ASHESI UNIVERSITY

MOVIN: REDESIGNING THE ONLINE RENT SEARCH EXPERIENCE FOR THE RESIDENTIAL REAL ESTATE SPACE IN GHANA

APPLIED PROJECT

B.Sc. Computer Science

Lenry Naa Odua-Adei Neequaye

2021

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APPLIED PROJECT

Applied Project submitted to the Department of Computer Science, Ashesi University in partial fulfillment of the requirements for the award of Bachelor of Science degree in Computer Science.

Lenry Naa Odua-Adei Neequaye

2021

DECLARATION

I hereby declare that this Applied Project is the result of my own original work and that no part of it has been presented for another degree in this university or elsewhere.

Candidate's Signature:

……

Candidate's Name:

Lenry Neequaye

……

Date:

13 May 2021

……

I hereby declare that preparation and presentation of this Applied Project were supervised in accordance with the guidelines on supervision of Applied Project laid down by Ashesi University.

Supervisor's Signature:

……

Supervisor's Name:

David Hutchful

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Date:

13 May 2021

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Abstract

The impact of technology in our world today is incomparable. It has become easier than ever to accomplish previously tedious tasks such as shopping for food, sending money to loved ones, and even now, finding a place to live. Concerning finding accommodation today, specifically a residential property to rent for a considerable amount of time, many digital tools have been designed to make the process simple and short. However, in Ghana, some of the tools available do not fully streamline the renting process from a customer's initial search to their evaluation period and finally the end of their search, including a signed leasing agreement between themselves and the landlord or agency handling the property. This applied project proposes a web application with an improved user experience that allows:

- Customers to better filter through properties and view both information on properties and their respective communities, thereby reducing the many intermediary calls that traditionally occur between customers and landlords or agents working under agencies handling properties.
- Agencies and landlords to quickly reach a wider audience with their property listings and earn more while seamlessly communicating with interested customers. Kindly note that although all homeowners are referred to as landlords in this paper, the comments in this project apply to both landlords and landladies.

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Chapter 1: Introduction

Residential real estate refers to any property used for residential purposes and includes, but is not limited to, single-family homes, townhouses, apartments, high-value homes and vacation homes. Fortunately, technology has improved the way we interact with our natural world today, bringing various housing options to the fingertips of potential renters or buyers (referred to as customers in this project). What would otherwise be a seemingly complex task can now be done with the help of online resources such as web and mobile applications.

1.1 Background

Having a homely place to return to after a long day can be very refreshing. However, finding a place to call home either temporarily or permanently in Accra can be a hassle – especially if you are a university student, an entry or mid-level employee, or simply new to the renting or buying space. Being the hotspot of many booming businesses today, Accra is often teeming with people looking for a place to work and essentially live to reduce their commute time and expenses.

In 2011, a report by UN-Habitat, a body directed by the United Nations General Assembly to promote socially sustainable cities by providing adequate shelter, noted that renting is likely to continue in Ghana's housing markets, given that the ratio of income to housing prices is still low [1]. The report also highlights that when speaking about their future housing plans, Ghanaians spoke of either 'building a house' or 'renting a room' [1].

According to a 2019 report released eight years later on Ghana's housing market, the author comments that Ghana's housing market is growing steadily due to an influx of non-resident Ghanaians and foreign investors [2]. However, the article indicates that the rental market in Accra is still quite large, with about 37.5% of all households renting and about 40.4% of households

owning their homes. The remaining 20.5% of household occupants live rent-free, and 1.6% live in housing units provided by their employers [2]. These statistics attest to the fact that the renting space in Ghana is still relatively large.

Although there are many websites and applications that provide information on available housing options, they often have informational gaps that make the renting process significantly longer and leave such potential customers feeling underwhelmed or unable to budget or plan their move. These gaps include, but are not limited to, the lack of a good resource that will:

1. Provide potential customers with as much information as possible on the livability and relevant leasing information of an available housing option.
    a. Here, livability is described as the sum of factors that make a place ready for habitation. These factors include, but are not limited to, amenities available, utilities (included in the rent or otherwise), and house rules, amongst others.
    b. Leasing information refers to but is not limited to documents provided by the customer to formalize the lease, available leasing options offered by the property handlers, and the negotiability of prices stated, amongst others.
2. Give customers as much information as possible to paint a good enough picture of the new community they may eventually move into.
3. Allow customers to seamlessly communicate with the agents or landlords in charge of properties they are interested in, so they can move from home seekers to new tenants.

1.2 Literature Review

The literature reviewed around this subject focused primarily on representing experiences virtually to people, the effectiveness of the Internet in the marketing of residential real estate property, and the critical factors that determine a housing unit's acceptability.

One article commenting on the impact of technology on real estate marketing notes that technology, specifically the Internet, is replacing traditional marketing methods such as newspaper ads and magazines and that online sources of information are more relevant to younger buyers today [3]. Thus, this article duly justifies the benefits of using a digital tool to connect interested customers to property landlords or agents working with agencies.

Regarding virtual experiences, an insightful study into the use of virtual reality (VR) and augmented reality (AR) technologies in the digital residential real estate space revealed that the use of such technologies improved the customers' information search and their evaluation time [4]. These technologies are especially applicable in demographics where housing is in high demand [4].

In another study, the authors developed an Android application to aid the home search in an area with high housing demand. A point of improvement identified here was using a filtering system that would show customers only housing options they were qualified to apply to [5]. This filtering system would reduce the search time and possible customer dissatisfaction since customers would avoid applying for housing options for which they may be automatically disqualified. Although people in Accra do not typically apply for housing, some landlords have preferences for the type of tenants they would accept. Thus this filtering system can be used to effectively shorten the search process for both customers and landlords or agents linked to agencies.

In addition, an interesting study regarding the use of pathos by an agent in an online listing of a residential property reveals that the use of particular descriptive language can influence a potential homebuyer's decision [6]. Here, pathos is defined as flowery language intended to make buyers more favorably inclined towards a property, such as "good buy" and "well-maintained" [6]. Thus, the wording used is very vital in the marketing of a residential property.

Finally, salient insights were gleaned from a study focused on generating success criteria for sustainable and affordable housing units in Nigeria. The research first sets a precedent by acknowledging that rapid urbanization and a growing influx of migrants have resulted in growing housing issues [7]. Due to this, there was a need to discuss sustainability and a means of improving the quality of residential livelihoods of low-income households while keeping rental prices reasonable [7]. Thus, an analysis to generate some success criteria and household validation was conducted. The study's results revealed that security (of lives and property) ranked highest [7]. Other criteria such as accessibility (i.e., transportation infrastructure, proximity to workplaces and employment opportunities), technology (i.e., the presence of modern technologies in housing units), affordability (i.e., rental prices against income), and others were also deemed important [7].

1.3 Related Work

Concerning existing technology, a popular site with a significant number of listings today is meQasa.com. meQasa primarily serves the Ghanaian community and helps users find residential or commercial property to rent or buy in Ghana [8]. A typical user flow of the site involves a customer searching for a property of their choice using the provided filters, signing up to get access to the agent's number, then communicating with the agent outside the website. Currently, meQasa does not handle payments for property viewings customers schedule with agents, nor does it handle

payments to agencies or landlords for properties that customers choose to rent or buy. Although meQasa's current flow has shortened the property search process to an extent, it still does not fill some of the gaps mentioned earlier in Chapter 1.1.

The findings from these articles and research into existing solutions proved to be a solid foundation in finding out what has been done in the digital residential real estate space and opened up an opportunity to consider what more could be done, especially in the Ghanaian space.

1.4 End Product and Functionality

This project's contributions to the residential real estate industry in Ghana will be to provide an online resource, named **Movin**, that will make the renting process easy, engaging and transparent by providing as much detail as possible on the livability, leasing information, and community in which available housing options are located. It also seeks to maintain a high level of transparency by informing customers of all the possible costs they may incur and allowing them to get estimates based on varying lease durations. Ideally, Movin will allow for communication with landlords and agents working with agencies handling properties, as most landlords still employ agencies to help them manage the lease or sales of their residential properties.

Chapter 2: Requirements

This chapter seeks to discuss the requirements gathering procedure used, analyze the results of this procedure, highlight the relevant users and use cases of the proposed system, and outline the requirements to be addressed in this project.

2.1 Requirements Gathering Procedure

The goal of the requirements gathering phase is to understand the process customers employ in searching for a residential real estate property, the pain points in their journey, and possible opportunities for improvement in this process. It also hopes to make connections between the findings from the literature reviewed and the results of this data gathering process. A mixed-methods research design was employed, where both quantitative and qualitative research was conducted, and their findings were combined to gain a more holistic picture of the problem. For the quantitative research, a Google survey form was designed and sent out across various social media channels to learn the current steps customers take in searching for a residential place to rent or buy in Ghana. For the qualitative research, semi-structured interviews were conducted over a consensually recorded Zoom call with current and prospective customers living in Ghana. After this two-fold research, both approaches were analyzed to reveal key findings and potential points of correlation.

2.2 Survey Form Analysis

The survey form ended with 66 responses, with 59.1% (39 people) indicating that they had tried to search for a residential place to rent or buy in Ghana, and 40.9% (27 people) indicating that they had not tried to search for a residential place to rent or buy in Ghana. For simplicity's

sake, we will refer to the 59.1% of respondents as Group A and the 40.9% of respondents as Group B.

2.2.1 Group A: Key Findings

- A majority of people (87.2% or 34 people) from this group were between the ages of 18 and 22 years inclusive, while a few people (12.8% or 5 people) were between the ages of 23 and 27 years inclusive.
- Most people (66.7% or 26 people) in this group were currently in an undergraduate university, and a good number (30.8% or 12 people) stated they had graduated from an undergraduate university as their highest form of education.
- A large proportion from this group (84.6% or 33 people) were currently living with parent(s) or guardian(s), with a few (10.3% or 4 people) currently renting a place.
- Out of the proportion of people not renting or living in a place they had bought (89.7% or 35 people), most (71.4% or 25 people) had looked solely for a place to rent in Ghana, while a few (25.7% or 9 people) had looked for both a place to rent and buy in Ghana.
- A primary means of searching for a place for most in this group was online (87.2% or 34 people), while 38.5% (15 people) had seen an ad on social media (for example, on Twitter, Instagram, WhatsApp, Facebook, etc.). A good proportion (35.9% or 14 people) had also searched by asking a friend. Figure 2.2.1 shows this below.
- When asked about their searching experience, a significant proportion (41% or 16 people) of respondents indicated it was difficult, while a considerable proportion (25.6% or 10 people) stated they were neutral about it. Some respondents (12.8% or 5 people) found it somewhat difficult. Only a few found it either very easy, somewhat easy, and easy.

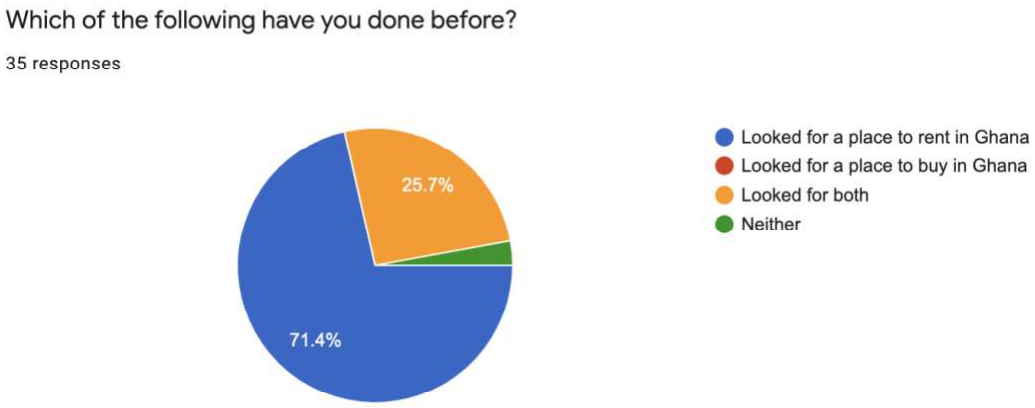

Figure 2.1: Responses to the survey question "Which of the following have you done before?"

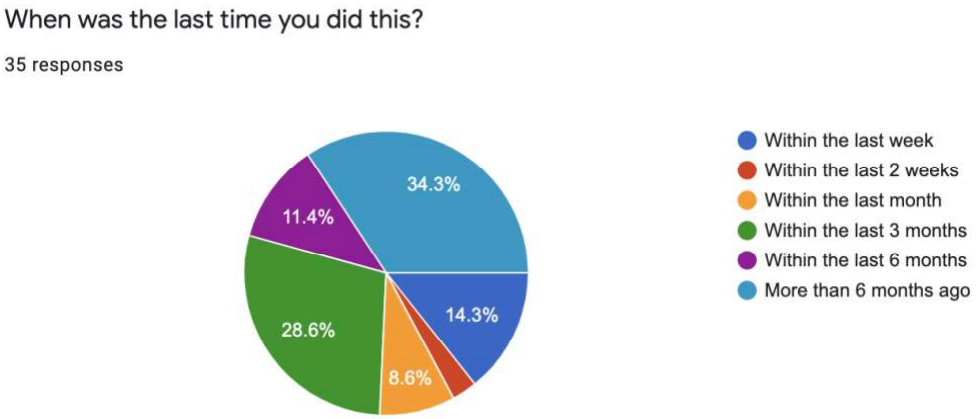

Figure 2.2: Responses to the survey question "When was the last time you did this?"

Figure 1.3: Responses to the survey question "How would you rate your searching experience?"

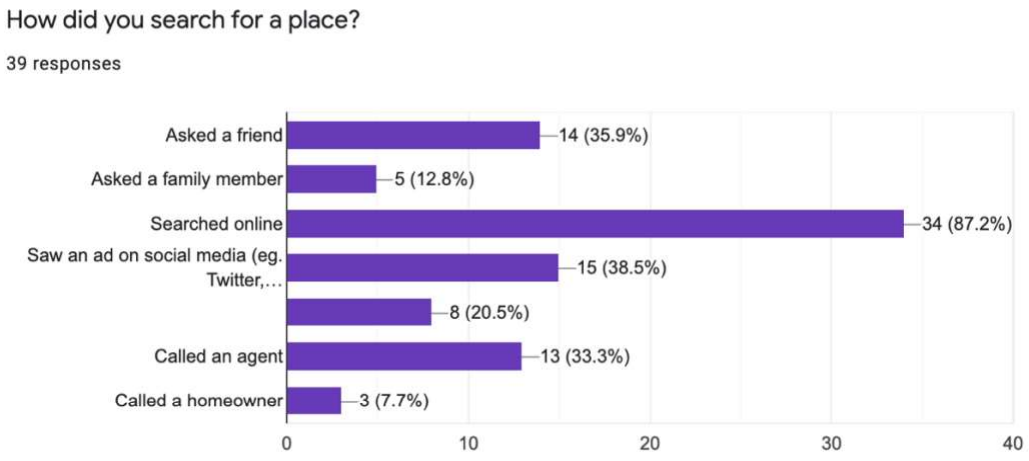

Figure 2.4: Responses to the survey question "How did you search for a place?"

2.2.2 Group A: Responses on the Survey Form about the Search Process

- **Websites used in the search, if applicable:** meqasa.com, jiji.com, booking.com, airbnb.com, tripadvisor.com, tonaton.com, leasemaster.com, olx.com, and goldkey.com.
- **Positive aspects of the search:** Searching online was of great benefit to some because they could view many options, see images of the residential listings and filter out options based on location and price. Other positive aspects included the ability to contact agents or landlords via a provided number online.
- **Negative aspects of the search:** Difficulty working with agents was a key issue. This was due to the inability to effectively schedule meetings with agents, failure to get quick feedback, paying fees for little help provided, and questionable credibility of agent reviews online. Other issues included the inability to personalize the search on some websites beyond choosing a location, selecting from the limited availability of affordable housing options, and being provided limited payment options. Some also complained about having to travel long distances to view these properties in person.

- **Things they would have wanted to know during their search:** Some indicated that they would have wanted to know or do the following during their search:
    - The renting laws and process in Ghana.
    - Gain access to better-looking pictures of the listings and their facilities.
    - View pictures of agents/landlords for easy identification when scheduling meetings with such ones and get access to the actual location of the listing.
    - Be provided with better assistance and access to affordable listings with varying payment options and better filtering options.
    - Be able to gauge the noise levels of the property's community and learn about its infrastructure (for example, the presence or absence of tarred roads, streetlights, drainage systems, etc.).
    - A convenient way to view properties without having to go there in person.

2.2.3 Group B: Key Findings

A majority of people in Group B (81.5% or 22 people) stated that they would consider searching for a residential place to rent or buy in Ghana, while a few (18.5% or 5 people) stated that they would not. The majority in Group B expressed that they would like to know the following during their search:

- Property prices, location, number of rooms, rent agreement terms, the safety of the property's community and the property itself during floods, distance from commercial areas, and a way to gauge the affordability of a listed property.

2.2.4 Concluding Points

This section of the survey allowed participants to express any further thoughts they felt had not been captured in the previous questions in the survey form. The comments recorded included:

- The need for society to be educated on the renting process in Ghana and for the government to implement rent advance policies.
- The fact that high rent prices in Ghana deterred most from searching, so there is a need for the search for affordable housing to be made more straightforward.

2.3 Interview Analysis: Customers

Semi-structured interviews were conducted over recorded Zoom calls with three current and prospective customers between the ages of 18 to 24 years inclusive. Each participant was asked a set list of questions, with leeway being made for slight deviations in the conversation. This section deals with the key findings from each participant.

Participant 1

Bio: A 2020 University of Ghana (alias Legon) graduate currently in law school in Ghana. She is currently renting a hostel in Accra to be closer to her school.

Searching process: She used a Google search, walked around looking for ads on available places, and asked friends and family for help. She finally got an agent's number from a friend, and he helped her find her current place. Then, she visited the place with her mum, got the owner's number from the caretaker, and her mum negotiated the price with the owner.

Challenges faced during the search: Pricey listings on meqasa.com discouraged her and forced her to purely use Google searches, which resulted in a more prolonged searching and evaluation period. The agent requested a high fee for doing minimal work, which she deemed

unfair. Also, no formal lease agreement was signed since the owner stated that their hostel residents do not typically sign lease agreements. Thus, only a form was signed to officiate the lease.

Things she would want to know during the search: These include security of the community, noise levels of the community, water and electricity stability, and nearby hotspots. She proposed a website similar to meqasa.com, but with better search filters and more affordable listings.

Opinion on using landlords, agencies, or both: She prefers dealing with landlords instead of agents because she believes the latter request high fees for doing little to aid the search.

Perception of virtual tours using AR technology: She commented that she would still visit the place in person after taking a virtual tour online because it would allow her to see the community better.

Participant 2

Bio: A 2019 Ashesi University graduate currently working for a company in Ghana. He is currently living at home with his parent. However, he has considered renting a place in Ghana to gain independence. He currently prefers the idea of renting because he believes it is cheaper than buying a place in Ghana.

Searching process: His search for a place to rent was solely informational, as he sought to understand the price ranges for particular communities. He only checked the website, meqasa.com.

Positive aspects of the search: The website allowed him to search by specific areas, see properties and the agencies handling them while providing a number he could contact agents with.

Challenges faced during the search: Apartments on the website were pricey.

Things he would want to know during the search: Price of listing, the type of area (e.g., whether it was a slum, a gated community, etc.), what happens during a flood, proximity to amenities (e.g., hospital, police station), as well as water and light stability.

Opinion on using landlords, agencies, or both: He would prefer dealing with agents because he believes they are more likely to be on time and have more time to work with him, as opposed to landlords who may be busy.

Perception of virtual tours using AR technology: He mentioned that he would still visit the place in person to get a better view of the community since that may not be captured in the AR virtual tour.

Participant 3

Bio: A 2019 Kwame Nkrumah University of Science and Technology (KNUST) graduate currently working with a company in Ghana. He is currently renting a place in Accra, and this is his second time doing so.

Searching process: He mostly searched by asking friends, family members, and agents. His brother's friend connected him with an agent who helped him find the first place he rented. His mum reached out to cousins and uncles, who linked her to an agent for his current place. Also, he checked the websites tonaton.com and meqasa.com.

Challenges faced during the search: Listings on meqasa.com were pricey. The agent he was connected with was unavailable to give him a tour of his current place, so his cousin had to do so. Further, the landlady of his current place did not provide a lease agreement; she only wanted him to pay. Thus, he had to create his lease agreement and get it signed by the landlady.

Things he would want to know during the search: Information about the community (e.g., whether it was a slum, a residential community, etc.), rent extension options, security of the place, water and light stability, garbage disposal methods, available furnishings, customization possibilities for the property, visiting and going out policies, as well as the type of neighbors currently living in the community.

Opinion on using landlords, agencies, or both: He would prefer to deal with landlords because he believes they would help him understand the community better.

Perception of virtual tours using AR technology: He mentioned he would still visit the place in person to get a better view of the community.

2.4 Compiling Survey and Interview Results

Based on the survey results and interviews conducted, the pain points revealed served as a stepping stone to designing opportunities for improvement in the current renting flow. Considering the use of AR, all the respondents from the interview noted that, despite the added advantage it gives in offering a more realistic view of the property itself, AR technologies may not help them explore the property's surrounding community. Thus, to address this problem, the four success criteria from the study in Nigeria – security, accessibility, technology, and affordability – were considered when developing Movin. Since the community a property is located in is not devoid of the property itself, there is a need to help customers learn about it.

2.5 User Personas

Based on the research conducted, the proposed system has three users:

- **Primary users:** Customers - previously defined as potential or current renters or buyers. However, this project will focus on potential and current renters for now, given the time constraint. Thus, the term *customers* now refer to potential renters.
- **Secondary user:** Agencies with agents managing properties for landlords or real estate developers.
- **Secondary user:** Landlords managing their properties.

2.5.1 Customers

These are the goals for atypical customers as shown in the diagram below, Figure 2.4.1:

- Find a new place to rent easily and quickly, with little costs incurred.
- Learn about the respective communities' properties are located in.
- Learn about the renting laws and processes in Ghana.
- Save up for their move.

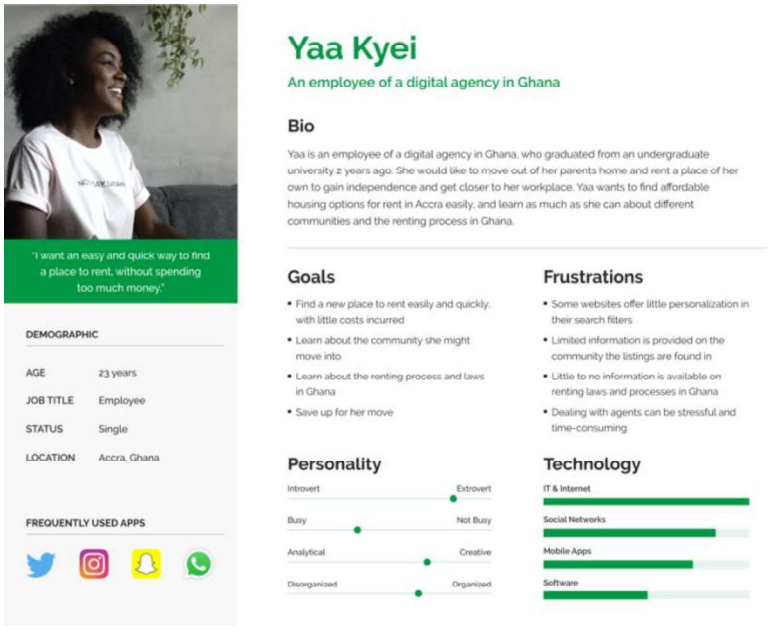

Figure 2.2: User persona for customers

2.5.2 Agencies

These are the goals for atypical agencies as shown in the diagram below, Figure 2.4.2:

- Make their property listings available to a broader audience.
- Generate more sales.
- Monitor the work of their agents.
- Increase their customer conversion and retention rate.

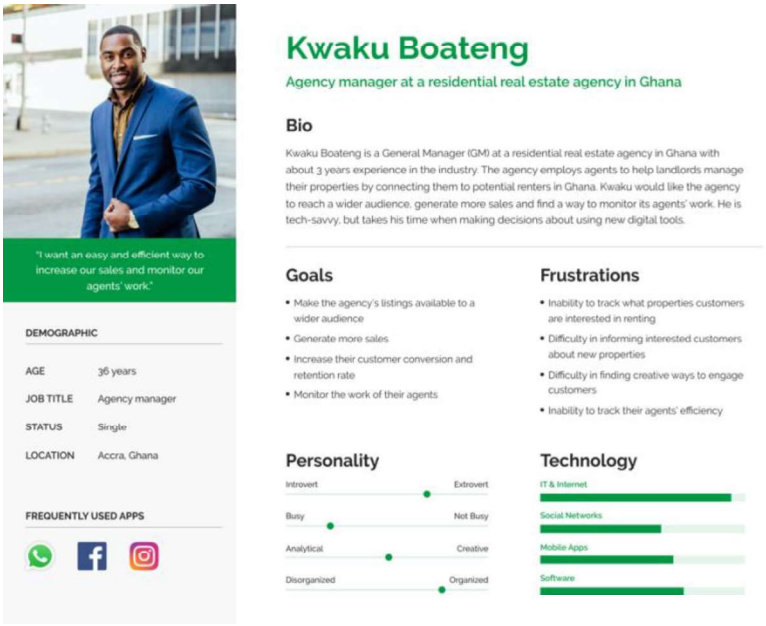

Figure 2.3: User persona for agencies

2.5.3 Landlords

These are the goals for atypical landlords as shown in the diagram below, Figure 2.4.3:

- Make their property listings available to a wider audience.
- Generate more sales.
- Increase their customer conversion and retention rate.

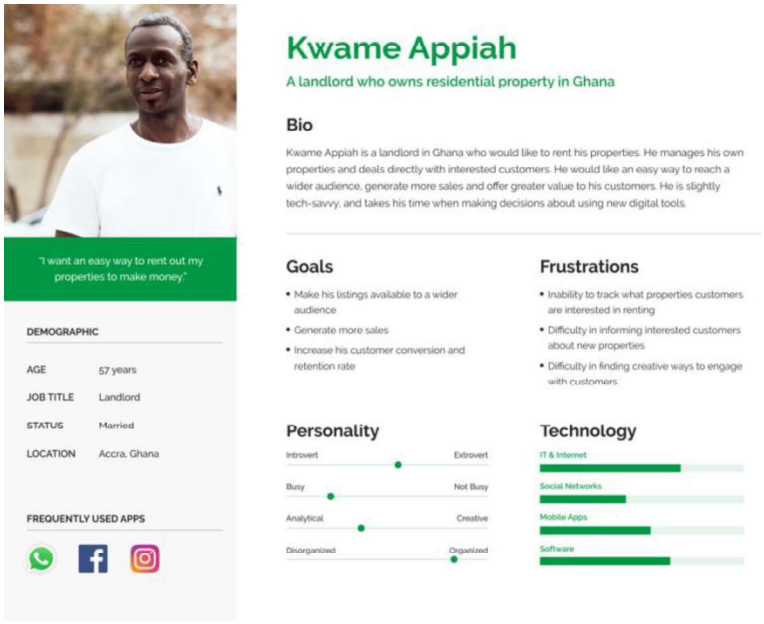

Figure 2.4: User persona for landlords

2.6 Unified Modelling Language (UML) Use Case Diagrams

UML use case diagrams are a great way to outline system requirements for different use cases of a system from a user's perspective. They summarize the relationships between users, use cases, and systems without detailing the order in which the uses cases should be executed. This section presents use case diagrams for each of the three users for this system.

2.6.1 Use Case Diagram: Customer

The main actions a customer takes in the use case diagram are as follows:

- Search for available listings, with an option to save listings and search preferences.
- View details about a property listing and its community details, with an option to save their favorite properties upon signing up and logging in.
- View an agent or landlord's profile, with an option to view the agent's respective agency's profile.

- Book a viewing with an agent or landlord.
- Compare saved properties.
- Learn about the renting process.

The main action of the system would be to display articles related to the renting process.

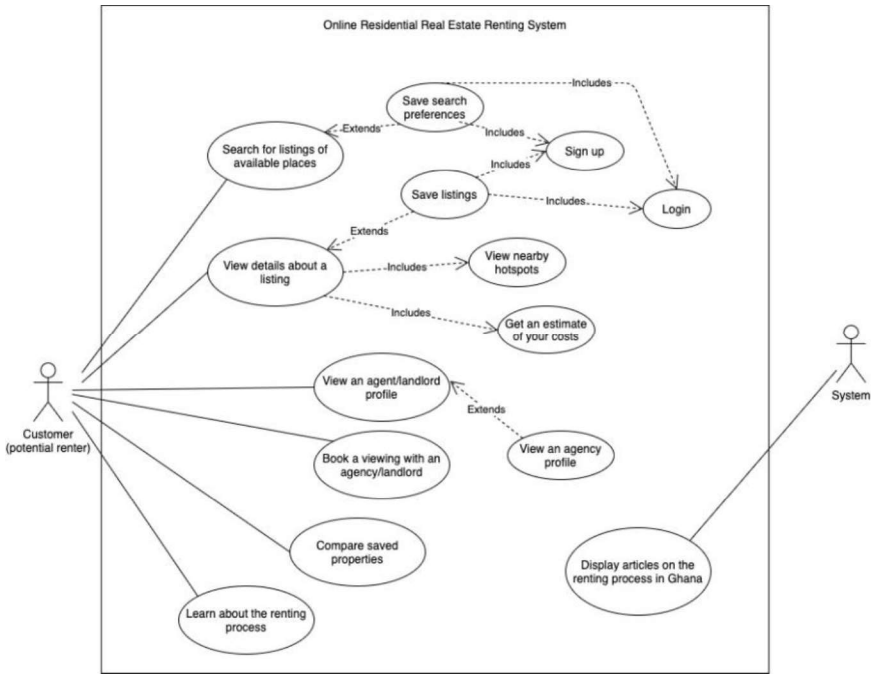

Figure 2.5: Use case diagram for customers

2.6.2 Use Case Diagram: Agency Manager

The main actions an agency manager or administrator takes in the use case diagram are:

- Upload property listings with the extended functionality of editing and deleting properties.
- Add agents to the agency's system, with the options of editing agent profiles and deleting agents.

- Assign properties to agents.
- Track the number of views on various listings uploaded.
- Manage bookings that customers make with agents in the agency.

The system's main action will be to track the number of views on properties uploaded.

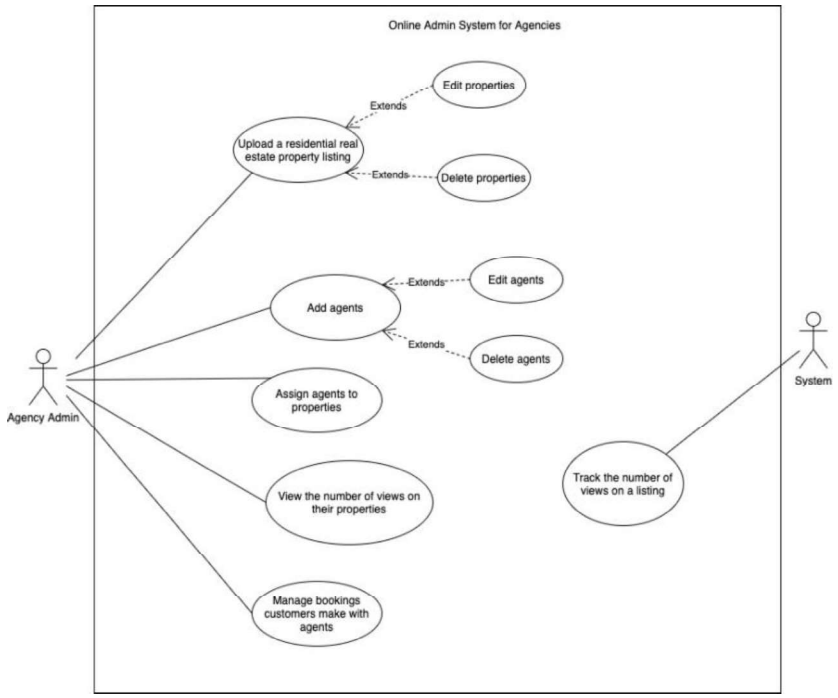

Figure 2.6: Use case diagram for an agency

2.6.3 Use Case Diagram: Landlord

The main actions a landlord takes in the use case diagram are:

- Upload property listings with the extended functionality of editing and deleting properties.
- Track the number of views on various listings uploaded.
- Manage bookings that customers make with them.

The system's main action will be to track the number of views on properties uploaded.

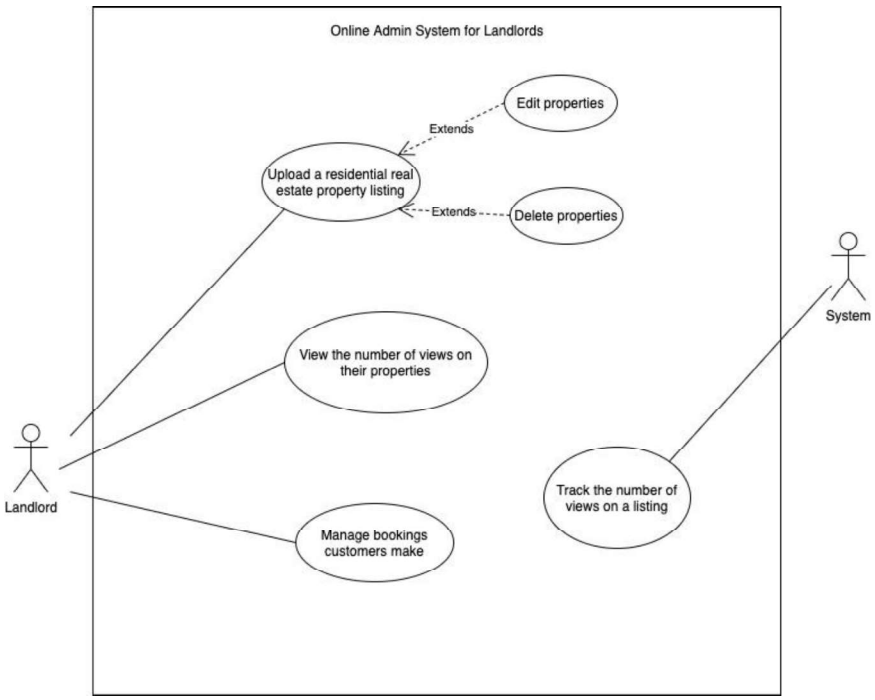

Figure 2.7: Use case diagram for a landlord

2.7 Functional Requirements

REQ-001: Customers, agency managers, and landlords can create accounts and log in to them easily.

REQ-002: Customers can view a list of available properties.

REQ-003: Customers can personalize search filters to fit their needs and receive a list of options that match their filters well.

REQ-004: Customers can save search filters when logged into their accounts.

REQ-005: Customers can save properties when logged into their accounts.

REQ-006: Customers can view all the details related to a property and its community information.

REQ-007: Customers can leave reviews on some of the features of the community a property is located in.

REQ-008: Customers should be able to view agency, agent, and landlord profiles easily, as well as any related information.

REQ-009: Customers should be able to review agencies, agents, and landlords.

REQ-010: Customers should be able to schedule viewing days and times with agents from agencies, as well as with landlords.

REQ-011: Customers should be able to get an estimate of their total cost for a property based on a selected preferred duration and provided costs.

REQ-012: Agency managers should be able to add, edit and delete properties easily and quickly with the help of integrated tools.

REQ-013: Agency managers should be able to add, edit and delete agents from the system smoothly.

REQ-014: Agency managers should be able to view agent profiles.

REQ-015: Agency managers should be able to manage bookings that customers make with their agents.

REQ-016: Agency managers and landlords should be able to see how many views specific property listings receive.

REQ-017: All users, except the Movin administrator, can have multiple roles with varying abilities/permissions under the same registered account as such:

- A customer can be a landlord.
- An agency manager can be a customer.
- An agency manager can be an agent.
- An agency manager can be a landlord.
- An agent can be a customer.

- An agent can be a landlord.
- A Movin administrator cannot have multiple roles.

2.8 Non-Functional Requirements

NF-001: Pages should load quickly and must be readily available to all users. Ideally, pages should load in less than 10 seconds.

NF-002: Information displayed must be accurate and resistant to tampering by unauthorized users.

NF-003: Users should have a delightful experience when engaging with the system, resulting from a clean user interface since decluttered screens are essential to helping users make quick and easy decisions.

NF-004: Forms on the system will be broken down into sections that can be completed quickly without pressure or confusion.

NF-005: Information on users of the system and properties should be stored securely and be easily retrievable.

NF-006: Since Movin has multiple users with varying roles and abilities/permissions associated with them, accounts will be handled such that overlaps can occur with restricted access per role. Each role will have a set of abilities/permissions that allow a user to perform certain actions and view specific data related to whatever role they are logged in as at any point in time.

NF-007: The system should be built in a modular way with reusable components so that future integrations and updates can occur seamlessly.

Chapter 3: System Architecture

The system application architecture used in implementing this project is a 3-tier architecture, defined as a software application architecture that sorts applications into three tiers- the presentation tier, application tier, and data tier [9]. A significant advantage of this architecture is that each tier runs on a separate server so that it can be developed quickly, simultaneously, and scaled easily [9]. Additionally, there is enhanced reliability since a fault in one tier does not reduce the performance of another tier [9]. Further, security is also increased since the presentation, and data tiers cannot interact directly [9].

3.1 Three-Tier Architecture

In web development, the three tiers are the web server, application server, and database server. Thus, for the Movin system, the three tiers are as follows:

- **Web server:** This is the presentation tier that displays the user interface. In the case of Movin, this is the website that serves dynamic web pages for users to view property, schedule bookings for viewings, add a property, and so forth.
- **Application server:** This is the application tier that holds the business logic for processing user requests. This tier will be developed using the PHP: Hypertext Preprocessor (PHP) web application framework, Laravel, which uses the Model-View-Controller (MVC) architectural pattern.
- **Database server:** This is the data tier that stores and manages information processed by the application. This tier will be handled using the relational database management system MySQL.

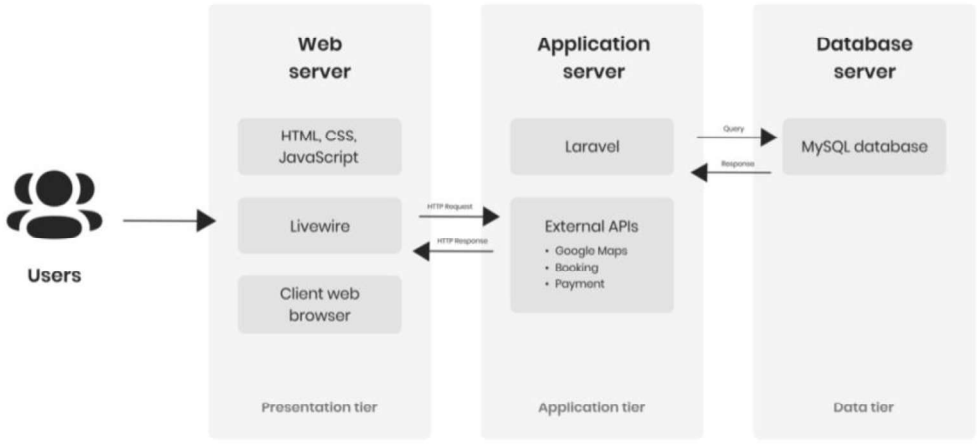

Figure 3.1: Three-tier architecture for Movin

3.2 Architectural Pattern: MVC

The architectural pattern used for the application server is the MVC design pattern, as this aids in interaction management in many web-based systems. In this design pattern, the application logic is divided into three main functional components:

- **Model:** This is the central component that manages how data is stored in the database and the business logic and rules of the web application.
- **View:** This is the presentation layer that controls which components are made visible to the user in the form of a graphical user interface- in this case, a web application viewed in a web browser. Thus, the view includes all functionality that users can directly interact with, such as clicking buttons or keying in data.
- **Controller:** This component connects the model and the view by collecting input supplied by users from the view, using business logic to convert it into requests for the model, retrieving data from the model, and then updating the view with the new data from the model.

MVC provides a great way to handle information in this system because it is loosely coupled. Each component (model, view, and controller) can work independently of each other, making the code modular, reusable, and easy to modify. Figure 3 below depicts a high-level overview of the system architecture. A user sends a Hypertext Transfer Protocol (HTTP) request from the view and any provided data to the necessary controller. The controller then performs the required action as defined by its business logic and informs the model of which information to retrieve or update in the database. Next, the model returns the required data from the database and passes that to the controller. Finally, the controller passes the new data to the view, and the view displays the new data to the user via an HTTP response.

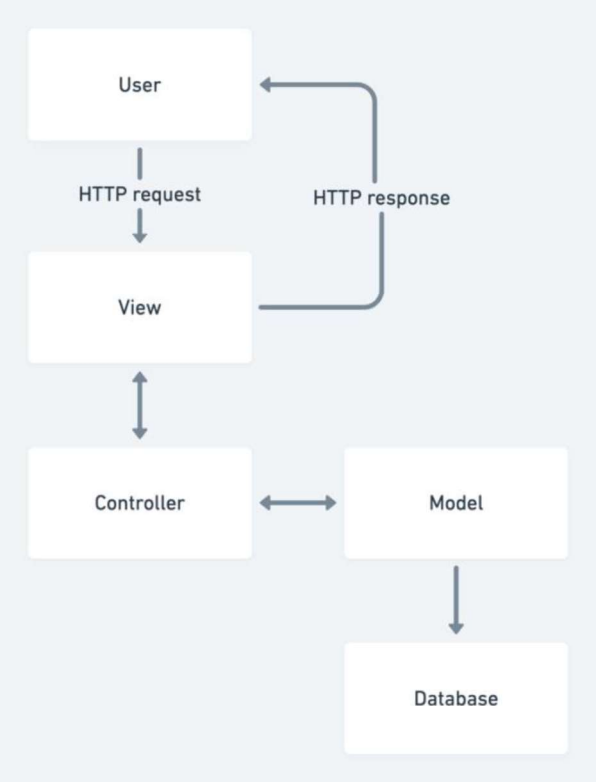

Figure 3.2: MVC architecture implemented by Laravel

3.3 Application Architecture: Information and Transaction System

Any system that includes interaction with a shared database can be called a transaction-based information system [10]. In recent times, resource management systems are designed as web-based systems that provide users with an interface to interact with the system through a web browser [10]. Based on the definition above, Movin qualifies as a transaction-based system because it provides customers access to a list of properties and allows them to book and pay for viewings with the respective agents or landlords linked to those properties. Thus, we can say that Movin is a transaction-based information system developed using a 3-tier architecture supplemented by the MVC pattern.

3.4 Achieving MVC Using Laravel

The system implements the MVC architectural pattern using Laravel, Livewire (a full-stack framework for Laravel to handle reactive components), and the relational database management system, MySQL. Laravel is the preferred choice because it has been designed with the MVC pattern in mind, thus ensures that code modularity and reusability are enforced [11].

In the Movin system, Laravel's Eloquent Object-Relational Mapper (ORM) is used to map each database table to a corresponding "Model" that will be used to interact with that table [12]. Each model is created with a migration file used by Laravel to define the model's attributes/fields. This file then creates tables using the predefined columns in the database, which map to the migration and model created [12]. All models are then updated with their relationships to other tables. Then, a controller with the required functions is also created for each model that needs one. Laravel simplifies this by allowing you to create a model, migration, and controller in a single line of code.

When the user makes a request, the necessary controller will interact with its respective model before sending over information to its corresponding view to display. The view would be implemented using Laravel's Blade templating engine and Livewire components, which allow users to build highly user-friendly and interactive web pages. Livewire components are essentially PHP classes that extend Livewire component classes and display Blade files [13].

Laravel and Livewire, when used together, allow you to create unique interfaces that provide a great user experience for event-driven web applications (i.e., web applications that require frequent client-side actions), such as Movin. Additionally, Laravel's extensive features were leveraged for authentication and authorization handling, cross-site request forgery (CSRF) prevention, asset compilation, and caching, amongst others.

3.5 Database Design

Movin's database design is made up of 35 normalized tables. These tables were created and managed using MySQL. The table below describes what role each of the primary tables in the database plays. The Entity-Relationship (ER) diagram can be found in Appendix A.1.

Table 3.1: Database design and description of significant tables

Database table name	**Description**
Units	This table contains all the essential details on each property/unit uploaded by an agency manager or landlord, such as the location, the unit type, housing type, and furnishing type. This table also keeps track of which users

	uploaded which units and which leasing information it is linked to.
Unit_types	Unit types are classified as parent units or standalone units. A parent unit is a multi-unit made up of a group of standalone units (e.g., an apartment complex made up of apartments). However, a standalone unit is a freestanding, single unit (e.g., a house can be a standalone unit).
Housing_types	This table contains a list of housing types that a unit can be linked to and their respective descriptions (e.g., apartment, house, townhouse, etc.).
Parent_units	This table keeps track of all units defined as parent units and other unique fields to parent units, such as the number of floors and elevators. It also has its corresponding unit ID from the Units table.
Standalone_units	This table keeps track of all units defined as standalone units and other unique fields to standalone units, such as the number of bedrooms and bathrooms and the floor number (if applicable). It also stores the parent unit ID

	to match it to its parent unit if it has a parent. Lastly, it stores its corresponding unit ID from the Units table.
Leasing_details	This table stores leasing information linked to each unit, such as the agency fee (if applicable), price of the property, service charge, viewing fee, lease options, and the negotiability of the agency fee, property price, and leasing options stated.
Users	This table stores all the essential details a user provides when they sign up on the system. These details include a user's first name, last name, phone number, email, password, profile picture, and agency name (if applicable).
Roles	This table stores a list of possible roles a user can have and their respective descriptions. Currently, the available roles are customer, agency manager, agent, landlord, and Movin administrator.
Permissions	This table stores a list of permissions that can be assigned to a role.

Permission_role	This table stores the permissions related to each role since each role has a unique set of permissions.
Role_user	This table keeps track of which roles are linked to which users, thereby making it easier to find which permissions to grant users using the permission_role table.
Agencies	This table stores all the essential details of an agency. These details include the agency's name, location, and logo (if available).
Agency_user	This table contains a list of users associated with an agency (i.e., agency managers and agents).
Bookings	This table keeps track of upcoming viewings customers have booked with an agent or landlord for a specific unit. Basic details such as the unit ID, customer's ID, booking ID, start and end time of the booking, and booking status are stored.
Saved_units	This table keeps track of which properties are saved by which users.
Review_types	This table stores the names of each of the four review types for a property's community (i.e.,

	Entertainment, Safety, Quiet neighborhood, and Ease of movement)
Review_details	The table stores each statement linked to a review type and the ID of its related review type. Many statements make up a review type.
Review_detail_unit	This table keeps track of the review level a user leaves for the review detail for each unit.

The minor tables in the Movin database keep track of data specific to each unit such as facilities, amenities, house rules, payment options, documents required, and leasing information (which includes details such as agency commission rate, price per month for the property, service charge per month and leasing options).

Chapter 4: Implementation

Movin is a system that allows customers to find available properties for rent, save these properties, and book viewings with the agents or landlords handling these properties. For these properties to be made accessible to the customer, agency managers have to upload these properties, assign agents to them, and set up booking slots for these agents so that customers can book with them. Additionally, landlords also have to upload their properties and set up their booking slots so that customers can book with them.

4.1 Design and Development Approach: Kanban (An Agile Methodology)

The Agile development model proved to be a suitable fit for this project since it focuses on customer satisfaction and an iterative approach to product management and development. While the Agile model determines the principles that act as a basis for the development strategy, the Kanban method (using Kanban boards) was used to execute the necessary tasks [14]. Kanban is focused on visualizing tasks to be completed, reducing tasks in progress, and increasing deliverables and the time it takes to complete a project [14]. The Kanban boards used for this project can be found in Appendix A.2.

4.2 Implementation: Tools

Some tools were employed to produce a very detailed and engaging user experience for users of this system. This section discusses the importance of each tool used and its contribution to the project.

4.2.1 Tool: Figma

The implementation of this project was two-fold: first, the user interface and user experience (UI/UX) designs were created using Figma, then the functionality was integrated using the frameworks to be discussed later in this paper. Figma makes it extremely easy for people to create UI/UX designs via a web browser (or the desktop app), link the designs to form a working prototype, and then use it for testing with users [15]. Furthermore, Figma allows you to set up a design system that serves as the building block for your web page designs. Thus, the colors, buttons, and their various states, icons, and relevant elements for this project were created such that they could be tweaked globally and effortlessly reused in the design.

4.2.2 Tool: Webflow

Bearing in mind that usability is a critical factor in maintaining a seamless and smooth experience for users of the system, there was a need to develop the Figma designs to look and feel exactly as they should. To do this, the preferred tool used was Webflow. Webflow is a page builder and visual web design tool built on basic web design standards such as the box model [16]. Thus, any web pages designed using Webflow are created using Hypertext Markup Language (HTML), Cascading Style Sheets (CSS), and JavaScript (JS) building blocks [16]. These web pages can then be converted into simple, elegant HTML, CSS, and JS code for use later in the project.

4.3 Implementation: Frameworks

A framework is a platform used as a starting point in developing applications, as it provides a structure that developers can follow when building specific programs [17].

Frameworks can ensure order and are customizable, as they give developers the freedom to add any libraries or packages that they see fit. To fast-track development, some frameworks were used in bringing this project to life.

4.3.1 Framework: Laravel

Laravel is a PHP framework that implements the MVC architectural pattern [18]. Thus, the coding structure is simplified such that there is improved maintainability and modularity [18]. Laravel was chosen as the preferred framework for this project for a good number of reasons, such as the following:

- Laravel is a progressive framework with an extensive documentation library and an array of screencasts to help you learn as quickly as possible without being overwhelmed [11]. Thus, the learning curve is not as steep for beginners.
- It has a budding developer community that frequently contributes to the framework [11]. According to one research study, Laravel is often used in information technology services, real estate, and many more [18].
- As indicated in Chapter 2, Laravel uses the Eloquent ORM to map database tables to a "Model" that will be used to interact with the database. Thus, simple queries can be written in PHP syntax instead of SQL queries [18].
- Laravel makes use of the Blade templating engine, which allows data to be displayed, layouts to be extended, and components to be rendered effortlessly. Blade also comes with its method of handling conditional statements [19].

- Another reason for using Laravel is its enhanced security features, such as CSRF protection, authentication scaffolding, middleware, and password encryption, which are necessary for the Movin system [19].
- Since users can have multiple roles, and each role has its unique set of permissions, authorization is an essential component of this system. Laravel authorizes actions using gates and policies [20]. In the Movin system, gates are used to determine if a user can perform a global action that is not related to a model or resource, such as viewing a dashboard. Movin also uses policies to ensure that users are authorized to perform specific actions linked to a model or resource controller, such as adding and updating properties and agents, booking slots, and many more.

4.3.2 Framework: Livewire

As stated in Chapter 2, Livewire is a framework for Laravel that makes building dynamic and interactive web pages as simple as possible. In the Movin system, Livewire was used to create the dynamic components users interact with, such as forms, data tables, file upload sections, and many more.

By default, Livewire components are rendered on the server and displayed using Blade templates; thus, authorization is handled by Laravel before displaying or altering data from components [13]. Although server-side rendering means that the components have to be rendered every time they are required, this can be solved using caching.

Lastly, a great advantage of using Livewire is that it results in a faster time-to-content because server-side rendered components do not need to wait for all the necessary parts to be

downloaded and displayed, so users will see results quicker [21]. This is essential to a system such as Movin, where users are constantly switching between properties.

4.4 Packages Used

A few packages were used to bring this project to fruition:

- The Laravel permission package by Spatie was used to manage the user roles and permissions in this project [22]. Spatie provides easy-to-use methods for accessing these roles and permissions and can also be used seamlessly with Laravel's gates.
- The Laravel Phone package by Propaganistas was used to verify if all phone numbers entered through forms were valid Ghanaian phone numbers [23]. This ensures that customers can contact agencies or landlords.

4.5 Implementation: Application Programming Interfaces (APIs)

APIs act as intermediaries between applications that need to communicate with each other. For Movin, a primary API used was the Google Maps JavaScript API, specifically the Places Autocomplete, the Places Library, and the Distance Matrix. The Places Autocomplete was used to retrieve a list of possible locations that could match a property's location [24]. This was done with the help of Address AutoComplete form by solodev [25]. The Places Library in the API was used to retrieve details about a particular type of place (e.g., a restaurant, an airport, etc.) [26]. Then, the Distance Matrix service was used to calculate the distance between a property and a particular type of place [27]. Screenshots of relevant parts of the system can be found in Appendix A.3.

4.5.1 Using Google Maps JavaScript API

A significant constraint using this API was that, per the Privacy Policy, one might only store the field named *place.id* (which identifies a specific location on the map) as defined by Google Maps, in one's personal or commercial database for use later. No other details on a place in Google Maps may be stored. Thus, subsequent calls need to be made using this saved *place.id* in one's personal or commercial database to access other services and libraries provided by Google Maps.

On each property page, as viewed by a customer on the web application, there are three high-level tabs: Details, Community, and Estimate. On the Community tab, the page displayed to the customer is divided into three sections:

- **Key Services:** This is a list of critical services, defined by the Movin system as a set of 6 services essential to life and safety. These services include the nearest airport, hospital, shopping mall, gas station, police station, and fire service station. These are retrieved using the Places Library and Distance Matrix Service provided by the Google Maps JavaScript API.
- **Nearby Hotspots:** These are broken down into two main categories: restaurants and nightlife. These are also retrieved using the Places Library and Distance Matrix Service provided by Google Maps JavaScript API.
- **Residents said this about the community:** The information in this section should ideally be provided from past or current property renters. However, since getting such information will be challenging and time-consuming to start with, the information on the cards shown in this section is provided by the agency or landlord uploading the property.

To ensure transparency, a note is displayed on this section of the page informing the customer that details in this section were uploaded by the landlord or agency handling the property, thus, are subject to bias. The four cards displayed in this section are:

- Entertainment, Safety, Quiet neighborhood, and Ease of movement.
- Each card has a set of pre-defined statements that explain what the card means. For example, under Entertainment, one can find these statements:
  - There are daytime events
  - There is nightlife
- Subsequently, for each statement under a high-level card, the relative ranking of High, Medium, and Low, given to it by the agency or landlord handling the property, is displayed to the user.
  - A low ranking means most people say the community does not have a lot of this feature. A medium ranking means that some people say the community has a lot of this feature, while others say otherwise. Finally, a high ranking means most people say the community has a lot of this feature available.

The Google Maps JavaScript API documentation defines an SKU as the combination of the Product API and the service or function called. Thus, key SKUs used in this project were:

- **Embed:** To display a map on the relevant web pages of the site.
- **Dynamic Maps:** To allow users of the site to interact with the map.
- **Autocomplete (included with Places Details) - Per Session + Place Details + Basic Data:** To allow agency managers and landlords uploading their property to search for

the property's specific address and use this in their upload process. Later, the *place.id* of the address is stored in Movin's database and used to retrieve details about Key Services and Nearby Hotspots for a property.

- **Places Details + Basic Data:** To retrieve information on a place using the *place.id*.
- **Find Place - ID Only:** To get the *place.id* as defined by the API documentation.
- **Places - Nearby Search + Basic Data + Contact Data + Atmosphere Data:** To conduct a search of nearby places for a specific property, based on a specific type of place and return a result of places with details classified as basic, contact, and atmosphere by Google Maps.

To get the information required for Key Services and Nearby Hotspots, this is the current implementation used during the process of an agency manager or landlord uploading a property:

1. The agency manager or landlord sets the property's location by searching for it using the autocomplete widget provided by Google Maps. Here, the *place.id* of the property location can be accessed and stored later on in the database when the flow is completed.
2. The agency manager or landlord proceeds to the next step in the flow till they reach the end and finally upload the property so that customers can view it.
3. Now, when a customer opens that property's information page and navigates to the Community tab, calls are made to the Places Library and the Distance Matrix service, based on the *place.id* stored for the property. Results are retrieved for the Key Services and Nearby Hotspots sections of the Movin site and displayed to the customer.

Chapter 5: Testing and Results

5.1 User Testing for Usability of Movin

To test the usability of the Movin system with customers, scenario-based testing was employed. Guided tests were conducted for the following significant flows:

- Navigating to a property's information page.
- Checking the community details for a 3-bedroom apartment in East Legon.
- Getting an estimate of a customer's total costs for a property of their choice, based on their chosen lease option and duration.

Testing was done over Zoom calls using a link to a Figma prototype. Since the prototype mimics the application in terms of its look, feel, and interactions, it proved to be a good option for testing. Three testers were used, and a feedback session took place after to learn about what the experience was like for them and any comments they had on the design and user flow. Then, the feedback garnered was used to iterate and tweak the designs.

5.2 User Testing for Functionality

To test the functionality of the Movin system, scenario-based testing was again employed for these flows:

- Adding a multi-unit property, then adding its sub-properties.
- Adding the ratings for the community details for the *Residents said this about the community* section for properties uploaded.

Testing was done over Zoom calls, and testers were given remote access to control the screen and perform the tasks required. Three testers were used and timed, then a feedback session took

place after to discuss how they would rank the experience, any challenges faced, and any errors they came across.

Chapter 6: Conclusions and Recommendations

This chapter outlines the functional requirements met in this project and highlights the current limitations of the system. Challenges encountered during the design and implementation phases are also discussed in this chapter.

6.1 Functional Requirements Met in this project

The functional requirements met in this project are as follows:

REQ-001: Customers, agency managers, and landlords can create accounts and log in to them easily.

REQ-002: Customers can view a list of available properties.

REQ-003: Customers can personalize search filters to fit their needs and receive a list of options that match their filters well.

REQ-005: Customers can save properties when logged into their accounts.

REQ-006: Customers can view all the details related to a property and its community information.

REQ-007: This requirement was tweaked, given the time constraint. Thus, rather than allow customers to leave reviews on details of the community, only agency managers and landlords can upload these details for customers to view.

REQ-011: Customers can get an estimate of their total cost for a property based on a selected preferred duration and provided costs.

REQ-012: Agency managers should be able to add, edit and delete properties easily and quickly with the help of integrated tools.

REQ-017: All users, except the Movin administrator, can have multiple roles with varying abilities/permissions under the same registered account as such:

6.2 Implementation Challenges and Limitations

A few challenges and limitations are as follows:

- Given the time constraint, all functionality dealing with setting up booking slots for agents and landlords and then allowing customers to book viewings with such ones based on the available slots could not be completed.
- Inability to retrieve places of different types (e.g., restaurants, cafes, etc.) all as one group (e.g., food and drink) from the Google Maps JavaScript API. Thus, this restricted the different results that could be retrieved under a category in the *Nearby Hotspots* section on the Community page.
- Currently, customers cannot leave reviews on the *Residents said this about the community* section on the Community page, as this information is currently only provided by agency managers and landlords. This gives rise to a positive bias that is not handled by the system currently.
- This system focuses on the customer side. Thus, validations were not made with agency managers or landlords about pain points in their search for prospective tenants, for solutions to be created for them. Only the required features that will allow customers to solve their problems were considered in this project when designing for agency managers and landlords.

6.3 Future Work

Possible additions to the Movin system are as follows:

- In the future, customers should be able to save search filters when logged into their accounts. This will make it easy for customers to keep track of their most recent searches and allow them to re-apply them without having to reselect all the necessary filters.
- Customers should be able to view agency, agent, and landlord profiles easily and any related information. This will offer customers the chance to see multiple properties handled by agents or landlords they prefer, all at once.
- Customers should be able to leave extensive reviews on agencies, agents, and landlords, besides the basic star rating.
- The Movin system can help new ones to the renting space by providing articles or posts on renting laws and renting processes in various countries.
- Further research can be done into how to create an equally seamless process for agency managers and landlords, taking into account their current frustrations, so that Movin can address the issues of all its users and make the renting process as engaging and transparent as possible.
- Finally, a mobile version of the system would be a great supplement, as many people today perform searches on the Internet using their mobile devices.

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Appendix

A.1. Entity-Relationship (ER) Diagram for Database Design for Movin

The ER diagram below shows the database design for Movin. This aided in the creation of the database tables and models in Laravel.

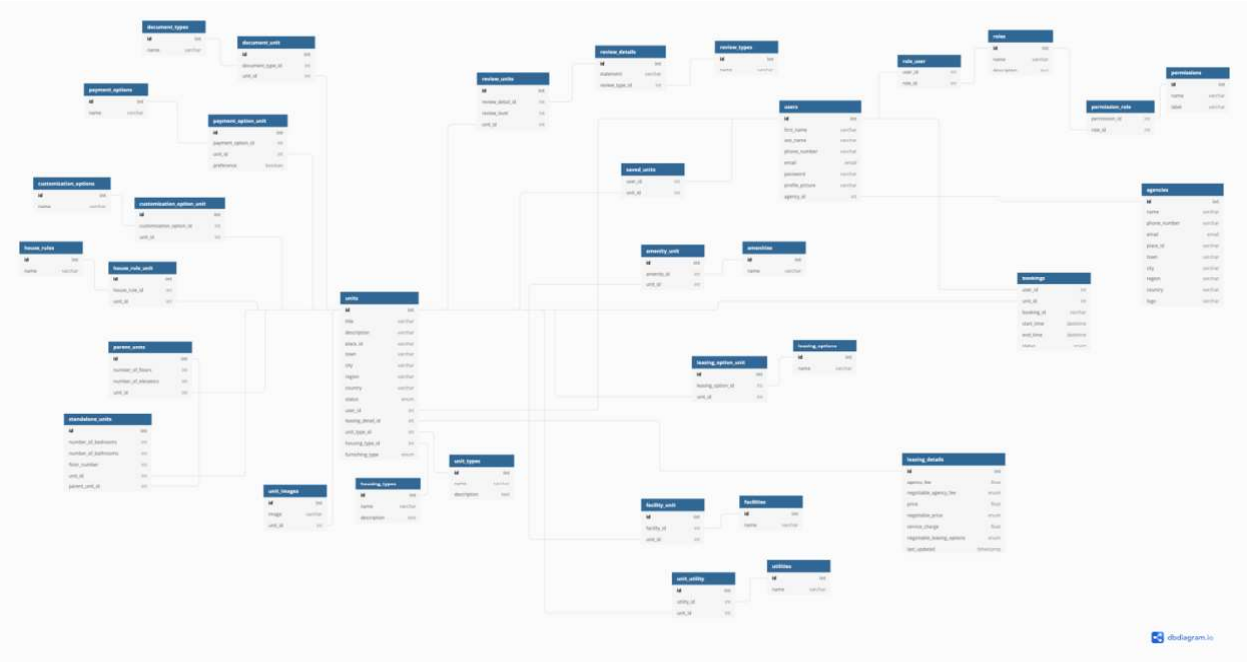

Figure A.1.1: Full view of the ER diagram for Movin

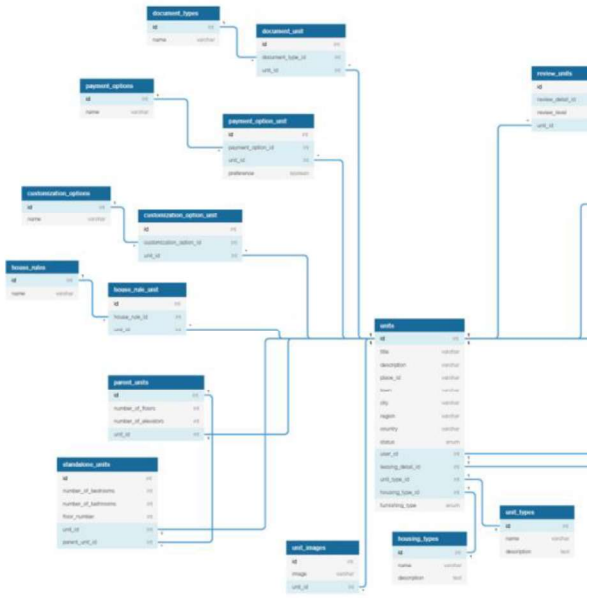

Figure A.1.2: A section of the ER diagram showing connections between the Units table and some of its closely related tables

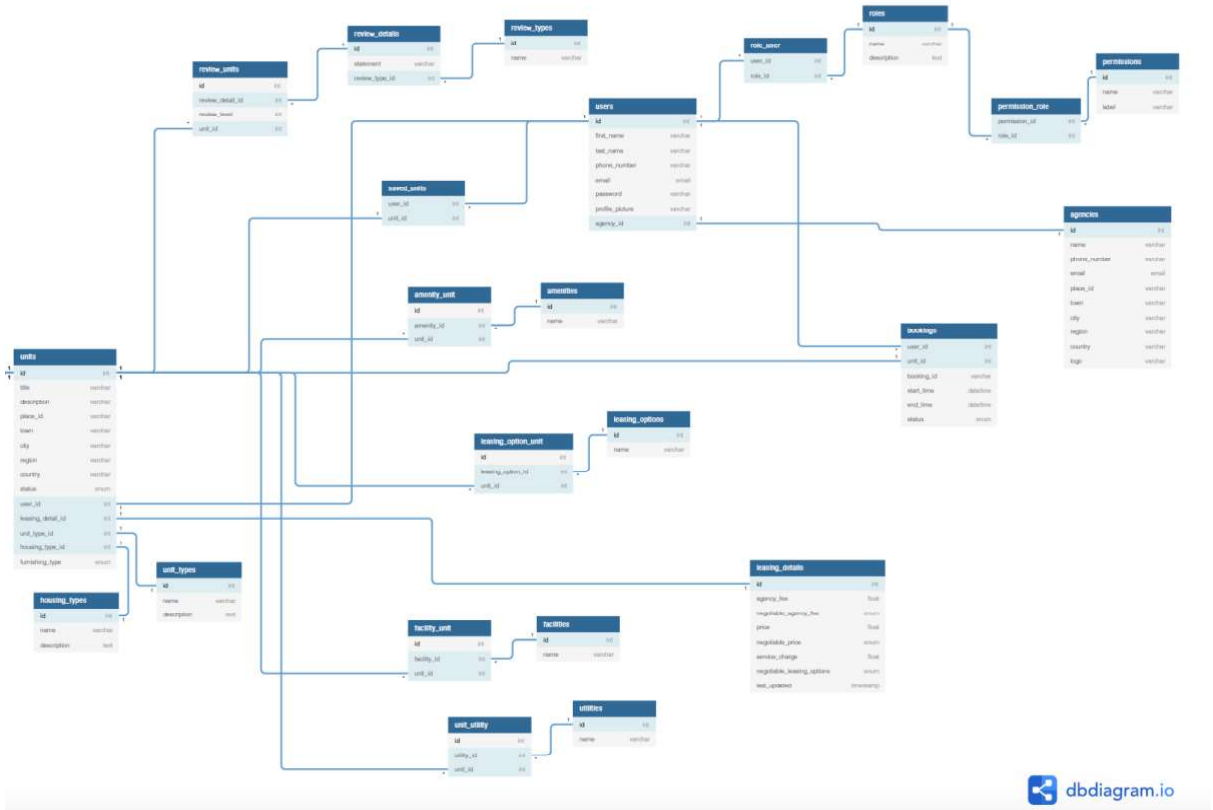

Figure A.1.3: A section of the ER diagram showing connections between the Units table and some of its closely related tables as well as connections between the Users table and its related table

A.2. Kanban Boards

The figures below show snippets of the Kanban boards used for the design and development of this project.

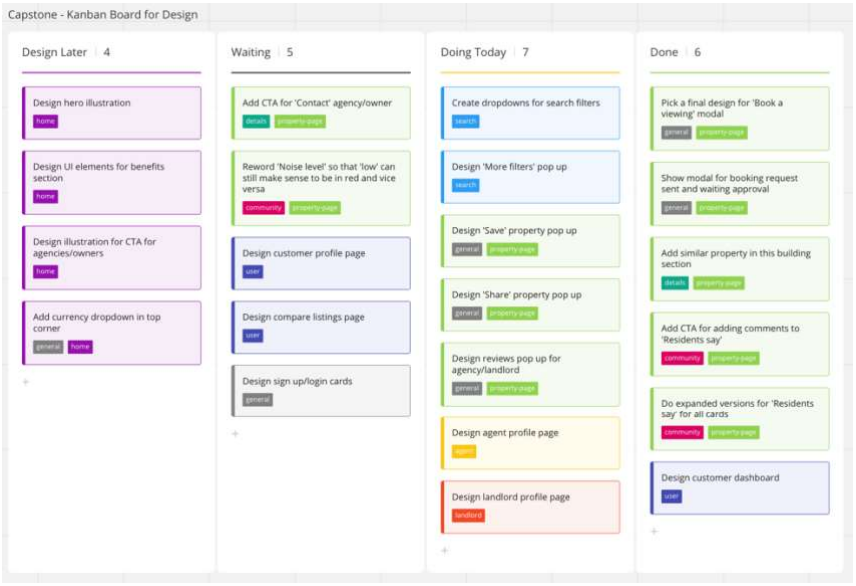

Figure A.2.1: Snippet of a day's Kanban board for design

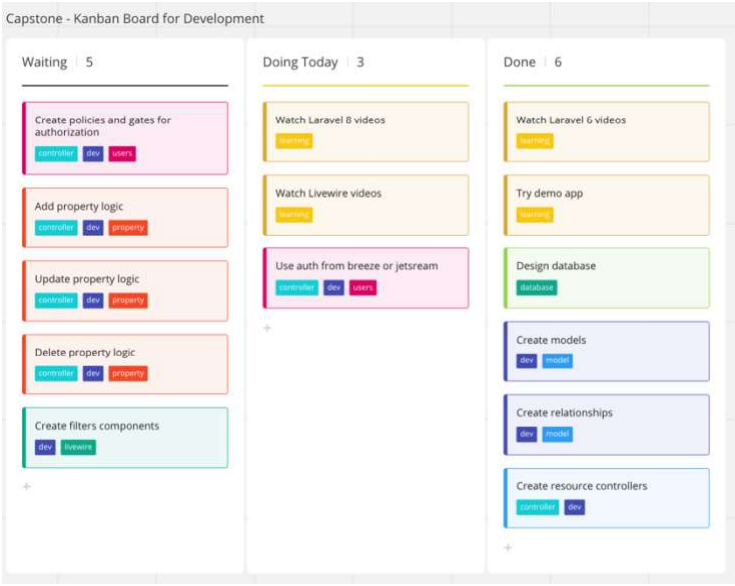

Figure A.2.2: A snippet of a day's Kanban board for development

A.3. Screenshots of relevant parts of Movin

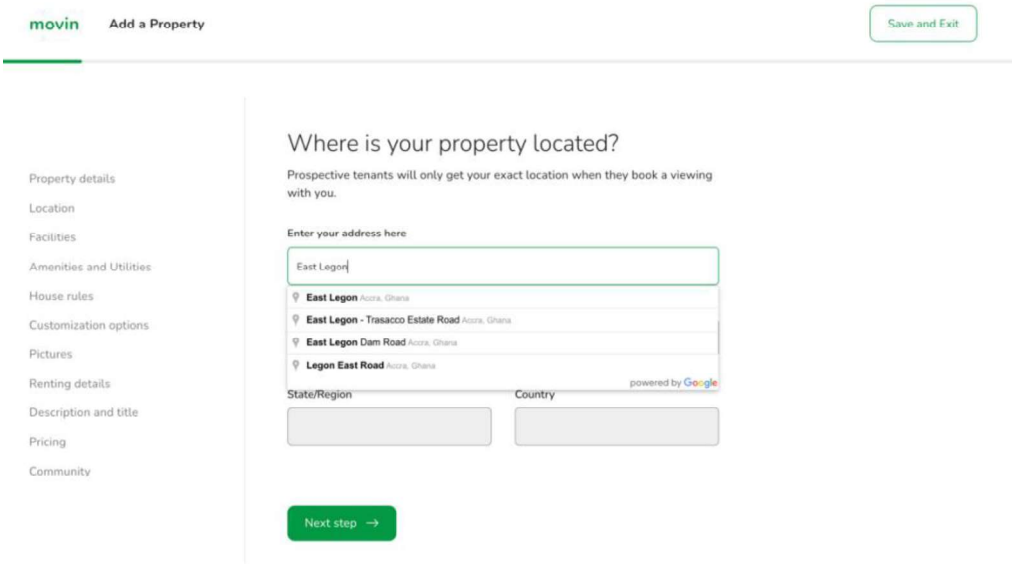

Figure A.3.1: Selecting the property's location using the autocomplete widget

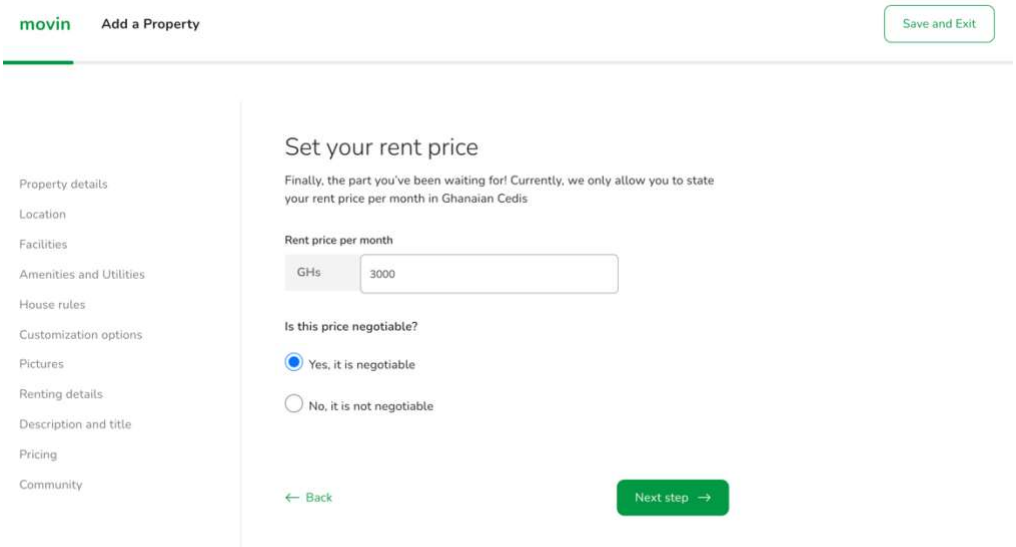

Figure A.3.2: Adding the price of the rent and setting negotiability on the rent price

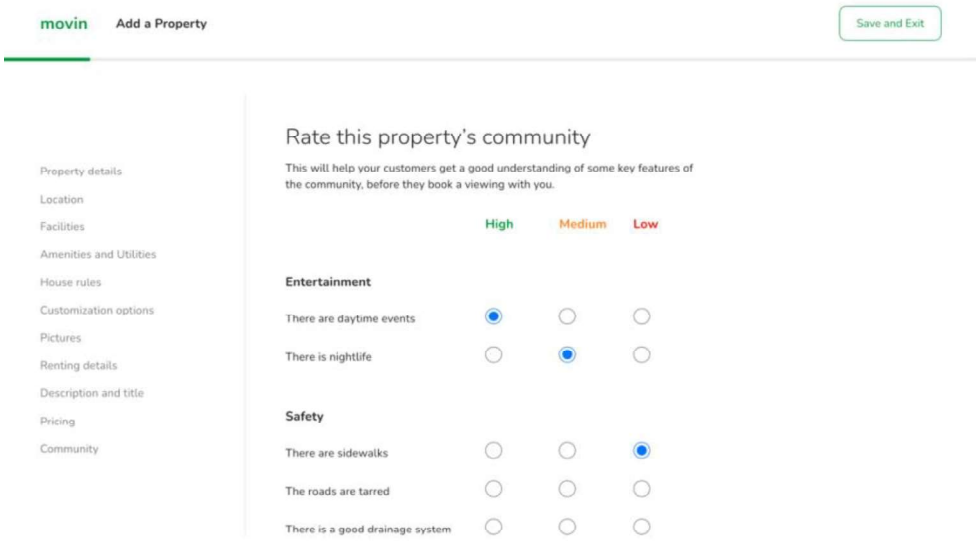

Figure A.3.3: Rating the property's community - Part 1

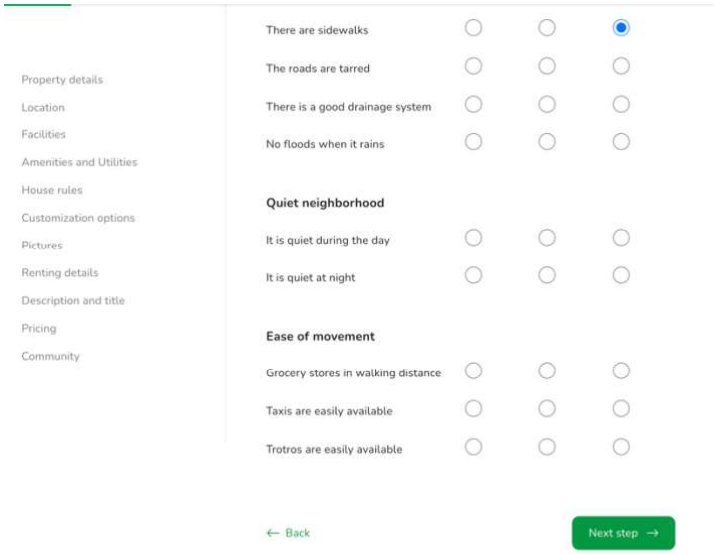

Figure A.3.4: Rating the property's community - Part 2

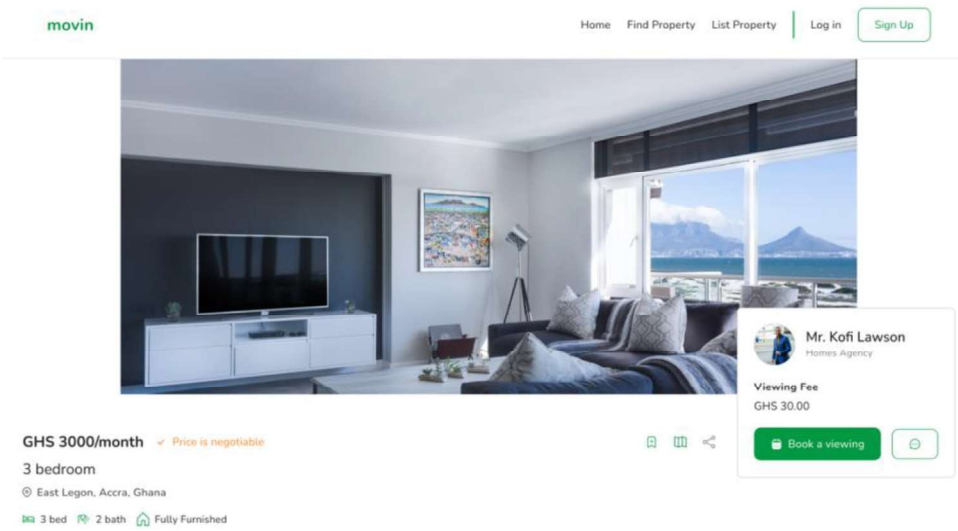

Figure A.3.5: Hero section of a property's information page

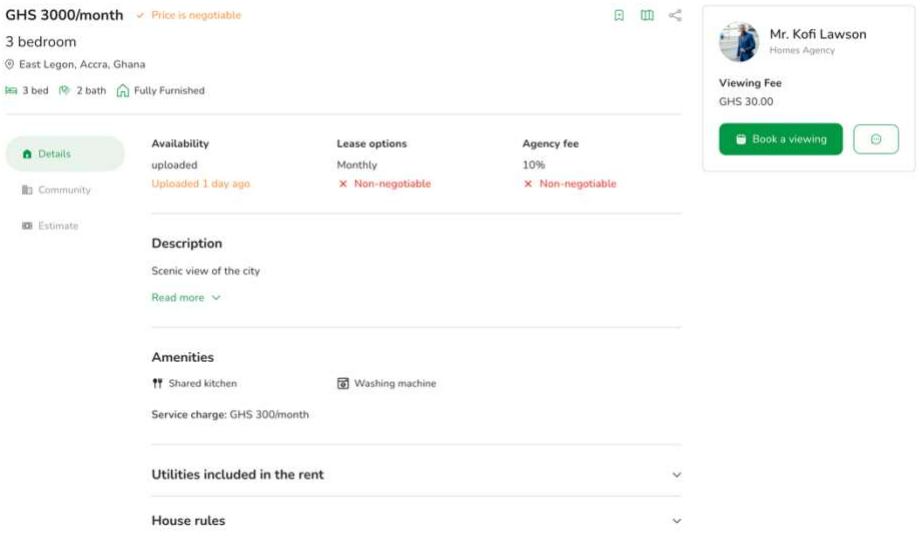

Figure A.3.6: Details tab - Part 1

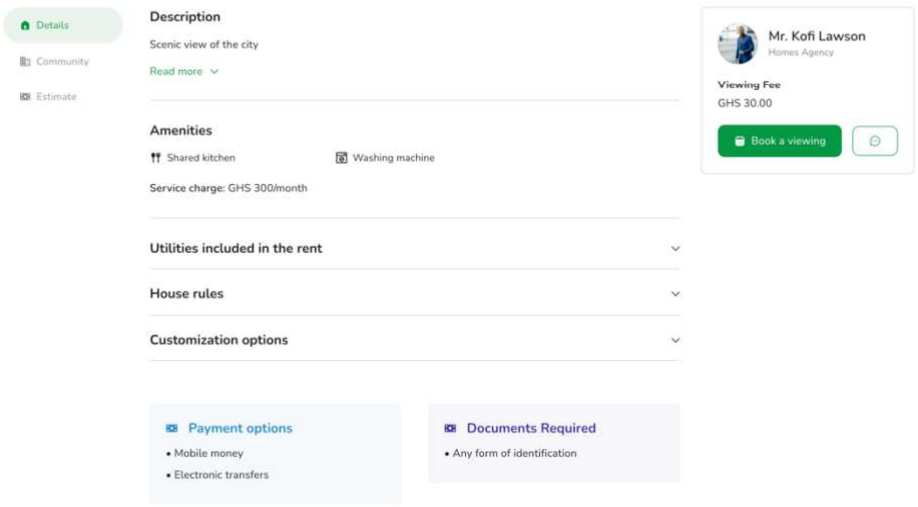

Figure A.3.7: Details tab - Part 2 – Accordions closed

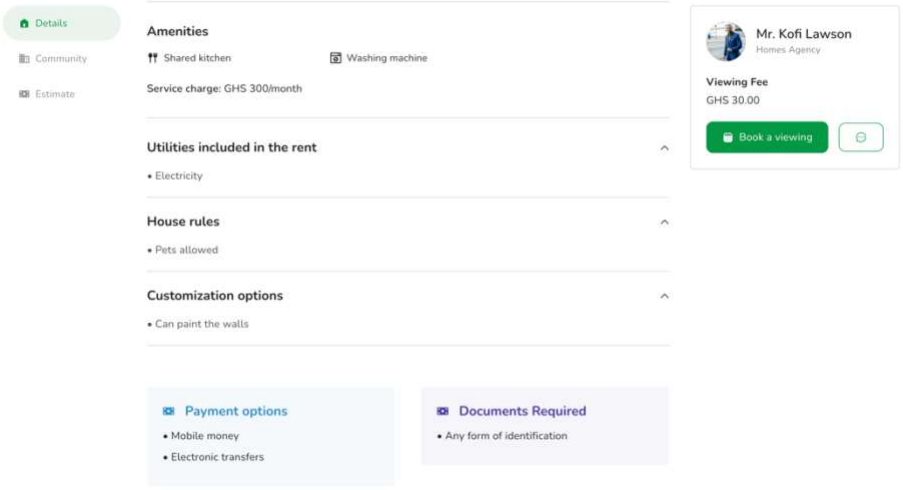

Figure A.3.8: Details tab - Part 3 – Accordions open

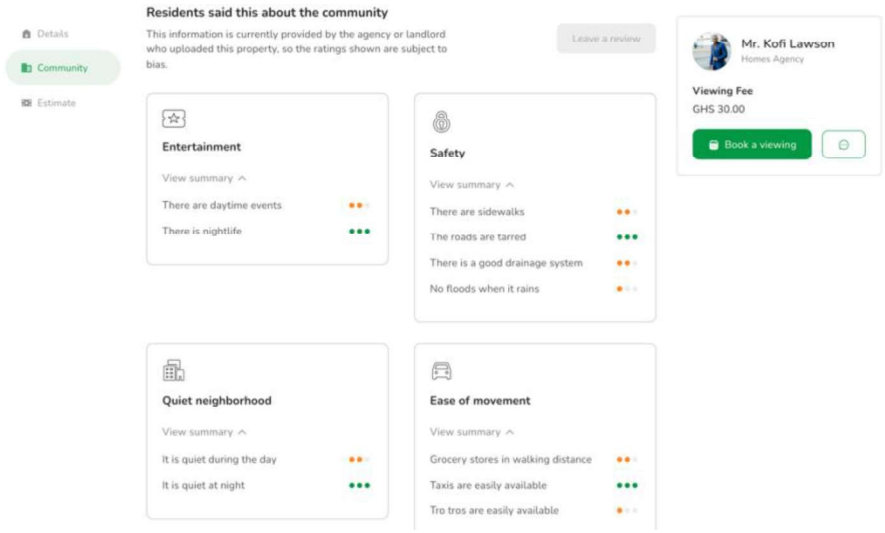

Figure A.3.9: Community tab - Showing Residents said section with cards open

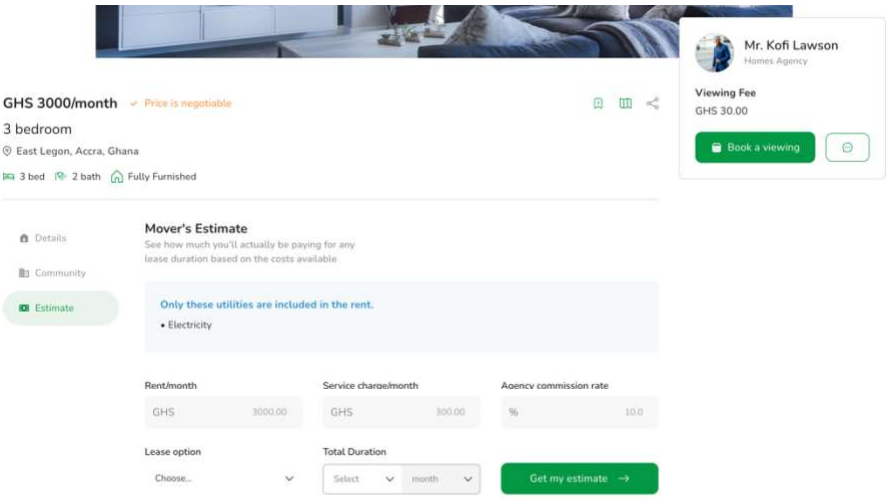

Figure A.3.10: Estimate tab