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Be My Home in Smart Cities: A Mobile Application for Stray Animal Tracking, Adoption and Shelter Management

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Abstract: The management, monitoring, and welfare of stray animals in Turkey has become more challenging due to the increasing population, rapid urbanization, and uncontrolled breeding. The increase in the number of stray animals leads to numerous problems such as traffic accidents, diseases, animal attacks, and environmental pollution, while the current shelter capacity remains insufficient. In this study, within the context of the smart city concept, the Be My Home mobile application has been developed for the management, tracking, and adoption of stray animals in smart cities. The Be My Home mobile application was developed in Java using Android Studio, while Firebase infrastructure was employed for data management. The system offers various features such as animal profiles, health and vaccination tracking, adoption, announcements and lost/found notifications, shelter reviews, shelter statistics, real-time data synchronization, location-based announcement filtering, and shelter management. Tests show that the application can be used effectively by both individual users and shelter officials. As a result, the developed mobile application has the potential to contribute to the smart city vision by enhancing stray animal welfare, enabling sustainable population management, modernizing shelters, and fostering responsible citizen participation.

1. Introduction

Stray animals have become a major problem in Turkey. Factors such as population growth, urbanization, and uncontrolled breeding are causing the number of stray animals to increase every day. It is known that a female dog can give birth to 12-18 puppies per year, which amounts to 67,000 puppies in 6 years (Bulut, 2023; Sürsal, 2023). This uncontrolled increase causes many problems such as traffic accidents, diseases like rabies, dog attacks, and environmental pollution (Kırışık and Öztürk, 2021; Yücel and Kıran, 2023). The health of animals is linked to the health of society. Therefore, it is everyone's responsibility to raise public awareness, develop sustainable solutions, improve the living conditions of animals, and protect public health (Şahin, 2024).

Current policies do not provide a sustainable solution to this problem. Proposed solutions include collecting stray dogs and placing them in shelters, providing them with regular food, treating their illnesses, vaccinating them, and neutering them (Uluchay, 2022; Sümer, 2024). However, despite ongoing efforts and international contributions, the stray animal population continues to grow. In addition to regular stray animals, a significant portion of the approximately 10 million pets that go missing each year are never reunited with their owners and eventually become stray animals themselves (Gonzalez, 2023). Methods such as lost-and-found notices or social media announcements often prove inadequate, and many animals are abandoned to the streets by their owners, who fail to anticipate the time, cost, and care required for their wellbeing (Real Flores and Abascal-Mena, 2018).

According to the 2024 study by the Marmara Municipalities Union, only 57 out of 107 municipalities have shelters. While the number of street animals identified is 322,711, the total number of animals in shelters is only 18,726. Efforts to help street animals are more intensive and organized in large cities, while in smaller cities services remain limited (Marmara Belediyeler Birliği, 2024). Shelter occupancy rates exceeding 100% and limited resources highlight the need for sustainable solutions, increasing the burden on municipalities and non-governmental organizations (NGOs) (Sümer, 2024).

According to data shared by the Istanbul Metropolitan Municipality, 855 animals were adopted in 2006; the highest number was recorded in 2014 and 2016, at 999. In recent years, a decline in adoption numbers has been observed again (İstanbul Büyükşehir Belediyesi, 2021). Shelters and rescue organizations need a digital platform to improve the adoption process (Jagtap, 2025). Studies show that people consider adopting animals but often do not follow through with this idea (Mohan-Gibbons et al., 2014). A survey indicated that 74% of participants were enthusiastic about using a mobile application for animal adoption (Santyn et al., 2018). Therefore, digital platforms can offer opportunities in this regard, and sharing information about stray animals has the potential to increase their visibility and accessibility, thereby improving their chances of finding a home (Bzdick, 2010). Announcements for animals should be made using social media and similar tools, and citizens should be encouraged to adopt these animals (Şahin, 2024).

Given these data, the Be My Home mobile application will enable shelters to be managed more efficiently and raise social awareness. The inclusion of smaller provinces in the system we have developed will strengthen inter-municipal coordination. This will enable effective work to be carried out in all regions, reduce the workload of shelter staff, and improve the welfare of stray animals. The Be My Home mobile application aims to provide a comprehensive solution to these animal-related issues. The developed mobile application combines functions such as listing stray animals, announcements and lost/found animal sharing module, address-based announcement notifications, animal information management, and shelter evaluation on

a single platform. Data on shelter capacity, sterilization and adoption rates, as well as health records, contribute to strengthening the decision making mechanisms of local governments.

The rest of the article will detail the system's technical infrastructure, functional features, and innovative aspects; then the results, contributions, and recommendations for the future will be discussed.

The literature includes various mobile and web-based platforms aimed at enhancing animal care, tracking, and adoption processes. Tailored to the diverse needs of users in different geographical contexts, these platforms provide distinct functionalities. Table 1 comparatively illustrates the functions and services offered by these systems. Shelter Soul (2025) is a web-based platform developed to improve pet adoption processes. It includes modules such as shelter management, smart animal matching, volunteer coordination, and donation tracking. Performance and usability tests have shown that the system operates reliably and is well-received by users (Jagtap, 2025). FurRescue (2025) is a mobile application developed to address issues related to stray animals in Malaysia. Users can share information about lost or stray animals through the app and create posts with location details. The app features dog breed recognition, geofencing, a community forum, and message exchange. It has been considered useful by users in tests conducted (Jean and Wahid, 2025). SRMS (2025) is a web platform developed to improve the organization of rescue and management activities related to stray animals. Through the system, users can report lost animals, make donations, participate in adoption processes, and provide support as volunteers. The platform has contributed to more efficient processes, particularly by enhancing communication between shelters and volunteers (Mammi, 2025). OnePet (2025) is an iOS-based mobile application developed to help pet owners find reliable caregivers. The app also provides resources such as shelter information, adoption options, nearby veterinary clinics, and guides and informative articles about animals. Surveys have shown positive feedback in terms of user experience, functionality, and ease of use (Darmawan and Khresna, 2025). Animal Ranger (2023) is a web-based platform developed to encourage the rescue of stray animals and their adoption from shelters. The application displays the locations of nearby animal shelters, lists animals available for adoption, and provides areas for reporting and adoption. The system has contributed to reducing information gaps and trust issues in the adoption process (Ferdianto et al., 2023). E-Pati (2021) is a platform offered by the Ankara Metropolitan Municipality, enabling citizens to report injured stray animals by calling the Capital Municipality's hotline and obtain online information about their status. It also offers services such as reporting unmuzzled stray dogs and scheduling sterilization appointments. Additionally, animals are listed on the website, and adoption procedures can be carried out for these animals (Ankara Metropolitan Municipality, 2021). SemtPati (2020) is a mobile application that enables detailed neighborhood-based records of street animals in Istanbul. Through the application, information such as the number of street animals, who feeds them, their medication and vaccination needs, and veterinary assistance can be regularly recorded and tracked. This facilitates the mapping of street dogs in neighborhoods across Istanbul (SemtPati, 2022). ShelterInfo (2019) is a mobile application designed to make the work of animal shelters easier. Users can use this application to obtain information about shelters, registered animals, and employees. Statistics such as sterilization rates are also available. Shelter information is updated on the website and can be viewed immediately in the application. Users can also easily view the nearest shelter on a map. This makes it more practical to track shelters and adopt animals (Türk and Şener, 2019).

Table 1. Mobile and web-based platforms that support the care, adoption, and locating of stray animals.

Application	Key Features	Platform	Adoption	Missing Pet Notice	Report of Sick Animals	Community Participation
Shelter Soul (Jagtap, 2025)	Adoption, smart pairing, shelter management, donations, volunteer coordination	Web	The smart pairing module ensures suitable matches between users and shelters.	No	No	No
FurRescue (Jean and Wahid, 2025)	Street animal listing, breed identification, geofencing, forum, chat rooms	Mobile	Users are notified about stray animals in the vicinity.	Users can share content.	Users can make reports.	Forum, registration of lost/sick and stray animals in the system.
SRMS (Mammi, 2025)	Report stray animals, make donations, adopt, provide educational resources.	Web	The animals found in shelters are listed.	No	No	Rescue, care, and adoption processes coordinated through the system.
OnePet (Darmawan and Khresna, 2025)	Pet sitter, shelter and veterinarian information, pet product sales, informative content, viewing adoptable animals at shelters.	Mobile	The animals found in shelters are listed.	No	No	No
Animal Ranger (Ferdianto et al., 2023)	Adoption, animal report, location-based pairing, report and adoption.	Web	The animals found in shelters are listed.	No	There is a form page for filing reports.	Animal reports, communication with shelters, posting on social media.
E-pati (Ankara Metropolitn Municipaliy , 2021)	Adoption of shelter animals, application for unregistered stray dogs, sterilization appointment.	Web	Animals in shelters are listed, and applications can be filed.	No	No	No
SemtPati (SemtPati, 2022)	Mapping and adoption of stray animals in Istanbul.	Web + Mobile	The animals shown on the app can be adopted.	No	No	Users add stray animals in their neighborhoods to the app, and mapping is carried out in this way.
ShelterInfo (Türk and Şener, 2019)	The shelter keeps records of employees and animals. Adoption, nearest shelter, and sterilization statistics.	Web + Mobile (Android)	The animals found in shelters are listed.	No	No	No
Proposed Be My Home Mobile App	Sharing statistics such as the adoption of animals in shelters, reports of lost/sick animals, shelter evaluations, shelter occupancy rates, and adoption numbers.	Mobile	The application lists animals that have not been adopted.	Users can share information about lost and found animals, and users are notified regionally about these posts.	Users can share sightings of sick/injured animals seen on the street; regional notifications are available.	Reporting lost/found/sick/injured animals, shelter assessment.

Looking at existing platforms, it is evident that most offer one-dimensional solutions. However, the proposed Be My Home mobile application stands out from the rest in this regard, offering a more comprehensive platform by sharing statistics such as adoption rates, reports of lost and sick animals, and shelter occupancy and adoption rates. Furthermore, the evaluation of shelters increases community participation and awareness, strengthening the reliability of the system. The Be My Home mobile application, which is designed on a centralised status management protocol, is distinct from existing solutions. It integrates shelter capacity, neutering information and geographical location data, providing a comprehensive data collection and decision support mechanism for smart city IoT ecosystems. The architectural uniqueness of the proposed system lies in its provision of a holistic operational infrastructure, combining heterogeneous functions (listing, reporting and management) within a centralised Firebase Real-Time Database structure. From this perspective, the proposed Be My Home mobile application offers a more comprehensive and functional solution for users, shelters, and local governments alike.

2. Material and Method

2.1. System architechture and design

As illustrated in Figure 1, the developed system consist of an Android mobile application on the client side, while the server side is supported by the Firebase (Android Developers, 2024) infrastructure. The client directly connects to the Realtime Database via the Firebase SDK. The overall architecture of the application ensures that data received from the client is processed on Firebase and shared simultaneously with all users.

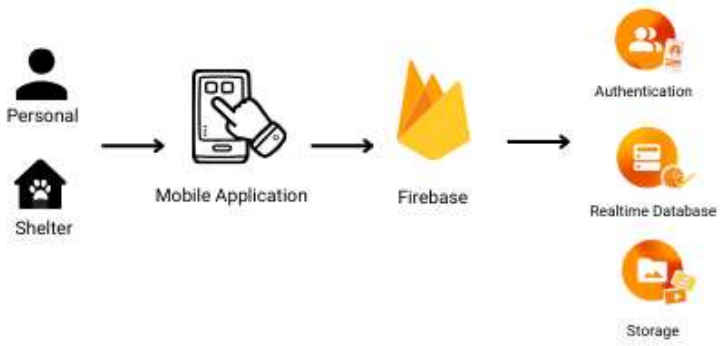

Figure 1. The overall architecture and design of the proposed system

2.1.1. The client side

The mobile application was developed using Java (Firebase, n.d.) on Android Studio (Oracle, n.d.). The pages of the mobile application have been designed with a simple and user-friendly interface, utilizing BottomNavigationView for transitions between modules and RecyclerView components for listing pages. Data obtained from Firebase Realtime Database for real-time data is connected to the RecyclerView component using an Adapter class and listed in the user interface.

The developed mobile application consists of six main modules: User Management Module, Animal Listings Viewing Module, Announcement Module, Shelter and Feedback Module, Profile Module, and Shelter Management Module. The modular structure of the developed mobile application, the working principles of these modules, and their relationships with each other are shown in the flow diagram in Figure 2.

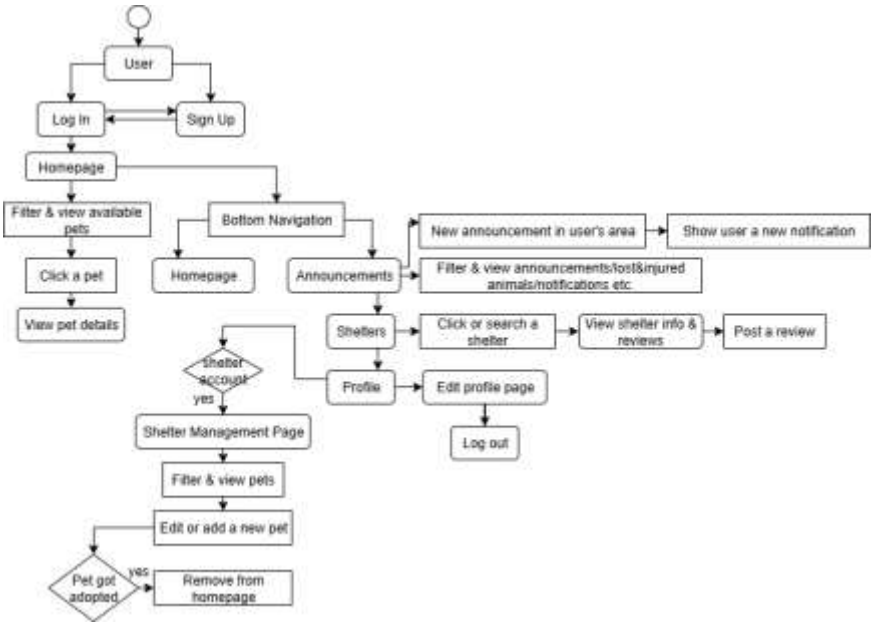

Figure 2. The modular structure and operating principle of the proposed system

2.1.2. Modules

The User Management Module enables users to log in to the system Firebase Authentication with their email and password, or they can create a new account. During the registration process, the user is asked to select an account type (citizen/shelter). This selection determines which modules the user can access within the system and which operations they can perform. For example, only shelters can add and update animal records.

The Animal Listings Viewing Module allows users to browse the animal listings shared by shelter authorities. These listings, stored in the Firebase Realtime Database, include details such as age, gender, vaccination information, species, and shelter location. Users can filter the listings by shelter or species and view detailed information about each animal. Users can access the details page of a specific listing by clicking on it.

The Announcement Module, designed for users to voluntarily share information about lost/found or injured/elderly stray animals they encounter, allows users to post updates containing location, description, and photos. These posts appear in real time on other user accounts located in the same region and are displayed to the user as new notifications.

The Shelter and Feedback Module, lists the shelters registered in the system, and users can search this list by shelter name. Users can view information such as the physical addresses, contact details, number of animals at the shelter, and user reviews for these shelters, and can rate and comment on the shelters. In the Profile Module, users can update their account information (name, address, email, password, etc.) or delete and update their reviews and posts. The Shelter Management Module is only accessible to accounts with a corporate account type. In this module, shelters can perform tasks such as updating the information of animals in their care and adding new animals. If an animal is adopted, shelter management updates the relevant field in this module and the related listing is set to inactive in the system. Shelter accounts can view these inactive listings in their own areas, while regular users cannot view them. The application's design has been shaped according to the principles of accessibility, simplicity, and efficiency. The colors, icons, and button placements used in the interface have been determined with user habits in mind. Fragments have been used in some areas during screen transitions, thereby improving the application's internal performance.

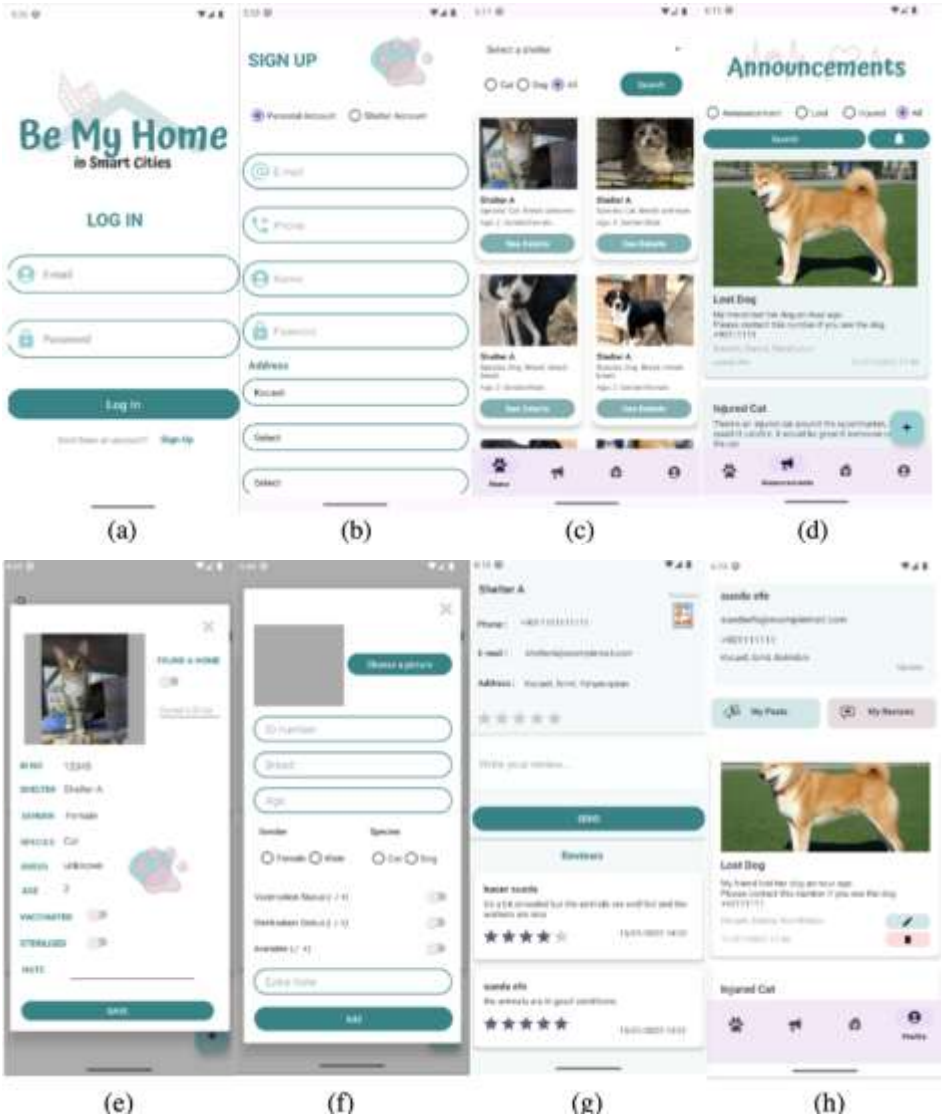

Figure 3. Screenshots of the Be My Home mobile application that has been developed (a) login, (b) registration, (c) animal listings, (d) announcements, (e) listing edit, (f) animal addition, (g) shelter evaluation and (h) user profile

The in-app interface screens of the developed mobile application are presented in Figure 3. Specifically, Figure 3(a) shows the login screen, Figure 3(b) the registration screen, Figure 3(c) the animal listings screen, Figure 3(d) the announcements screen, Figure 3(e) the listing edit screen, Figure 3(f) the new animal addition screen, Figure 3(g) the shelter evaluation screen, and Figure 3(h) the user profile screen.

2.2. Server side

The application's server side utilizes Google Firebase (Android Developers, 2024) infrastructure. Firebase offers numerous cloud-based services such as authentication, real-time data synchronization, media storage, and security management. This structure enables direct communication between the application and the database.

2.2.1. Firebase realtime database

Data are stored in the Firebase Database using a JSON based structure. Records concerning each animal's health, vaccination, location, and adoption status are managed exclusively by institutional accounts, while regular users are restricted from accessing or modifying these fields. With Firebase Realtime Database infrastructure, any changes made to

the data are synchronized instantly, allowing the current status to be tracked across the entire system. The database consists of the following nodes:

- Users: This node stores all user related information, including email, name, phone number, account type (citizen or shelter), and location details such as city, district, and neighborhood. The structure facilitates location based notification functionality within the system.
- Animals: This node stores information about animals entered by shelters. It includes the animal's vaccination status, sterilization information, age, gender, species, breed, adoption status, photo links, and description information. Each animal record stores the shelterID according to the shelter's foreign key rule.
- Announcements: This node contains announcements made by users regarding lost or found animals or events. Each record includes a title, description text, the sharing user's ID, location, timestamp, and a visual link if available.
- Reviews: This node stores reviews made for shelters. Each review contains text from the user, a score, a timestamp, and information on whether the review has been updated. Each review is stored with both the user ID and the target shelter ID.

Figure 4 provides a visual representation of the database tables.

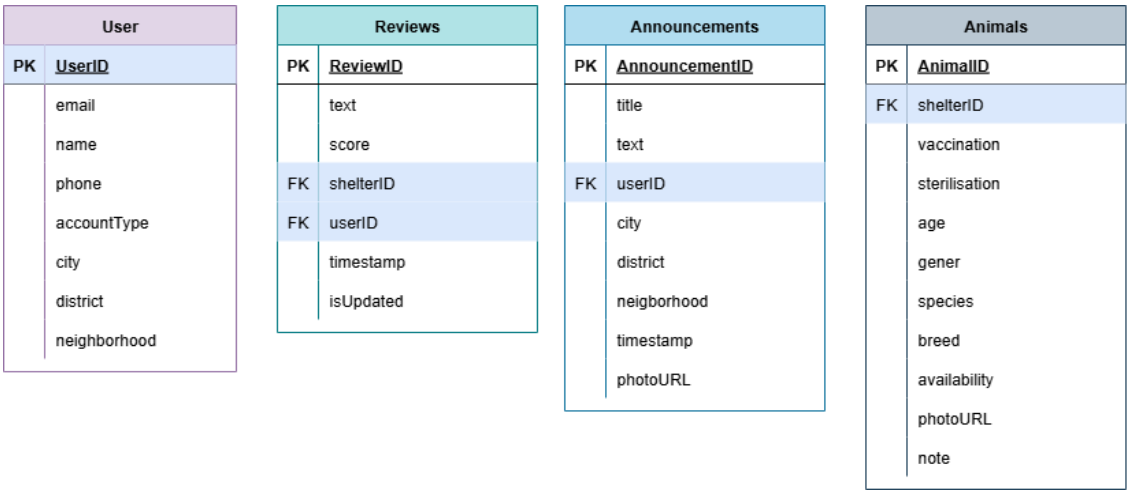

Figure 4. The entity-relationship diagram of the Firebase database employed in the application.

2.2.2. Firebase authentication

Firebase Authentication is used to enable users to log in to the system securely. Users register with an email address and password, and the system generates a unique UID for each user.

2.2.3. Firebase storage

Firebase Storage and the Glide library were used for managing visual content such as animal photos and announcement posters. For each file uploaded by the application, the system generates a unique URL, which is stored as a reference within the corresponding data nodes.

2.2.4. Firebase cloud functions

The developed system does not currently utilize Cloud Functions directly; however, it is anticipated that the system may benefit from them in the future for certain purposes discussed below. Tasks such as automatically archiving lost animal notices after a specific period (e.g., 30 days), tracking adoption statuses, or cleaning up inactive content can be performed using

scheduled Cloud Functions. When a user account is deleted, operations such as the automatic removal of announcements, comments, or animal data associated with that user can be executed. Additionally, when a new lost-animal or event announcement is created that matches user's address information, automatic notifications can be sent to users in the corresponding region via Firebase Cloud Messaging. Such location-based notifications, currently displayed with an in-app notification icon, can be made more effective and real-time by converting them into a system-triggered push notification structure with Cloud Functions.

2.3. Development environment and tools

In this study, Android Studio Iguana (1.2.2023) was chosen for the development of the Be My Home mobile application (Oracle, n.d.). Java was used as the programming language, and the application was developed in Java SE 8 (JDK 1.8) compatibility. Java 8 was chosen due to its widespread API support and stable structure on the Android platform (Firebase, n.d.). The application's minimum SDK level is set to API 24 (Android 7.0 Nougat), and the target SDK level is API 34 (Android 14). During the development process, Firebase SDKs were integrated for user authentication, real-time data management, and media storage operations. In this context, Firebase Authentication, Firebase Realtime Database, and Firebase Cloud Storage services were used (Android Developers, 2024).

3. Results and Discussion

A usability test was conducted to evaluate the interface of the developed mobile application, the functionality of its basic features, and the overall user experience. The results are presented in Table 2. Within this scope, the application was tested by four users. Two of the participants joined the testing process using individual user accounts, while the other two opened shelter accounts. Participants rated the various functions of the application on a 5-point Likert scale: 1: Very Bad, 2: Bad, 3: Neither Bad Nor Good, 4: Good, and 5: Very Good, and also shared their opinions about the application. The feedback received has been analyzed both on a user basis and by account type.

Table 2. Usability test results for the developed mobile application.

Questions	User 1 (Personal Account)	User 2 (Personal Account)	User 3 (Shelter Account)	User 4 (Shelter Account)
Registering for the application	Very Good	Very Good	Very Good	Very Good
Login process	Very Good	Very Good	Very Good	Very Good
Updating your profile information process	Very Good	Very Good	Very Good	Very Good
User-friendly interface	Very Good	Very Good	Good	Good
The operation of the functions used	Good	Good	Good	Very Good
Ease of finding the desired information or function	Very Good	Very Good	Good	Good
Result	**4.8/5**	**4.8/5**	**4.5/5**	**4.6/5**

When user feedback was reviewed, users stated that the Be My Home mobile app was useful and that the developed interface was simple and user-friendly. Requests were made to add functions such as commenting on announcements, adding photos to shelter reviews, and making the management panel button for shelters more prominent. Additionally, one user reported that the filtering feature sometimes responds slowly. This feedback indicates that the app's usability is generally viewed positively, but some details could be improved.

There are limitations regarding the sustainability of user participation in the usability test shown in Table 2. The usability test for the developed mobile application was designed to provide definitive error detection and workflow validation, particularly in the functional validation phase, rather than stochastic user sentiment analysis. The four users (two personal accounts and two shelter accounts) were not randomly selected, but rather acted as expert validators, performing specific functional scenarios as defined in the flow diagram in Figure 2. Upon examining Table 2, it can be seen that the Likert scale results yielded high scores. Based on these results, it appears that the proposed system operates within acceptable tolerance levels for a prototype.

4. Conclusion

This study contributes to the field by proposing a comprehensive system that facilitates the adoption of stray animals by addressing the shortcomings identified in the existing literature regarding shelter management, reporting of lost/injured animals, and citizen participation. The developed mobile application supports the smart city vision by encouraging participation not only from animal lovers but also from municipalities and shelter authorities. In this context, the system supports data-driven decision-making processes based on information such as shelter occupancy rates, animal health status, vaccinations, and location. Additionally, the ability for citizens to submit reports through the application, post notices about lost animals, and access information about shelters has a positive impact on encouraging increased digital participation. The developed system is expected to benefit animal shelters, local governments, and volunteers, and is anticipated to yield positive results such as the tracking of stray animals, the acceleration of adoption processes, and increased social awareness. The proposed method uses Firebase Authentication to simplify user identity management. This ensures that user UIDs are cryptographically unique and decoupled from application logic. Furthermore, the proposed method employs Role-Based Access Control (RBAC) in its architecture, strictly encapsulating write access to the database. Access to data is restricted to verified accounts. This makes it impossible for unauthorised organisations/users to misuse shelter reviews for official data entry. For the functional requirement of geographic restriction notifications, location data is stored in the Firebase database in the form of cryptographic encryption, just like other data. The architectural design of the proposed method guarantees low-latency network communication via Firebase's callback mechanism and ensures the sustainability of database performance through an automatic archiving strategy on the server side. However, the system also has various limitations, such as its need for an internet connection, the sustainability of user participation, the accuracy of manual data entry, and the differences in shelter structures across different cities.

The Be My Home mobile app bridges the gap between users and shelters, accelerating the adoption process, transparently sharing information about the animals location, health, sterilization, and vaccinations, and making it easier for users to access the shelters. At the same time, it enables the sharing of announcements about lost or in-need animals, thereby minimizing suffering in such situations. The developed system not only simplifies the adoption process but also provides a social solidarity environment that strengthens communication between users, shelters, and animal-loving communities. Thanks to its filtering and notification features, users can instantly follow developments in their area, thereby promoting environmental awareness and social participation. The fact that the application only allows shelters to add adoption postings makes the process safer. Additionally, feedback provided through comments encourages user contributions. The application ensures that data is updated in real time thanks to its Firebase-supported infrastructure. Processing the data obtained in this way supports local governments in achieving their smart city goals by creating and reporting statistical and real-time data that can contribute to their decision-making processes. In light of all these potential

developments, it is anticipated that the widespread use of the proposed Be My Home mobile application will significantly contribute to improving the living conditions of stray animals, sustainably managing the animal population in cities, and encouraging citizens to participate more actively and responsibly in city life. In future work, developing an iOS version of the mobile application is one of the key objectives to ensure it reaches a wider audience. Furthermore, the integration of AI-based recommendation systems is planned to improve adoption probability estimation and user-animal matching processes. In addition, more advanced analytical reporting dashboards will be developed for municipalities.

Declaration of Author Contributions

Hacer Sueda Efe was responsible fort the conceptualization, methodology, and software development, and prepared the original draft of the manuscript. Önder Yakut contributed to the review and editing of the manuscript and provided supervision throughout the study. Gizem Yıldız was responsible for editing, translation, and formatting of the manuscript.

Declaration of Conflicts of Interest

The authors state that there are no conflicts of interest associated with this research.

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