Application Design

Winter Semester 2021- 2022

Project Name: Local Advertising Application

Team Members:

Sandesh Gharge (sg27875)
Narayani Sachdeva (ns29110)

Abstract requirements definition

The context of the project is smart-city.

Some examples scenarios are: intelligent traffic management, advertisement of local offers, waste management, power grid control, smart public transportation on demand.

You are going to design an application that provides an innovative approach to one of the many problems that may be solved with smart-city approaches. You choose the topic of your specific project, either from the list above or anything that fits the context smart-city in large.

While you are free to choose your specific topic, your project shall fulfill the following requirements:

- *The estimated effort for the implementation of the project is 20 man-years and the delay is less than a year, i.e. you can work with at least 20 people in parallel.*
- *You need a more complex software architecture than a monolithic program.*
- *At least some part of the project requires a Human-Machine Interface that can be implemented with a touch-screen GUI interface following the guidelines on utility, usability, UX and QoE.*
- *At least one of project's entities is controlled by two concurrent input sources (i.e. some sensor that detects the presence of a pedestrian at a traffic light (source 1) a smart police car on duty approaching the same traffic light (source 2)).*
- *Your project is suitable for implementing one set of design patterns. The sets are detailed below.*

Choose one of the following sets of design patterns. You have to implement each design pattern at least once in your project except for the one in brackets which is optional and provides bonus points. You may ask for exchanging design patterns in the lecture, the decision is based on whether the replacement pattern has the same complexity.

- *Set 1: Composite, Memento, Builder, Adapter, Observer, (Event-based asynchronous)*
- *Set 2: Visitor, Abstract Factory, Interpreter, Singleton, Interceptor, (Reader/Writer Lock)*
- *Set 3: Chain of Responsibility, Decorator, Factory, Proxy, Flyweight, (Thread Pool)*
- *Set 4: Monitor Object, Composite, Decorator, Strategy, Iterator Pattern, (Active Object)*

We will be implementing Set 1 of design patterns for our Application. i.e.

- *Set 1: Composite, Memento, Builder, Adapter, Observer, (Event-based asynchronous)*

Local Advertising Application

Introduction:

Local Advertising Application as the name suggest, is an application which help the people to stay updated with offers and events in the local area. This application focuses on advertising on a web application so that it will be open to everyone. Advertisement can have multiple parts such as Job Offers, Supermarket offers, Clothing offers and about any upcoming events.

Apart from people who will visit the website, it also forms an opportunity for any organisation or even people to post their own ad. As a result, this can will be a 2-way platform and would benefit everyone. This application can work in 2 languages i.e., English or German

First, we will talk about post the advertisement on this website.

All the advertisement is divided into 2 major parts -

1. Organisational Ads
    - These ads are generic to many organisations such as clothing industry, Hair Salon, Electronic Industry and many more.
    - This part is implemented using Composite Design Pattern, where Organisation ads are divided further into Job Opportunity, Offers, Events.
    - To post the ad, it is important to add few mandatory values such as description, link of the website if available, which will help people understand the offers easily and clearly.
    - Organisational Advertisement is where many people can take advantage of the offers and enjoy the benefits.

2. Individual Ads
    - Individual Ads feature is mostly used by the local people.
    - People from anywhere who wants to sell and rent a car or house can use this feature.
    - While posting the ad, there are few mandatory information that has to be provided for the transaction to make possible. e.g., Contact details and description of the product i.e., Type of product whether it is a car or house or any electronic product that must be sold or rented.
    - If these details are provided, it becomes easy for people to directly contact and complete the sale.
    - These are ads will be visible to everyone but only one can complete the transaction.
    - This feature can be used by people who wants to sell or buy any used stuff.

Now we can go into how a user will behave when he or she visit the website.

- Visitor

A visitor will be able to see all the offers and events as soon as he / she opens the website.

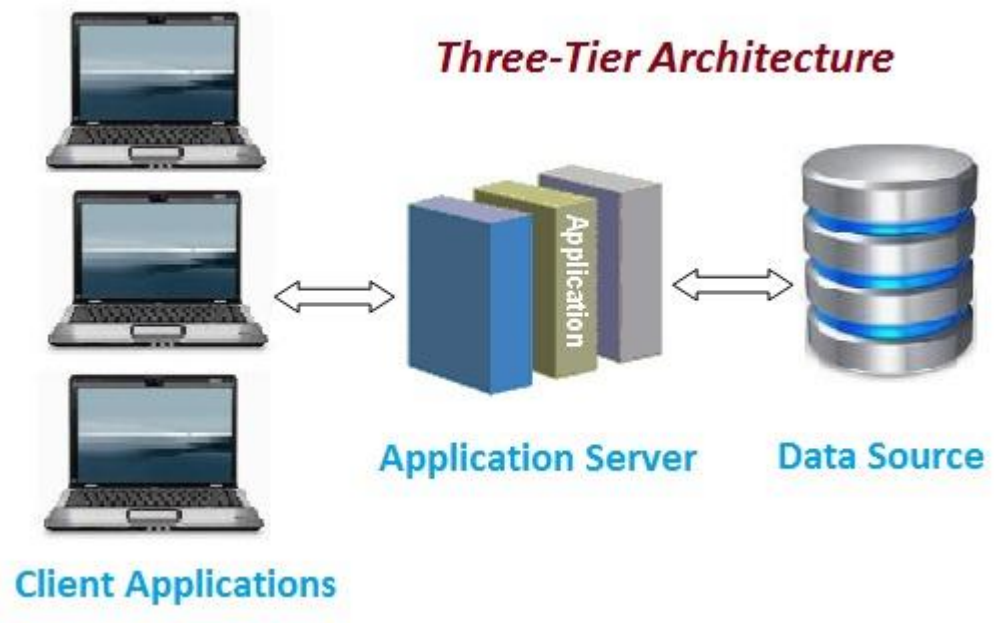
- Logged In User

A logged user will be benefitted with an additional feature apart form the feature that a visitor is enjoying.
A logged user can save the ads that he / she may find it important and relevant.
This will allow a user to see the ad any time later, in case, he / she is planning to revisit the same advertise again.

3 - Tier Architecture

This application can be build using 3 - Tier Architecture, in this case MEAN stack application is used -

1. Presentation Layer
   - This layer forms the front of the application
   - As a part of the web application, front end is designed using angular and typescript.
   - This framework not only helps design responsive and attractive User Interface but also easy API setup.
   - Use of Angular Material and bootstrap is helpful when the application is opened using mobile browser.
   - In case MEAN stack is not used, this front can be developed using HTML5, CSS.



2. Application Layer
   - This layer takes care of the business logic and forms as a middleware between database and front end.
   - In case of MEAN stack architecture, this layer is designed using Express JS framework.
   - It is also possible to develop using Spring framework along with JAVA.
   - This layer can be hosted on application servers, or on the cloud or also on a dedicated workstation depending on the complexity of the application.

3. Database Layer
   - This is the layer where all the data is stored.
   - Database layer can be implemented in many ways i.e., using SQL Database or MongoDB etc.
   - Similar to Application layer, this layer can be hosted on cloud or database server or dedicated workstation depending on the complexity of the application.

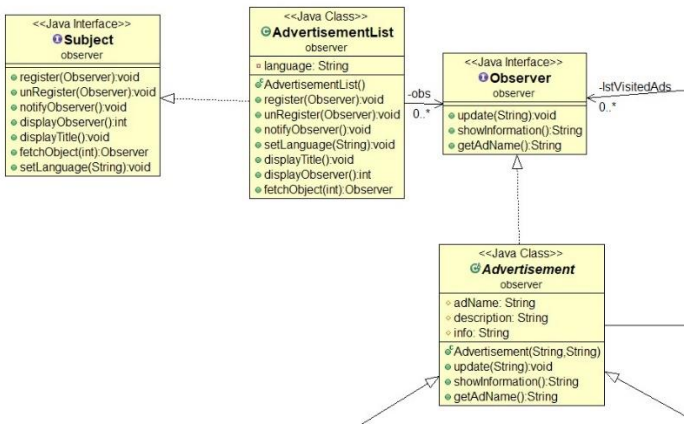
Benefits of 3 Tier Architecture

3 Tier Architecture have several benefits -

1. Easy Maintenance
   - Since the entire application is divided into multiple modules, each module can be focused separately to maintain the application in case of any issues or failure.
   - Different teams can be formed for each module, hence dividing the workload.
2. Security
   - Application layer can be used to add the security, so that it will be difficult to penetrate from presentation to get the data from database.
3. Scalability
   - Multiple presentation layer can be used with one application layer.
   - This feature helps the development of Mobile applications so that a user doesn't have to open the application from browser while using a mobile phone.
   - This mobile application can be developed with any platform i.e., Android and iOS.

Design Patterns Used (Set 1):

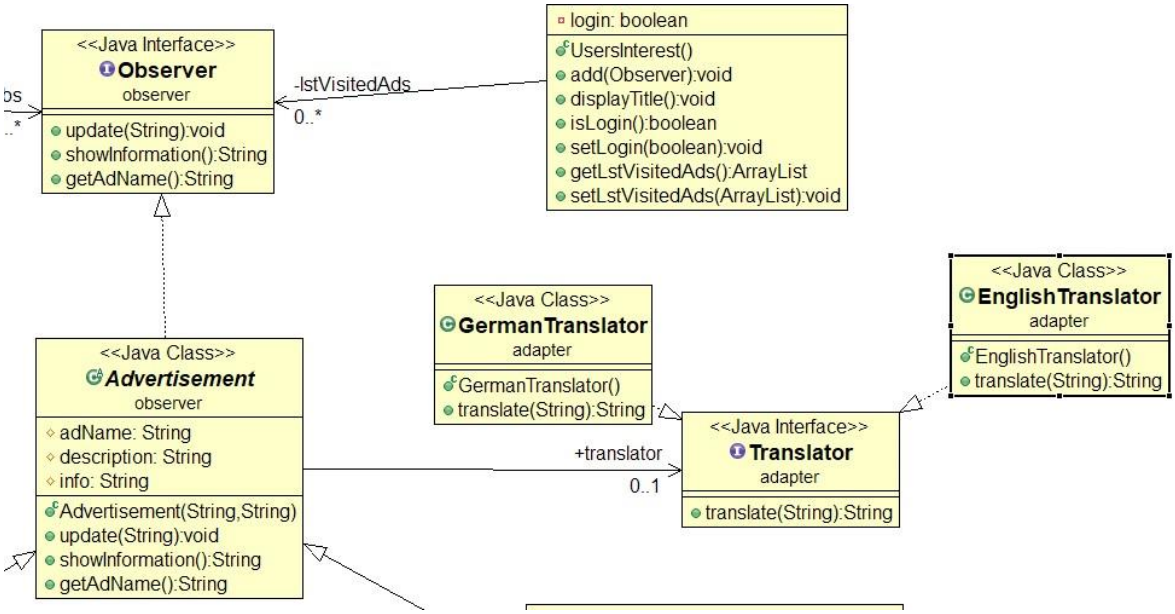
1. Observer Pattern
   - This pattern is used for updating the language from German to English and English to German.
   - After the there is a change in language event is triggered, translation process is executed for all the advertising observer objects which are stored and displayed in the front end.
   - This implementation is divided into 2 parts -
     i. Parent Interface of advertisement object implements Observer which has the method to initiate the language translation process.
     ii. A class which stores the list of Observer, implements Subject interface which stores the current language and listens to change in language event.



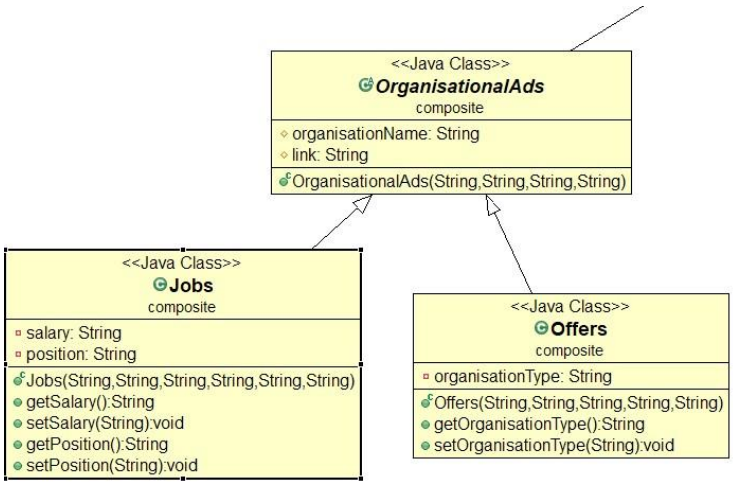
   - Now whenever the language is changed in the subject, it calls the update function of Observer which initiates the translation process.

- In this project, Advertisement abstract class implements Observer and AdvertisementList implements Subject interface.

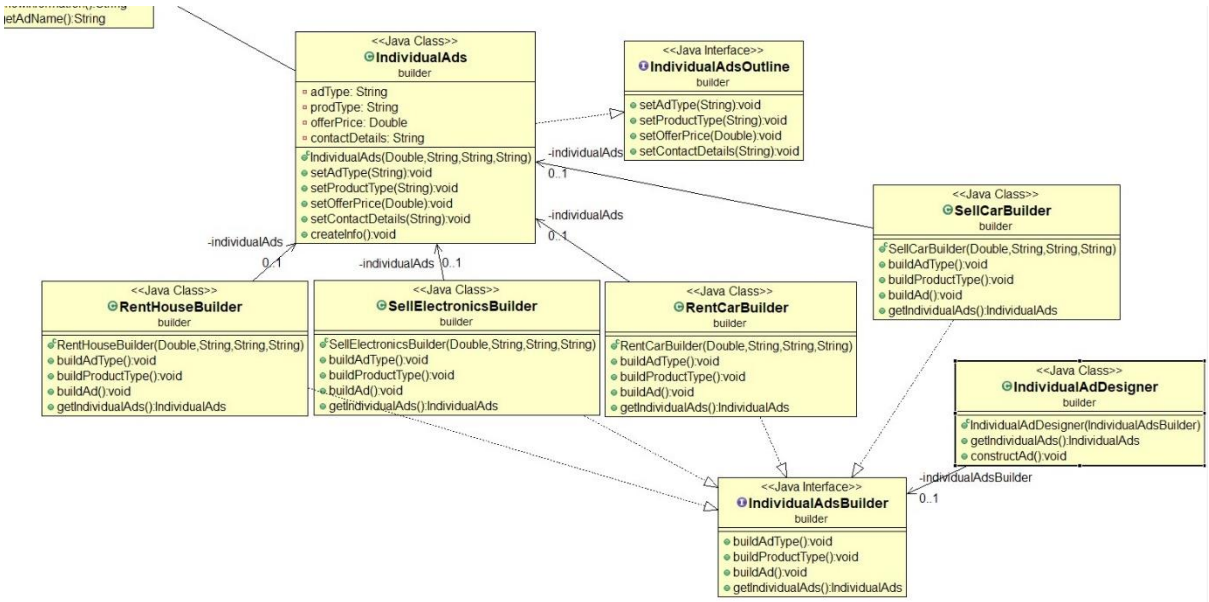
2. Adapter Pattern
   - We have already discussed the change in language event which is responsible to initiate the translation process.
   - This pattern takes care of the translation process.
   - We have used 2 adapter one for translating the content from English to German and one for translating the content from German to English.
   - Hence once the translation event is initiated, adapter carry out the functionality of translating the information of each observer object stored.



3. Composite Pattern
   - Advertisement class, as discussed above is implemented into 2 further class i.e., Organisational Ads and Individual Ads.
   - Composite pattern is used to design Organisational Ads.
   - There are 3 leaf nodes to Organisational Ads
     i. Offers
     ii. Job Opportunity
     iii. Events
   - Since the 3 leaf nodes have different context as compared to each other creating different nodes seemed to be a feasible option.
   - Hence composite pattern fits perfectly in this requirement.
   - All this object can be stored in a single list.
   - Apart from these 3 nodes, the Individual Ads overall can also be considered as a leaf node, as a part of composite pattern.

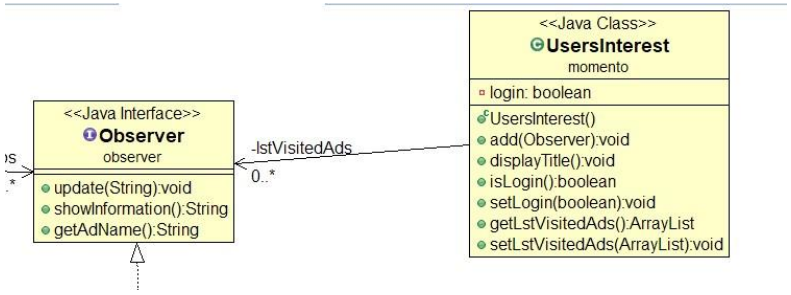


4. Builder Pattern
   - Builder Pattern is used to design Individual Ads.
   - Individual ads mainly refer to selling or renting any electronic device, house, car etc.
   - Builder Pattern helps to create concreate builder classes which can be of
     i. Selling electronic Device
     ii. Selling House
     iii. Renting Car
     iv. Renting a House and many more….
   - Such concrete classes can be used to create Individual Ads object.
   - Once, concrete builder classes are defined it becomes easy to use implement Builder Pattern.

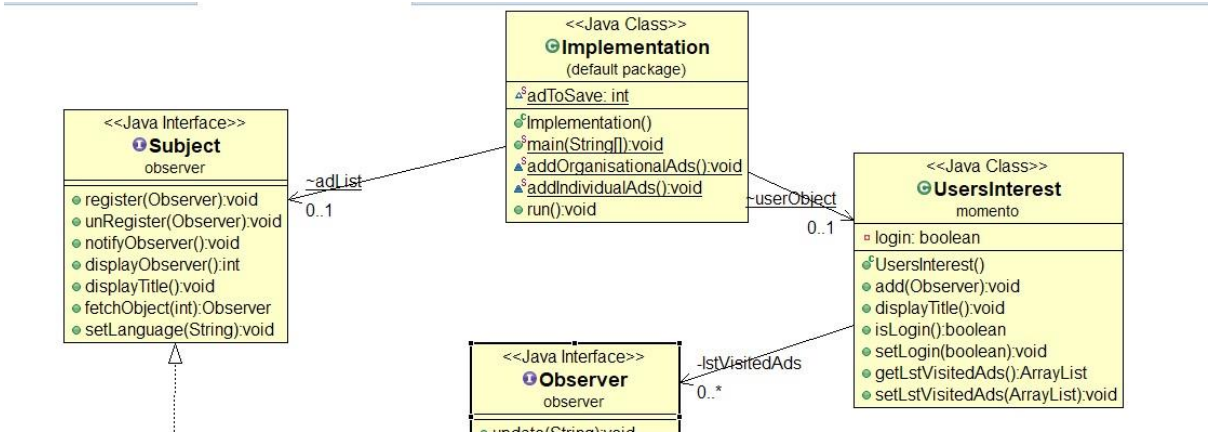


5. Memento Pattern
   - Memento Pattern is used to recommend the advertisement that user has is interested in.

- This pattern stores the advertisement objects in a form of list in the User's object only if the user is logged in.
- In case, the user is not logged in, this feature will be disabled.
- This implementation can be helpful for user who wants to go through the ads later after logging out.
- The demo that is prepared in the submitted code works for single user.



6. Event Based Asynchronous Pattern
   - Asynchronous functionality will find many implementations in any major application system.
   - In our application this pattern is used for saving the recommended ads into User profile.
   - Event based Asynchronous pattern can further used to implement download functionality, i.e., a user has initiated downloading a pdf file. In case the file is big it should not stop user from accessing the application till the document is downloaded.
   - *Note : While the running demo application, the recommended advertisement are correctly visible only after the user logs out and logs in again. Due to asynchronization the results are not displayed immediately.*



Working of Combined Design Pattern

1. Observer and Adapter
   - These two patterns work together to carry out the translation process.
   - As discussed earlier, Observer initiates the process of translation whereas the translation process is carried out by Adapter.
2. Observer, Composite, Builder
   - If referred to class diagram, Observer is parent class to classes which are implemented with Composite and Builder patterns.
   - Observer is responsible to initiate language translation for all the child object i.e., both composite and builder-based objects.
3. Event Based Asynchronous and Memento
   - Memento pattern is used to save the advertisement objects into list of recommendation.
   - This process of saving the advertisement objects into list of recommendation is implemented using Event Based Asynchronous Pattern.

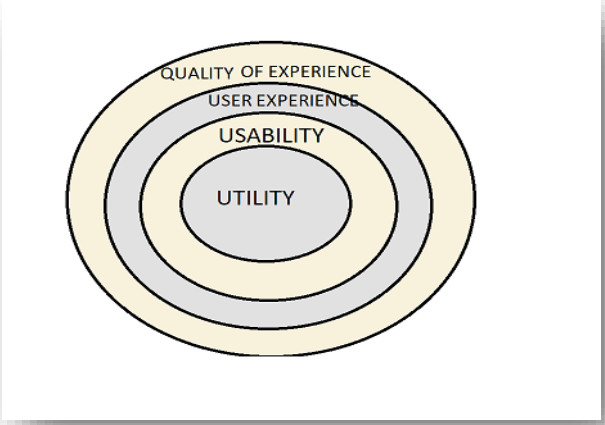
Use cases:

1. Student
   - A student can access this application for accommodation purpose. There are advertisements in this application related to renting a house which will prove useful to student.
   - A student can also use this application to buy or sell an electronic product.
   - This application will also be help full for notifying latest offers on fashion, supermarket etc.
   - A student can also look for working student job offers through this application.
   - A student can lookout for groceries offers to save money visiting the advertisement offers.

2. Local User
   - A local user will be happy to use this application for many reasons.
   - One, he will be updated with latest events and offers around the city.
   - Second, he can use the website to sell or buy different used products.
   - Third, he can also look for jobs that can be full time or part time depending on the needs.

3. Organisation
   - Any marketing industry or organisation (e.g., REWE, Netto) with store outlet can enjoy many benefits through this application.
   - Any supermarket or fashion product shops can post advertisement which will help them to spread news of offers throughout the city, leading to good business.
   - Organisation can also post job offers, if there is any vacancy.

GUI and UX



UTILITY

The functionality of the design is referred to as utility. When discussing utility, the following questions should be asked

►Task and Goal

►Context of the task

►Targeted user group

►Environment (place, time, …)

The utility should ensure that the product fits the user's needs. If it solves an issue, There is no user experience without functionality.

USABILITY

PRINCIPLES OF USABILITY-

1. **Learnability** — Refers to how easy it is for users to learn how to accomplish basic tasks the first time they encounter the product.
2. **Efficiency** — Once users have learned the product or encountered it already, efficiency refers to how quickly they can perform tasks.
3. **Memorability** — How easily users can re-establish proficiency using a product after a period of not using it. In other words, it's how easily a user can remember how to use a product.
4. **Errors** — Observing the quantity and severity of errors committed by users while using the product as well as how easily they recover from such errors.
5. **Satisfaction** — Measures how pleasant it is for the user to use the product.

USER EXPERIENCE

Typical measures for user experience are:

►Satisfaction of the customer

►Probability that customers come back to use the service again

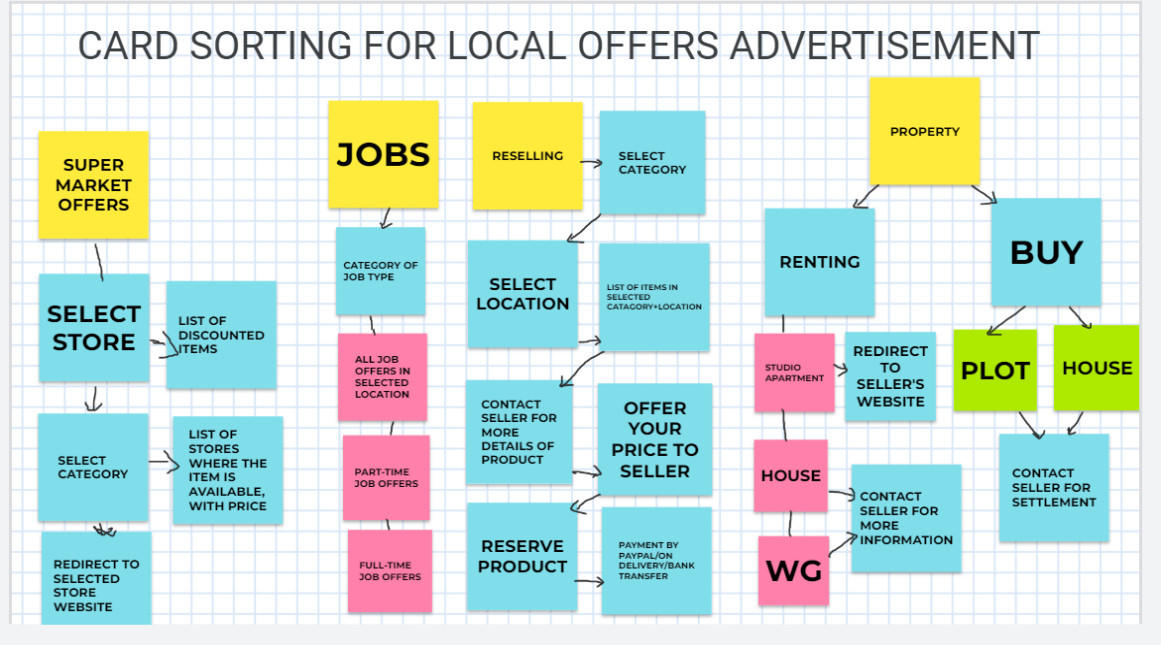
►Emotional binding

Determining requirements-

CARD SORTING

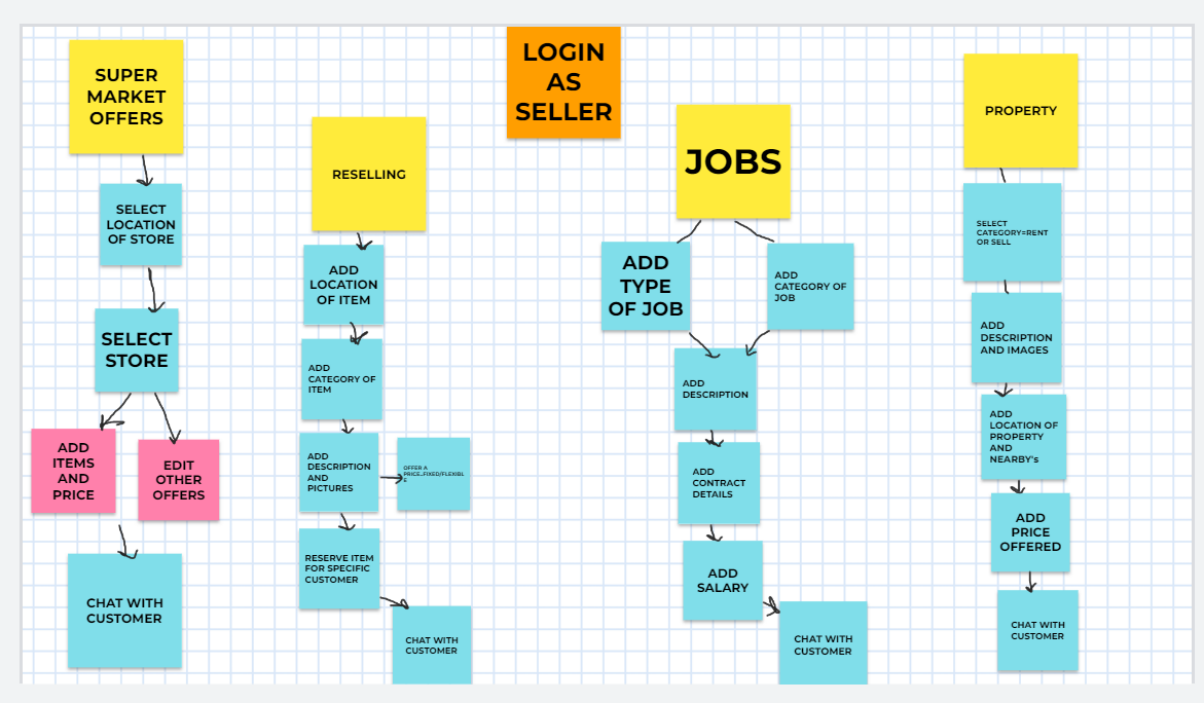
For determining requirments we used Open CARD SORTING method

We selected topics from content within ourwebsite into groups that make sense and then named each group we created in a way that feel accurately describes the content.



We used Google JamBoard to create Cards, In this picture, We implemented the Sorting from Buyer-end.

Yellow cards describe the Main Categories of the website and blue cards are sub-categories. Pink cards are sub-(sub-category). Buyer can follow the flow as shown in Picture.

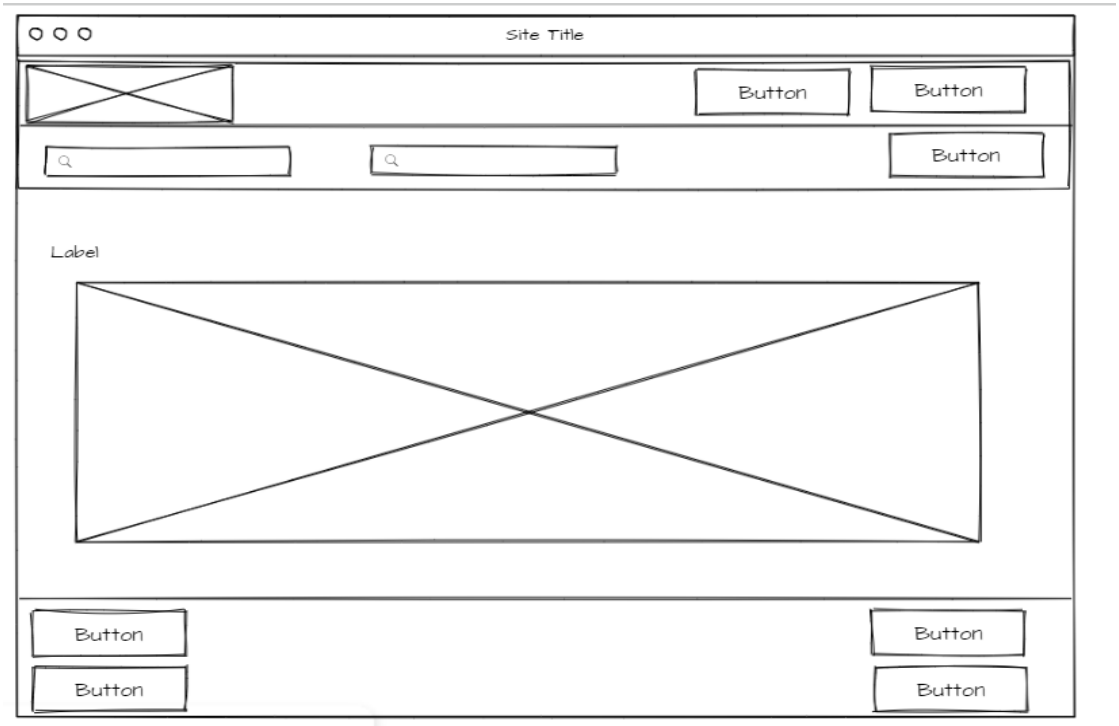


Here, we implemented the Sorting from Seller-end.

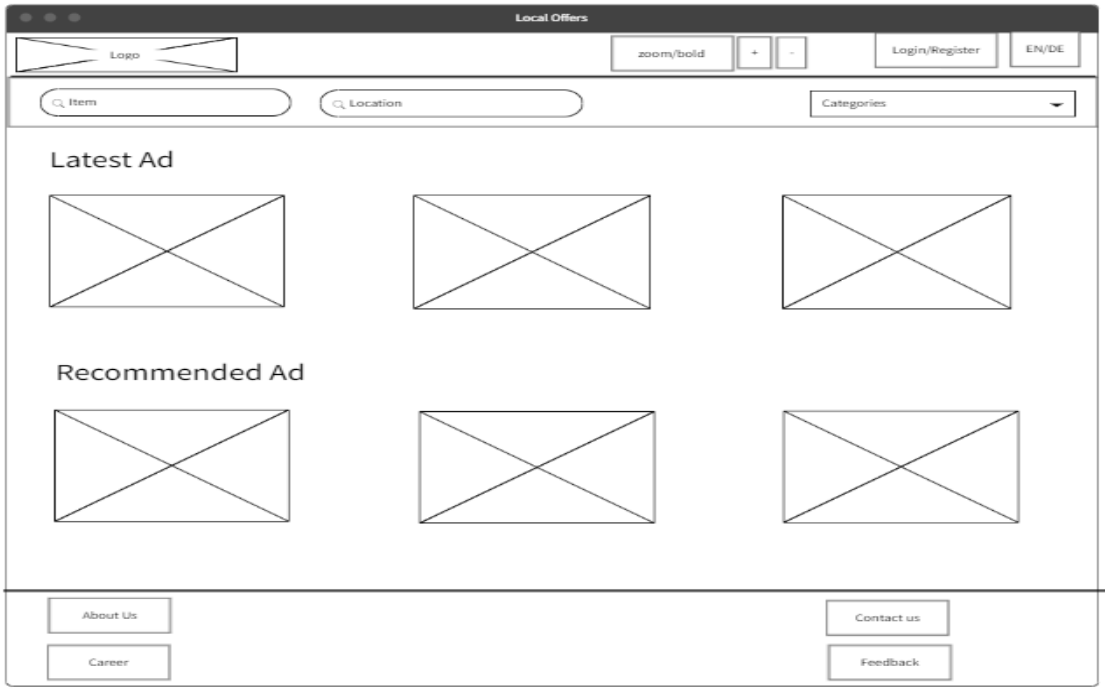
Yellow cards describe the Main Categories of the website and blue cards are sub-categories. Pink cards are sub-(sub-category). Seller can follow the flow as shown in Picture.

SCRIBBLE

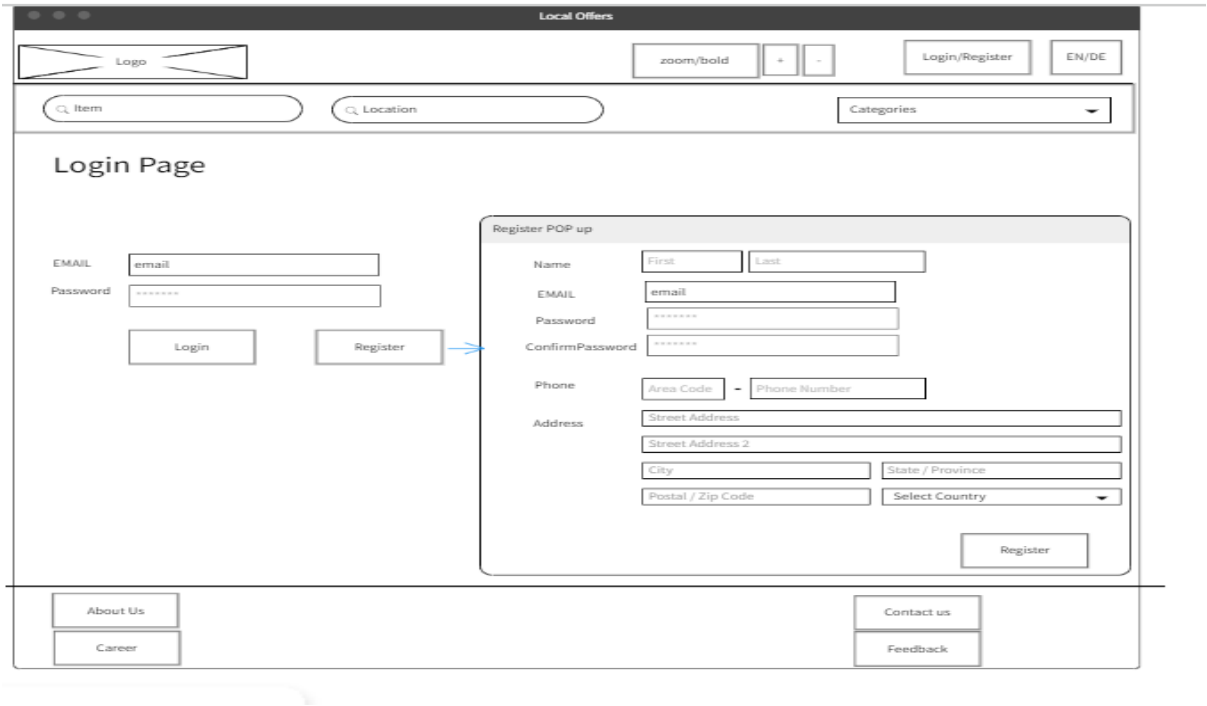
For making Scribble, We used MockFlow tool to create scribble and It show a first idea of the graphical layout of application page.



WIREFRAMES

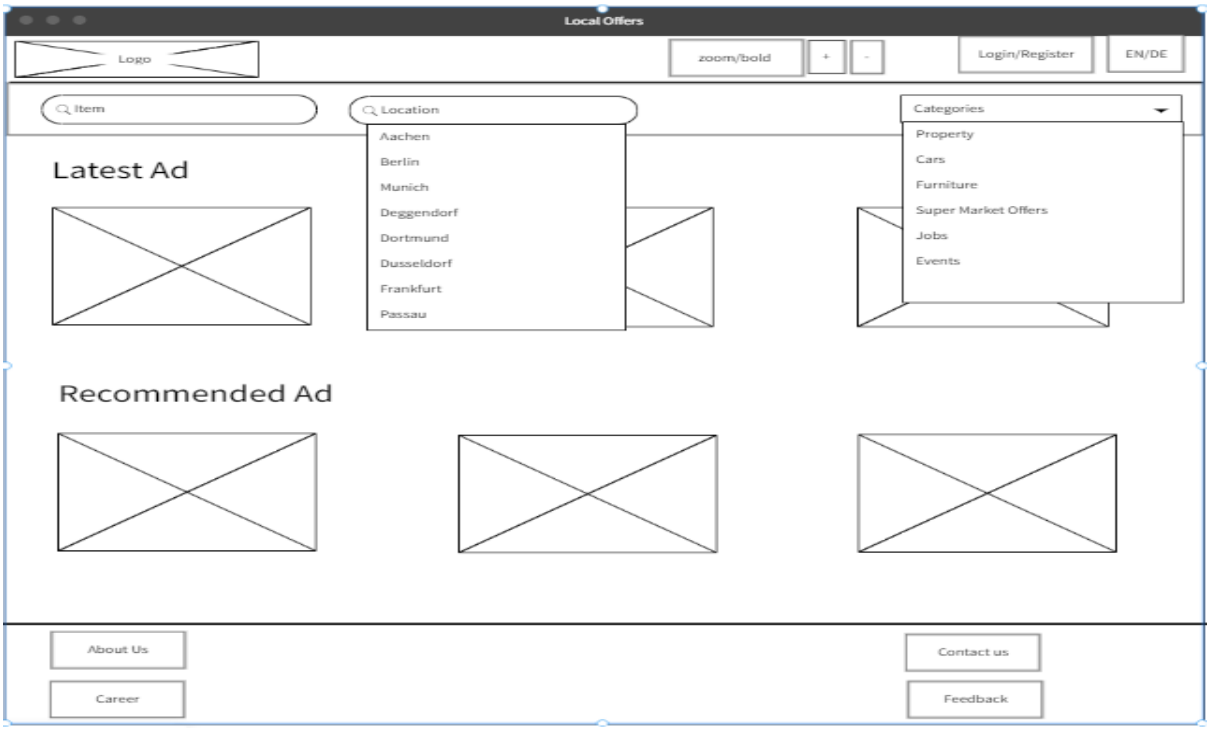


Here is the First Wireframe of Website, which shows first page.



The second Wireframe of Login Page, Here we have Login fields and a popup to register user which works on click Register button on LoginPage.

The Third Wireframe of Application, Here we Implemented User page where the user can see advertisements he/she posted and Messages. Also, the user can add new Advertisement.



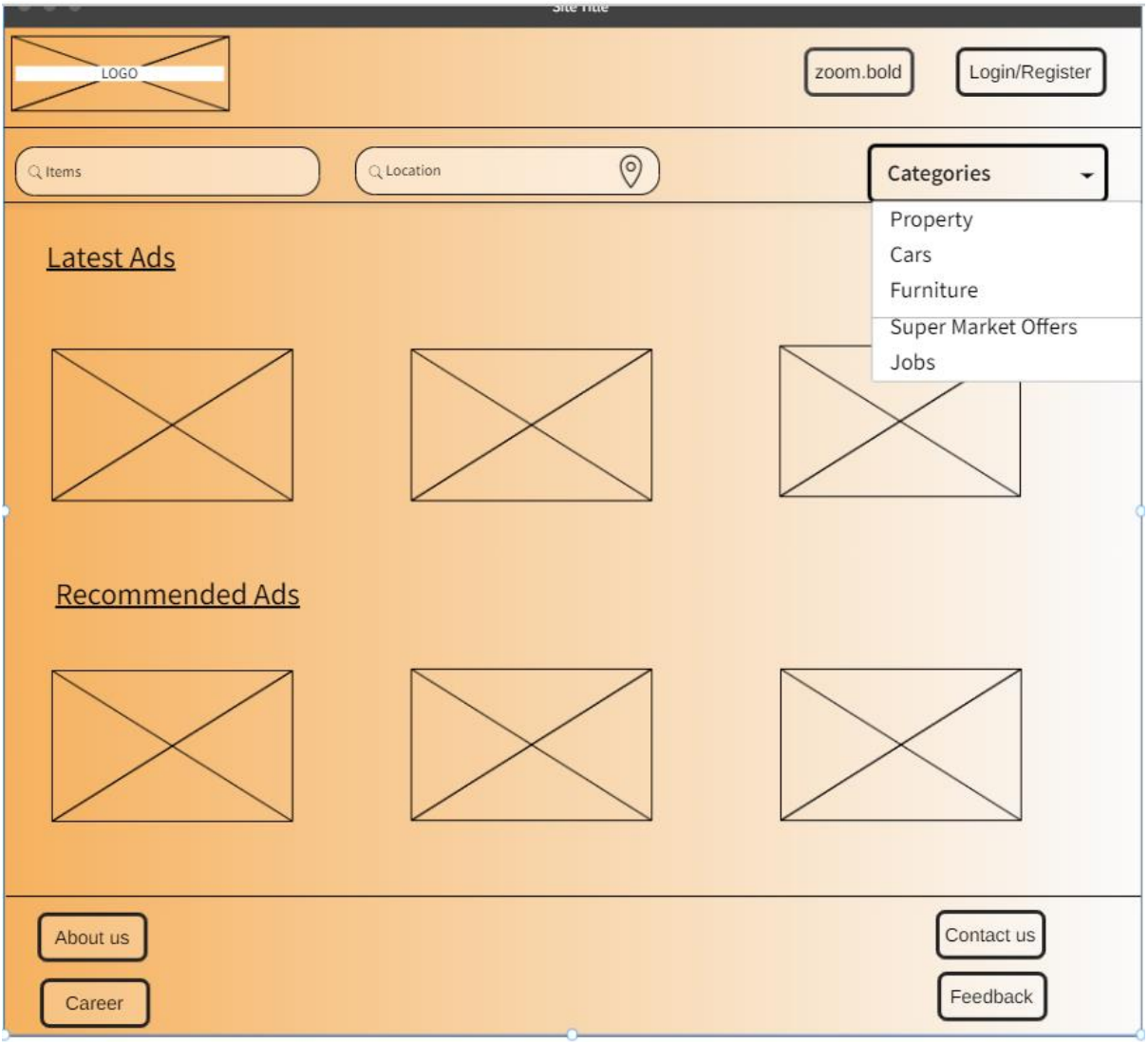
Here we Implemented Paper Prototype of the Application where dropdown button for categories and Location selection is working.

MOCKUP

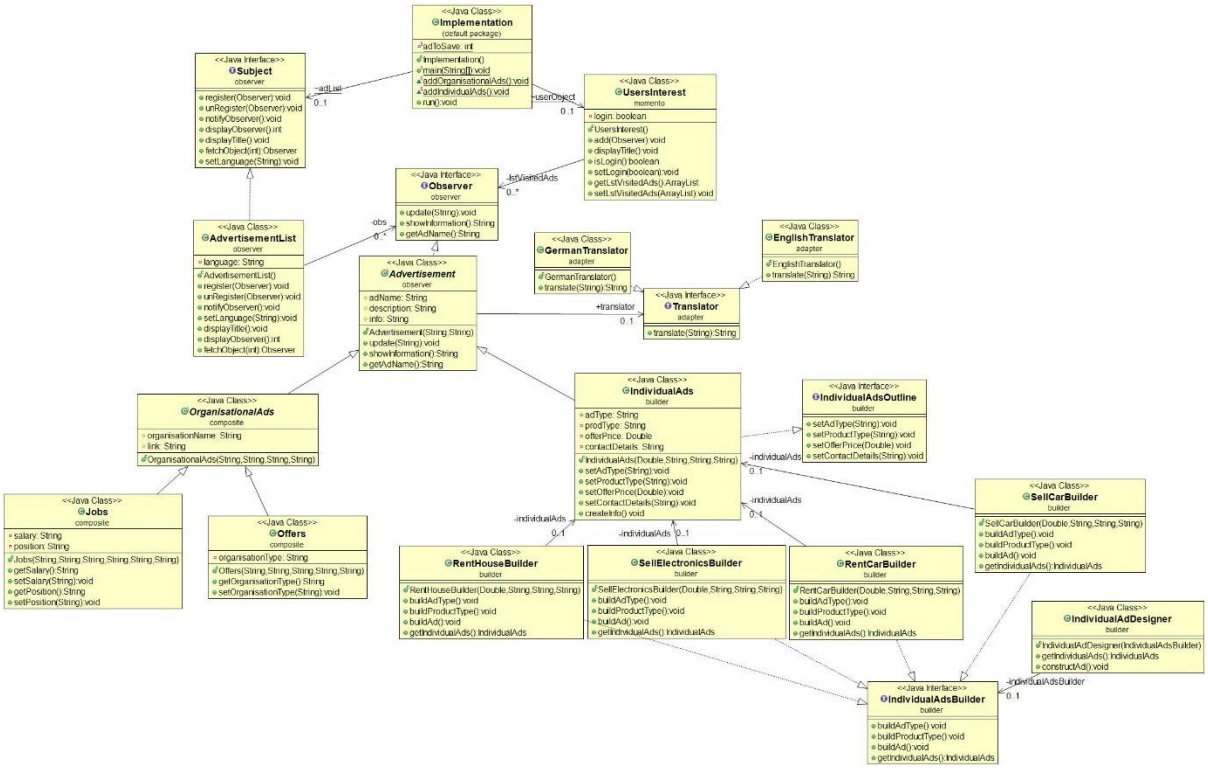
A mockup is a static design of a web page or application that features many of its final design elements but is not functional. A mockup is not as polished as a live page and typically includes some placeholder data. It's useful to breakdown each part of that definition.

Here we used Orange/White and Black color in our page as every color have its own significance.

- Orange: active, social, young
- White: Clear, concentrated, pure
- And Black colour in Contrast, which states empty, complete, classical.



Class Diagram:



Demonstration Output:

1. Displaying the advertisement

- Below screenshot shows how the advertisement are displayed for all the user who visits the website.

```
Advertisement Board :
1. REVE (Super Market) | : |Gemuse Offers| Description : Offer upto 10%| Website-Link : www.abc.com
2. Job Opportunity : Studio 449 Part Time Job Available Role : Bar Tender Estimated Salary : 12 Euro per hour Description : Can work either
3. Car For Rent | BWM Available | Offer Price : 200.0 | Contact Details : sandy@gmail.com +49 133133133
4. House For Rent | 2 rooms House | Offer Price : 300000.0 | Contact Details : vipul@gmail.com +49 123123123213
5. Car For Sale | Mercedes Benz | Offer Price : 45000.0 | Contact Details : anna@gmail.com +49 345345435
6. Electronics For Sale | Macbook M1 | Offer Price : 850.0 | Contact Details : vipul@gmail.com +49 17723487382

Select prefered option :
1. Login
2. Change Language to German
3. Change Language to English
4. Exit
```

2. Change the Language

- After you select the second option i.e., to change the content from English to German, below details are displayed.

```
Advertisement Board :
1. REVE (Super Market) | : |Gemuse Offers| Beschreibung : Offer upto 10%| Website-Link : www.abc.com
2. Stellenangebot : Studio 449 Part Time Job Available Rolle : Bar Tender Geschätztes Gehalt : 12 Euro per hour Beschreibung : Can work eith
3. Auto zu vermieten | BWM Available | Angebotspreis : 200.0 | Kontaktdetails : sandy@gmail.com +49 133133133
4. Haus zu vermieten | 2 rooms House | Angebotspreis : 300000.0 | Kontaktdetails : vipul@gmail.com +49 123123123213
5. Auto zu verkaufen | Mercedes Benz | Angebotspreis : 45000.0 | Kontaktdetails : anna@gmail.com +49 345345435
6. Elektronik zu verkaufen | Macbook M1 | Angebotspreis : 850.0 | Kontaktdetails : vipul@gmail.com +49 17723487382

Select prefered option :
1. Login
2. Change Language to German
3. Change Language to English
4. Exit
```

3. Login

- Once you login using option 1, you will be able to see the saved ads.
- Since this is the first login as a result, we will see there are no saved ads.
- Select the ad, you find interesting (in this case 2 is selected) and then logout.

```
Select prefered option :
1. Login
2. Change Language to German
3. Change Language to English
4. Exit

1
Select the advertisement to save or enter 'logout' to exit :

Saved Ads :

All Ads :
1. REVE (Super Market) | : |Gemuse Offers| Beschreibung : Offer upto 10%| Website-Link : www.abc.com
2. Stellenangebot : Studio 449 Part Time Job Available Rolle : Bar Tender Geschätztes Gehalt : 12 Euro per hour Beschreibung : Can work eith
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6. Elektronik zu verkaufen | Macbook M1 | Angebotspreis : 850.0 | Kontaktdetails : vipul@gmail.com +49 17723487382
2
```

4. Re Login

- After you re login the saved selected during last login will be saved ad displayed if required.

```
1
Select the advertisement to save or enter 'logout' to exit :

Saved Ads :
Part Time Job Available

All Ads :
1. REVE (Super Market) | : |Gemuse Offers| Beschreibung : Offer upto 10%| Website-Link : www.abc.com
2. Stellenangebot : Studio 449 Part Time Job Available Rolle : Bar Tender Geschätztes Gehalt : 12 Euro per hour Beschreibung : Can work eith
3. Auto zu vermieten | BWM Available | Angebotspreis : 200.0 | Kontaktdetails : sandy@gmail.com +49 133133133
4. Haus zu vermieten | 2 rooms House | Angebotspreis : 300000.0 | Kontaktdetails : vipul@gmail.com +49 123123123213
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6. Elektronik zu verkaufen | Macbook M1 | Angebotspreis : 850.0 | Kontaktdetails : vipul@gmail.com +49 17723487382
```

Distribution of Workload:

Task	Sandesh	Narayani
1.Researching about the online learning application		
2.Analysing use case Students, Local User		
3.Analysing use case Organisational User, Job Seeker		
4.Researching about design patterns Event Bases Asynchronous, Adapter, Observer		
5. Research about design patterns Composite, Memento, Builder		
6.Researching about System Architecture		
7.Analysing the User Experience and GUI		
8.Wireframes and Scribbles		
9.Analysing working for combined patterns		
10.Deciding the project flow		
11.Documenting the class structure		
12.Implementing the Builder		
13.Implementing the Composite		
14.Implementing the Observer		
15.Implementing the Adapter		
16.Implementing the Memento		
17.Implementing the Event Based Asynchronous		
18.Code Integration		
19.Class Diagram Generation		
20.Project Documentation		

Difficulties and Improvements-

Narayani Sachdeva

Difficulties

1. Initially, it was difficult to divide tasks.
2. Understanding MockUp tool.

Improvements

1. Location services must be implemented.
2. Frontend colour combination could be better.
3. Zoom In/Bold button functionality should be implemented properly.
4. More Categories can be defined
5. Feedback from customer functionality must be implemented.

Sandesh Gharge

Difficulties:

1. Implementing combined pattern
    - Understanding individual pattern was a quite an easy task.
    - I faced difficulties while implementing combination of patterns.

2. Relating best pattern for a module
    - After the dividing the application into multiple modules, it took time to identify how any pattern can be mapped to different modules.

Improvements

1. Multiple Language Implementation
    - The demo is designed for only 2 languages.
    - This can be extended to more than 2 languages with adapter.

2. Expired Events can be deleted
    - Currently, all the events are displayed on the screen, which can filter removing the expired events.