COMPAWNION:
A PROFILE MANAGEMENT SYSTEM with GEO-LOCATION SYSTEM for NOAH'S ARK DOG AND CAT SHELTER, MABALACAT, PAMPANGA

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ABSTRACT

This web application aims to improve the welfare and health of stray pets by the use of geo-location to rescue and shelter them until they find a new owner. The researchers used descriptive research methods to develop and design the web application patterned after the existing procedures and fit the requirements of the locale. Purposive sampling was utilized to identify the respondents. ISO 9126 was employed to evaluate the performance of the web application. The respondents found Compawnion web application as user friendly with an average mean of 4.29, which states that the system is easy to use and understand each function, the users can view the lists of adoptees, use the report function as well as add their pets into the system with ease. In terms of its acceptability, the respondents rated the said application as "highly acceptable" as it depicts the requirements of the stakeholders. The results showed Compawnion directly benefits animal health welfare and improves pet shelter procedures through the help of the application in reaching out to the community.

CCS Concepts

- Information systems → Database Management System Engines
- Image Classification→ Logic→Algorithm→ Accuracy
- Geo-location→ Algorithm

Keywords

Geo-location; Profile Management; Stray pets, Dogs, Cats, Mabalacat City

1. INTRODUCTION

While profile management involves overseeing user profiles within software applications, this research takes an innovative leap by developing a comprehensive framework designed for managing pet profiles within the animal shelter system.

The research study titled Compawnion: A Profile Management System with Geo-Location for Noah's Ark Dog and Cat Shelter, Mabalacat, Pampanga," focused on the operations of Noah's Ark Animal Dog and Cat Shelter. Situated in Mabalacat City, Pampanga, this non-government organization is dedicated to rescuing stray pets, providing shelter, assessing their health, and facilitating their adoption to new pet owners. Presently, the shelter accommodates 60 dogs and 140 cats, all either rescued from the streets or surrendered by owners who could no longer provide shelter and care. Its facilities can support a maximum of 300 stray pets.

This research primarily examines the development and functionality of the profile management system, with a particular emphasis on enhancing pet adoption processes.

Community surveys conducted by PubMed Central across 90 barangays Nueva Vizcaya, Palawan, and Tarlac respectively revealed concerning statistics: 53% of households, both urban and rural, reported at least one animal bite or scratch injury in the past three years. The rates of bites or scratches in Nueva Vizcaya, Palawan, and Tarlac averaged 67.3, 41.9, and 48.8 per 1,000 people per year, respectively. Alarmingly, only 44.9% sought medical treatment for these incidents [1]. These findings underscore the gravity of the issue, emphasizing the urgent need for effective solutions. The researchers conducted data gathering by interviewing the residents of the municipality of Mabalacat City, as well as a resident doctor in a local veterinary office. According to the interview with Dr. Abel Archievald P. Canlas who is in charge of handling the policies stated that they follow an Ordinance titled "Advocating Responsible Pet Ownership in the City of Mabalacat, Pampanga" also known as the City Ordinance No. 67, Series of 2017, that all dogs found wandering and/or roaming around streets, public plazas, markets, schools, parks and playgrounds and any other public places within the territorial jurisdiction of Mabalacat City and unaccompanied by their rightful owners are hereby considered "stray dogs". The Mabalacat City government utilizes diverse tactics and programs to mitigate the quantity of stray animals, one of these tactics is encouraging citizens to leash their pets, mostly dogs to prevent wandering away too far, another one is penalizing pet owners by sending their pets into the impound and depending on how long it takes for the rightful owner to gather their pet. In this research study, the researchers focused on cats and dogs specifically in the locale, which is one of the growing concerns of Mabalacat City. Pet abandonment poses significant risks to animals, subjecting them to hunger, thirst, injuries, and illnesses. Stray pets often multiply on the streets, overwhelming shelters that struggle with limited space and funds. The researchers want to develop a way to report stray animals by using geolocation technology to locate the whereabouts of the stray that needs to be rescued so the animal shelter's worker or owner to have an easier time locating the stray cat or dog. Compawnion is a web-based program that provides users with a platform for pet adoption and donation management, as well as a function for posting missing pets and comparing the rescued pet to them.

2. BACKGROUND OF THE STUDY

Pet abandonment, estimated at 12 million cases in 2019 by the Philippine Animal Welfare Society (PAWS) [2], remains a pressing societal issue. The severity of this problem is highlighted by reports from the Mabalacat District Hospital, where over 50 individuals received anti-rabies injections in a single day, based on recent records obtained during the researchers' interviews. This research focuses on the welfare of sheltered cats and dogs in Mabalacat City, specifically at Noah's Ark Dog and Cat Shelter. The shelter's reliance on manual profile documentation poses significant management challenges for staff and volunteers. The COVID-19 pandemic has further exacerbated the issue of stray pets, leading to a surge in abandonment cases. This not only jeopardizes the well-being of animals but also poses substantial public health risks. Alarming statistics from the Bicol Region in 2021 reported 51,125 cases of animal bites, resulting in 35 fatalities [3]. Moreover, from the beginning of 2023 to the first week of March, the Philippines recorded an 8% increase in rabies cases and deaths, totaling 55 cases [4]. These figures underscore the urgency of addressing this multifaceted problem to protect public health. In gathering data, the researchers interviewed pet owners in Mabalacat City and the municipality's local veterinary resident doctor, Dr. Abel Archievald P. Canlas. Dr. Canlas, responsible for implementing City Ordinance No. 67, Series of 2017, titled "Advocating Responsible Pet Ownership in the City of Mabalacat,Pampanga," highlighted measures such as leash usage promotion and pet impoundment to tackle the issue of stray animals. To combat pet abandonment, the researchers propose leveraging geo-location technology, specifically the Global Positioning System (GPS), for swift identification and location of stray animals. This approach facilitates prompt reporting using photos and additional details, with rescued animals directed to Noah's Ark Dog and Cat Shelter for care, shelter, and potential adoption. Noah's Ark Dog and Cat Shelter, the pioneer animal shelter in Pampanga, rescues stray cats and dogs from the streets or upon receiving alerts from concerned citizens. Despite limited resources funded primarily by the founder's personal finances and volunteer donations, the shelter provides separate accommodations for cats and dogs, along with quarantine facilities for sick animals. Monthly, they receive one or more abandoned animals, exclusively from rescued strays, and employ a rigorous screening process for adoption to ensure suitable placements. The researchers aim to streamline reporting using geolocation, reduce stray populations, and implement picture identification for reported animals through the web-based program "Compwanion." This platform facilitates pet adoption, donation management, missing pet posts, and comparison of rescued animals. The study addresses several research questions concerning pet care effectiveness, shelter resource management, the impact of pet platforms on pet adoption, and enhancements to reporting geolocation and the comparison functionalities. Additionally it tackles the under reported issue of stray and missing pets, aiming to promote responsible pet ownership and reduce stray populations in Mabalacat

3. OBJECTIVE OF THE STUDY

The primary goal of this research is to develop a user-friendly system to enhance the management of cats and dogs at Noah's Ark Dog and Cat Shelter in Mabalacat City. The specific objectives of this study are as follows:

1. To create a User-Friendly Web Platform: Showcase adoptable pets, shelter events, and announcements for increased visibility and engagement.
2. To implement Geo-Location Reporting: Enable residents to report stray animals in Mabalacat City with photos and precise location details, aiding swift rescue efforts.
3. To integrate Pet Vaccination Tracking: Empower pet owners with vaccination schedules, sending timely reminders a week before and on the exact day of vaccinations.
4. To develop an Easy Profile Creation System: Enable effortless creation of user and pet profiles for better usability.

5. To integrate Image Classification for Stray Reports: Identify potentially owned pets among strays using image classification, facilitating appropriate actions for reunification.

4. SCOPE AND LIMITATION

Scope

Pet Profiling Management: Focused on creating a web-based system for Noah's Ark Shelter to manage pet profiles, vaccinations, and ownership records.

User Registration and Authentication: Ensuring website security and narrowing potential pet adoption candidates.

Adoption Facilitation: Allowing remote browsing of adoptable pets, with a form for user information input and reporting of stray animals within Mabalacat using geo-fencing.

Database Utilization: Managing user and pet profiles to record vaccination dates, rescue information, and lawful ownership records.

Limitations

Registration Dependency: Only registered pets can be utilized within the system, requiring collaboration with local agencies for enriched data.

Image Processing Constraints: The system's image processing functionality may face challenges as objects obstruct pet images, potentially impacting identification accuracy.

Database Dependency: The system's effectiveness relies on the database's completeness, limiting functionalities based on available registered pets.

Algorithm Accuracy: The image processing tool's accuracy is affected by picture clarity, object obstruction, and the ongoing need for algorithm training for improved predictions.

5. RELATED LITERATURE

Pet Abandonment

For the adoption or buying of pets, websites are see everywhere but the mobile application is more suitable a well as comfortable for the users as well as th organizations [5]. According to the studies by [6] it revealed that between April and May 2020, during the early phase of the pandemic, there was a significant increase in the relative search volume (RSV) for pet, dog, and cat adoption compared to the average search volume over the past five years. The RSV ratio for both dog and cat adoption, when compared to the same period in 2019, showed an increase of up to 250%. However, the interest in dog adoption declined in July 2020 and returned to the typical level by December 2020. In contrast, the interest in cat adoption remained consistently high. In conclusion, the study indicated a surge in global interest in pet adoption, particularly for dogs, at the beginning of the COVID-19 pandemic. However, this heightened interest was not sustained, and the search volume for dog adoption decreased over time. On the other hand, the interest in cat adoption remained consistently high. The researchers expressed concern about potential separation anxiety and the possibility of owners abandoning their newly adopted pets once they return to work, particularly with the rollout of COVID-19 vaccines. The study found that web interest in adopting cats and dogs increased during the early phase of the COVID-19 pandemic, with sustained interest in cats but not dogs. The increased adoption rates appeared to cancel out the number of surrendered pets. However, some concerned newly adopted pets may experience separation anxiety or be returned to the shelter when owners are no longer working from home. This attachment to owners during the pandemic is known to be a risk factor for separation anxiety in dogs.

Animal shelter organizations have admitted that there are concerns about pet abandonment after the pandemic. The public interest in dog adoption has lessened in October and November following the announcement of the COVID-19 vaccine date. [7] The study found that during the COVID-19 pandemic, interest in dog adoption and the adoption rate increased significantly, while abandonment did not change. The well-being of dog owners was found to be related to their dogs' quality of life and behavior, as well as the likelihood of giving up a pet. These findings imply that the human-dog relationship may have potential benefits during the pandemic, and the study emphasizes the significance of study into crisis-driven alterations in human-animal partnerships [8]. Based on these findings, it is important to provide support and education to pet owners during the transition period to minimize separation anxiety and prevent pet abandonment [9]. Animal shelters face the challenge of increasing adoption rates, as millions of animals are euthanized each year due to overcrowding. This study aimed to predict the length of stay for animals in shelters by considering factors such as animal type, age, gender, breed, size, and shelter location. Various machine learning algorithms were used to develop models, with the gradient boosting algorithm showing the best performance. The results highlighted the importance of age for dogs, multicolor coats, and large or small size as predictors of length of stay. The findings can be used to minimize the time animals spend in shelters and reduce euthanization. Future research aims to determine which shelter locations are most likely to result in successful adoptions. The proposed tool can assist shelters in making informed decisions to balance adoption speed and relocation costs [10]. When looking for a pet, human-related factors include prior dog ownership experience, age, gender, ethnicity, income, education, and household structure. Various demographic factors, such as gender, age, and income, have also been identified as potential predictors of preference or behavior concerning choosing where to acquire dogs. In addition, social influences, such as trends in breed popularity, appear to influence decisions regarding which breed of dog to acquire. [11]. Each year, millions of animals are adopted from shelters in the US, but a significant percentage, around 7.20%, end up being returned. Behavioral issues, such as aggression towards humans and animals, are the main reasons for failed dog adoptions. Causes returns are less clear, but aggression and destructive behavior are common factors. Owners with children and first-time owners have a higher risk of returning adopted animals, while responsible caretaking reduces the likelihood of returns [12].

Pet Image Classification

Additionally, the system incorporates advanced technologies such as image processing and deep learning algorithms. These technologies enable animal detection and classification, ensuring accurate matching between pets and adopters. The system also utilizes sentiment analysis to evaluate public sentiment regarding pets based on textual data. This helps users gauge the general perception and popularity of different pets. The research emphasizes the benefits of the AI-based pet adoption system. It aims to raise awareness about stray animals and reduce euthanization rates by facilitating successful adoptions. By providing a user-friendly interface and personalized recommendations, the system encourages more individuals to consider adopting pets and contribute to animal welfare. Furthermore, the system enables users to share their own rescue stories, inspiring others to take part in pet adoption. The paper discusses the widespread applications of Object Detection, particularly in tasks like vehicle detection, face detection, and identifying objects in autonomous vehicles and pedestrian scenarios. TensorFlow's Object Detection API emerges as a powerful tool enabling the swift development and deployment of robust image recognition software. Object detection goes beyond mere object classification, encompassing object localization by drawing bounding boxes and identified objects.The study concentrates on detecting objects, especially those deemed threatening. To facilitate the detection of threatening objects, researchers utilize the Tensorflow Object Detection API to train the model. The implementation uses the Faster R-CNN algorithm. The constructed model is specifically designed for two classes of objects. Furthermore, the evaluation of the model is conducted using test data about these two classes, aiming to measure its performance in detecting the objects accurately. [13].

6. METHODS

The 'Mixed-Methods Research approach combines both qualitative and quantitative research techniques to enrich the study. Qualitative methods involved discussions with Mabalacat citizens to learn about their experiences with stray animals and their views on animal shelters. Interviews with Noah's Ark helped tailor the system to their specific needs regarding adoption and rescue processes. Quantitative research evaluated Compawnion's performance using feedback from alpha and beta testers. IT professionals participated in alpha testing, while beta testing involved pet owners and Noah's Ark staff. This assessment aimed to pinpoint areas needing improvement within the system.

The respondents are composed of 271 participants who own cats and/or dogs and reside in Mabalacat City, Philippines. The researcher used a Raosoft sample size calculator with a 90% confidence level to calculate the sample size, which consisted of 271 respondents. They are knowledgeable in owning and handling cats and dogs to answer the questionnaire from the researchers for the much-needed information on how they treated their cats and dogs. The researchers also interviewed the Noah's Ark Dog and Cat Shelter 10 staff members with the self-made questionnaires provided by the researchers to have a better understanding of the procedures done in the animal shelter and who the people most interested in adopting a new pet from the shelter.

The researchers adopted the Iterative Model as their Software Development Life Cycle (SDLC) approach to craft the system. This model involves breaking down processes into smaller, iterative parts, enabling flexibility and the integration of user feedback throughout development. Throughout the iterative process, the researchers continually incorporated user feedback obtained from surveys and interviews, aligning with the research's ultimate goal of refining and creating a more user-centric web application.

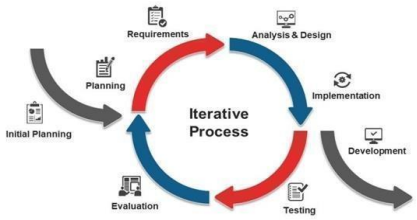

Figure 1 – Iterative Model

Statistical treatment of the data is necessary for the data to be used effectively. The researchers made use of the following statistical role to interpret the collected data effectively:

5-point Likert Scale

Point Values	Descriptive Rating
1	Strongly Disagree
2	Disagree
3	Neutral
4	Agree
5	Strongly Agree

Table 1 – Likert Scale

Weighted Mean

The weighted mean is a value that can be used to summarize a large set of numbers. The mean of a set is calculated by adding all the numbers in the set and dividing the total by the number of members in the set. The researcher used weighted means to calculate the average value of the pre-survey questionnaire and the alpha and beta questionnaires.

Raosoft Sample size calculator

Raosoft was used due to its user-friendly interface and robust survey capabilities to get the sample size and confidence level. The researchers took the population of Mabalacat City (293,244) and computed it with a Raosoft sample size calculator with a 90% confidence level and 5% margin of error and it shows the sample size of Mabalacat City is 271 respondents.

The conceptual framework of the study. It shows the relationship between the three major parts of the research

paradigm: input, process, and output. It shows variables and activities in completing the study. The input consists of the problem the researchers have observed while reading the related literature. The preliminary data gathered by the researchers from the municipality and the shelters shows the need for a profile managing system for Noah's Ark it also shows the research instrument use and the respondents use. For the process, the researchers conducted planning, analysis, design, implementation, testing, and integration to develop the website. The researchers also use diagrams such as data flow diagram, entity relationship diagram, use case diagram and system flowchart. The output is "Compawnion: A Profile Management System with Geo-Location System for Noah's Ark Dog and Cat Shelter, Mabalacat Pampanga" is a web application that includes a profile management system that caters to the adoption and rescue of stray animals in Mabalacat, the system also es geolocation the find the stray that had been reported inside Mabalacat faster.

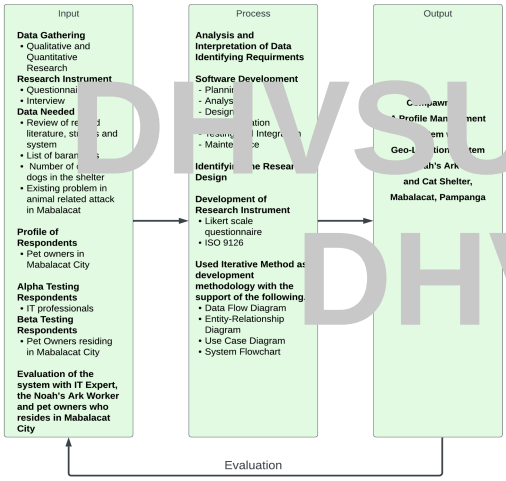

Figure 2 – Conceptual Framework

6. RESULTS AND DISCUSSION

This chapter presents the summary of the findings of the study as contained in the different tables, it shows the data gathered and these data are present in tabular forms.

Table 2: Overall Mean and Summary of Results Based on Residents' and IT Experts' Rating

	Residents		IT Experts	
Characteristics	**AWM**	**DR**	**AWM**	**DR**
Functionality	4.17	Excellent	4.1	Excellent
Efficiency	4.29	Excellent	3.9	Good
Usability	4.29	Excellent	3.9	Good
Reliability	4.19	Excellent	4.3	Excellent
Maintainability	4.26	Excellent	3.8	Good
Portability	4.35	Excellent	3.9	Good
Overall Mean	**4.26**	**Excellent**	**4**	**Excellent**

Table 2 summarizes the survey for the proposed system and evaluation. It can be concluded that the residents of Mabalacat, Pampanga, and IT experts find the proposed system to be Excellent based on the computed overall mean of 4.25 and 4, respectively. In the post-survey for the IT experts, they have some comments on each of the characteristics. In the Functionality, the "GPS not accurate; needed to retry 2 times to be accurate" and "Image processing needs improvement." Efficiency "The response time for adding pets was slow" and "The GPS was slow at locating our location." Compatibility "It was compatible with any devices; it just needed a little improvement in User Interface." Usability "The system needs some improvement in the UI and to be a little more user-friendly, the functions are recognizable." Reliability "The system just works okay; it does not crash." Maintainability "Have some bugs in certain areas, especially in the vaccine, because you can access the future dates." Security "The verification email is too long to be sent." Portability "The system works on any website I try so far." The researchers took the feedback of the IT experts seriously and upgraded the system by resolving GPS and image issues, improving efficiency by addressing slow responses, making it more user-friendly and compatible across devices, fixing bugs for reliability, streamlined security with faster verification emails, and ensuring it works well across various websites".

7. SUMMARY

This research project is a web-based pet profile management system that digitalizes and organizes the shelt ed cats and dogs' profiles, with an image report system that utilizes geolocation to track the coordinates of where the image has been taken to make it easier to track and rescue stray cats or dogs. This was made to improve the manual management of each cat and dog's profiles in the Noah's Ark Dog and Cat Shelter, Mabalacat, Pampanga as well as promote the animal shelter by providing a platform where all of the pets that are ready to be adopted are displayed in one place for users to easily access the site for them to browse and apply to adopt a pet. The proposed system entitled Compawnion: A Profile Management System with Geo-Location System for Noah's Ark Dog and Cat Shelter, Mabalacat, Pampanga was assessed by IT Experts for its functionality, efficiency, usability, reliability, maintainability, and portability. The overall weighted mean of the assessment is in the interpretation of Excellent. The residents assessed the functionality, efficiency, usability, reliability, maintainability, and portability of the system with the overall mean being 4.26 with the interpretation of Excellent. Therefore, the respondents for the post-survey concluded that the participants were satisfied with the proposed system and can function as intended to improve the profile management of the pets in Mabalacat City and Noah's Ark.

The following are the screenshots of the developed system:

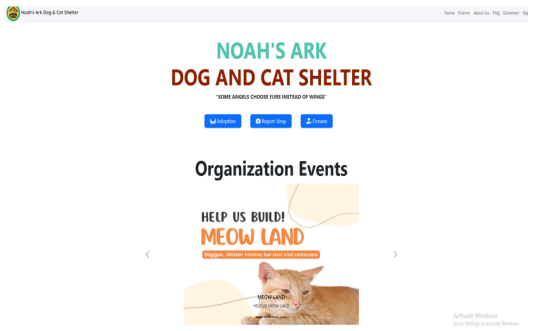

Figure 3: Homepage

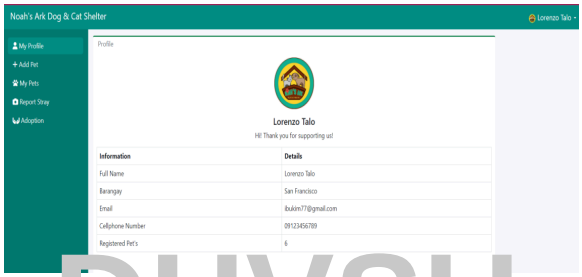

Figure 4: User Sidebar

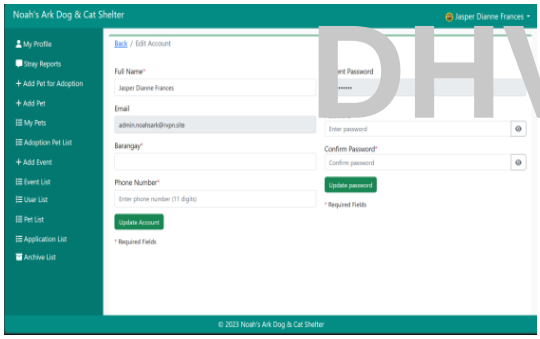

Figure 5: Admin Sidebar

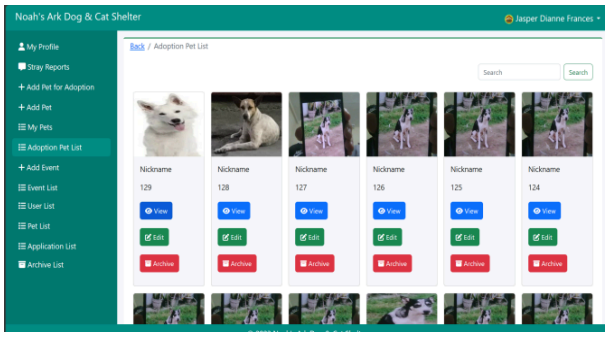

Figure 6: Adoption List

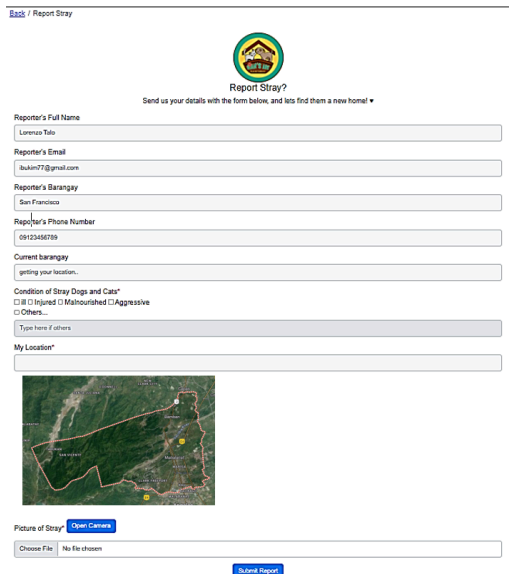

Figure 7: Report Form

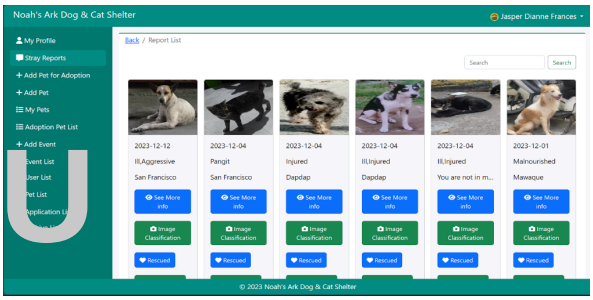

Figure 8: [illegible]

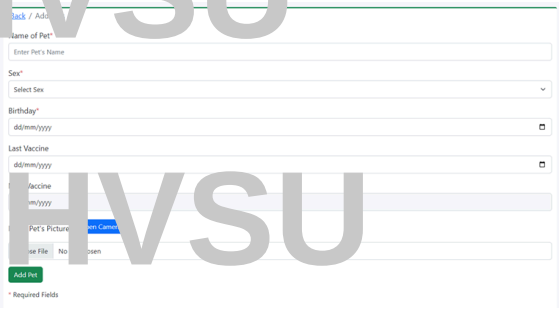

Figure [illegible]

8. CONCLUSION

The respondents from Mabalacat City are very aware of the long-standing issues regarding pet abandonment and breeding of pets that can also result in overpopulation of pets. The respondents either have a dog or cat, they can easily understand that the pets need to be tended with anti-rabies shots, and spaying and neutering them will be good for the pets to avoid the overpopulation of pets that can lead to pet abandonment. 37.61% of the respondents

tend to look at the physique of the pets to adopt them. There are 47.6% of the respondents who never visited a pet shelter so they are relying on the internet to find a pet to adopt with this the results showed the researcher a positive 4.26 AWM, in the creation of Compawnion. They can also view the list of pets that can be adopted and reported.

As the researchers embrace the digital age, stray pets need to cope with the times, for them to be able to find a warm and cozy home in the time they need it the most.

9. RECOMMENDATIONS

Future researchers should have technical knowledge and experience when it comes to implementing various algorithms and techniques that can greatly improve Compawnion. These recommendations play an important role in developing the system.

- Having a page dedicated to the history of donations.
- Make the donation button clickable.
- Making the proper adjustments to the system and turning it into an application that has a low system requirement to install and will cater to older devices.
- Improvement in object detection should increase the accuracy of pet classification.
- Improve the user interface of the system.

REFERENCES

[1] Amparo, A. C. B., Jaime, S. I., Roces, M. C. R., Dela Cruz, M. P. Z., Quezon, M. C. L., Licuan, D. A., Villalon, III, E. E. S., Hernandez, L. M., Baquilod, M. S., Taylor, L. M., & Nel, L. H. (2018, July 26). The evaluation of Animal Bite Treatment Centers in the Philippines from a patient perspective. NCBI.

[2] Malasig, J. (2020) PAWS pushes for Trap-Neuter-Return program to address overpopulation of stray animals in PH

[3] Jaucian M. (2022) DOH reports spike in animal bite cases, 35 deaths in Bicol last year

[4] Norie,GMA Integrated News & RICHA NORIEGA, GMA Integrated News. (2023, March 10). Rabies cases, deaths increase in 2023 — DOH | News

[5] Magdum, A., Magdum, A., Chavan, G., & Jadhav, S. (2023). Mobile Application of Pet Adoption System. IRJET.

[6] HO, J., Hussain, S., & Sparagano, O. (2021). Did the COVID-19 Pandemic Spark a Public Interest in Pet Adoption?

[7] HO, J., Hussain, S., & Sparagano, O. (2021). Did the COVID-19 Pandemic Spark a Public Interest in Pet Adoption?

[8] Morgan, L., Protopopova, A., Birkler, R. I. D., Itin-Shwartz, B., Sutton, G. A., Gamliel, A., Yakobson, B., & Raz, T. (2020). Human–dog relationships during the COVID-19 pandemic: booming dog adoption during social isolation.

[9] HO, J., Hussain, S., & Sparagano, O. (2021). Did the COVID-19 Pandemic Spark a Public Interest in Pet Adoption?

[10] Bradley, J., & Rajendran, S. (2021). Increasing adoption rates at animal shelters: a two-phase approach to predict length of stay and optimal shelter allocation - BMC Veterinary Research. BMC Veterinary Research

[11] Holland, K. E. (2019). Acquiring a Pet Dog: A Review of Factors Affecting the Decision-Making of Prospective Dog Owners. MDPI.

[12] Powell, L., reinhard, C., Satriale, D., Morris, M., Serpell, J., & Watson, B. (2021). Characterizing unsuccessful animal adoptions: age and breed predict the likelihood of return, reasons for return, and postreturn outcomes.

[13] Krishna Sai B.N., & Sasikala, T. (2019). Object Detection and Count of Objects in Image using Tensor Flow Object Detection API. 2019 International Conference on Smart Systems and Inventive Technology (ICSSIT).