegg.com/home/projects/rainierstatistics

3. Mt. Rainier National Park Climbing and Mountaineering. Retrieved June 17, 2020, from http://www.mountrainierclimbing.us/routes/stats/routetotals.php

4. Weather base – Mount Rainier National Park, Washington. Retrieved June 17, 2020, from https://www.weatherbase.com/weather/weather.php3?s=498654&cityname=Mount+Rainier+National+Park%2C+Washington%2C+United+States+of+America&units=us

5. Mt. Rainier – Day Hike. Retrieved June 17, 2020, from https://www.summitpost.org/mt-rainier-day-hike/649601/c-276262

6. AN EPIPHANY FROM THE TOP OF MT. RAINIER. Retrieved June 17, 2020, from https://akuoutdoor.com/blogs/stories/an-epiphany-from-the-top-of-mt-rainier

7. Shiny from R studio (Lesson 2 Tutorial). Retrieved June 17, 2020, from https://shiny.rstudio.com/tutorial/written-tutorial/lesson2/

8. Shiny from R studio (Application layout guide). Retrieved June 17, 2020, from https://shiny.rstudio.com/articles/layout-guide.html

9. Beginner's Guide on Web Scraping in R (using rvest) with hands-on example. Retrieved June 17, 2020, from https://www.analyticsvidhya.com/blog/2017/03/beginners-guide-on-web-scraping-in-r-using-rvest-with-hands-on-knowledge/

Appendix

Below are my five-sheet design:

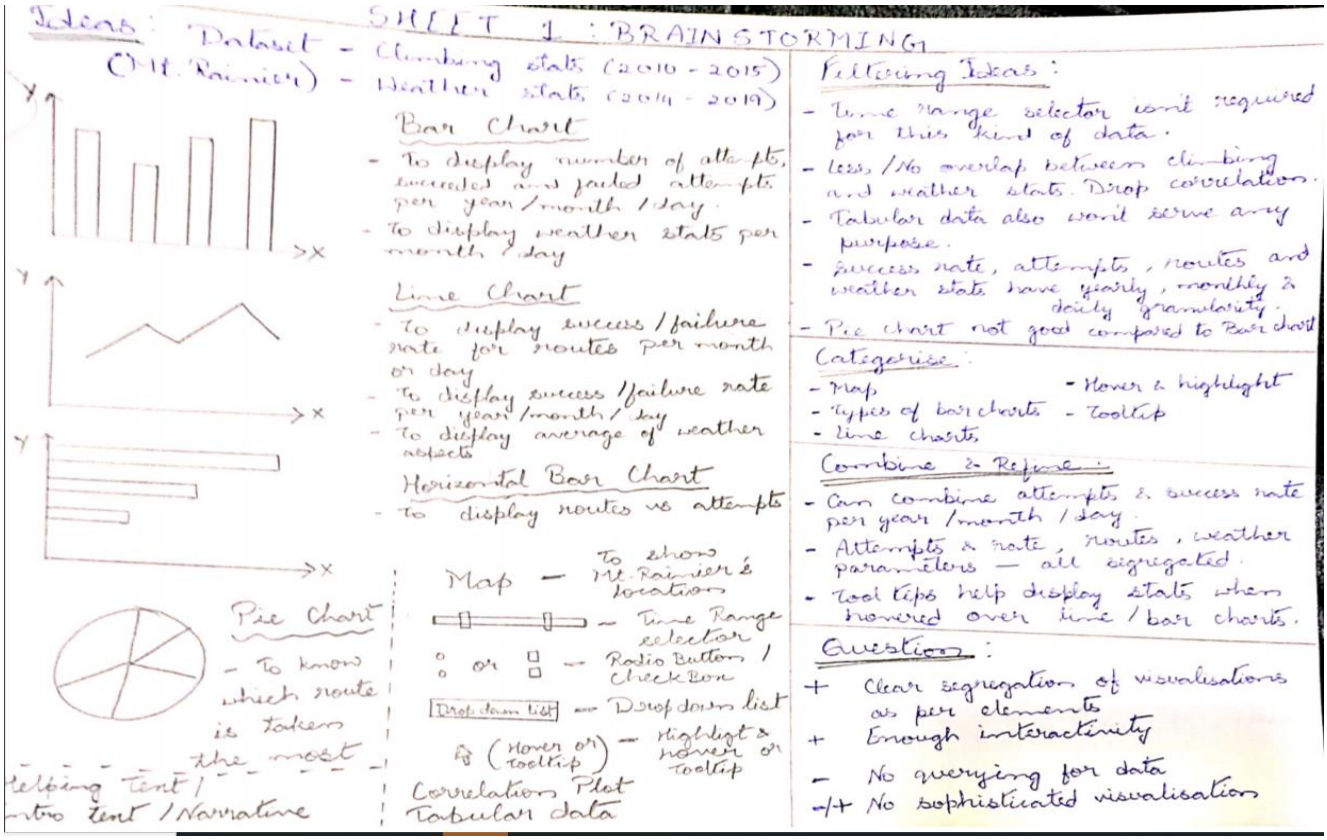


Figure 21: Sheet 1

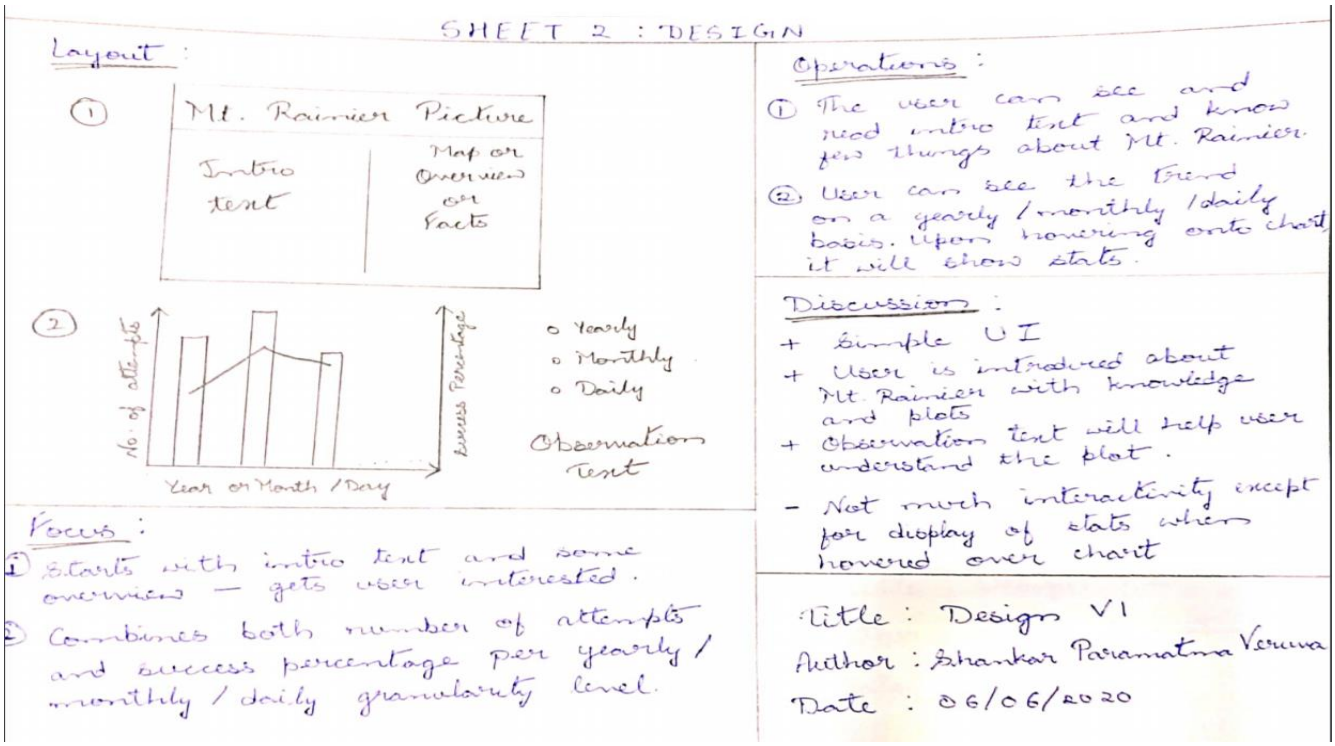


Figure 22: Sheet 2

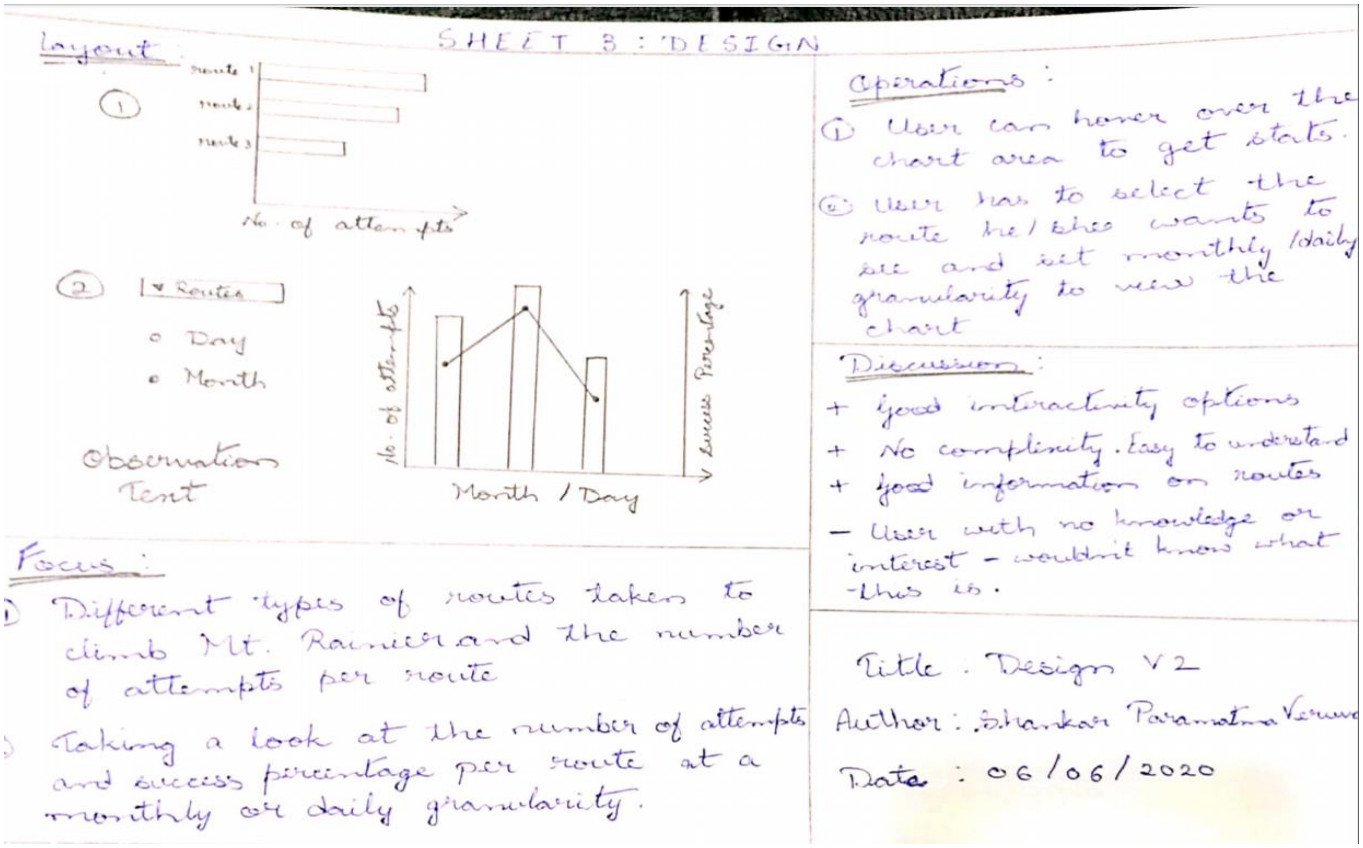


Figure 23: Sheet 3

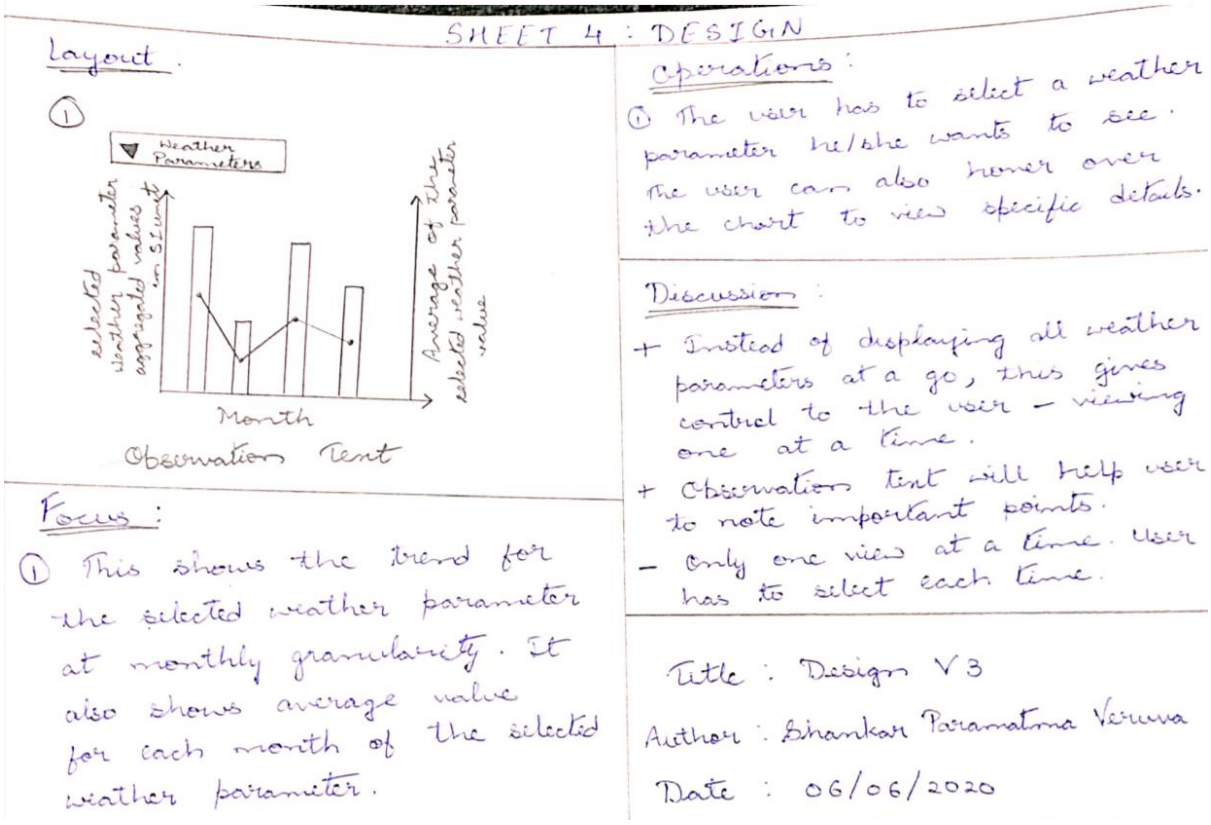


Figure 24: Sheet 4

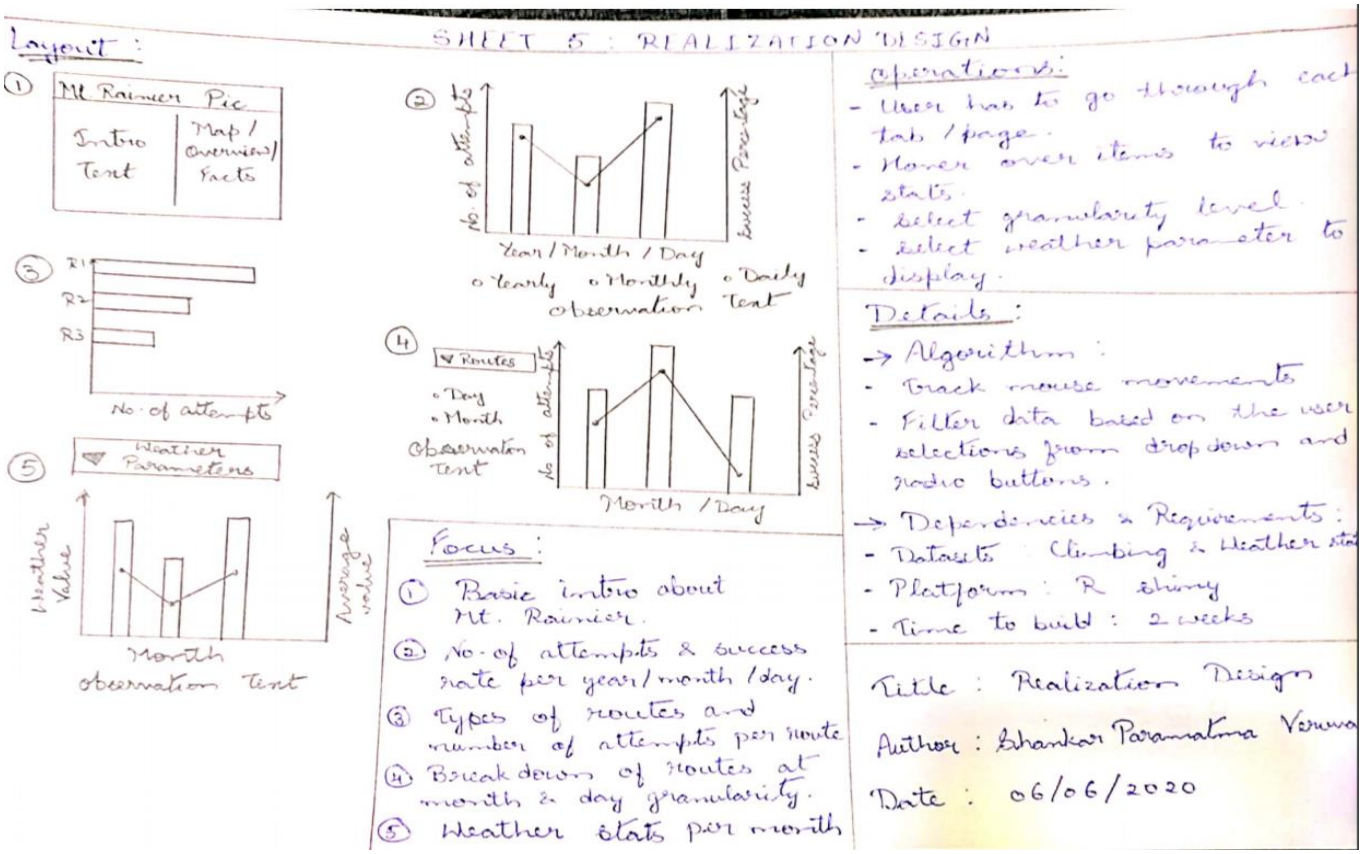


Figure 25: Sheet 5