Pawpal: An AI Powered Mobile application for Intelligent Pet Care and Social Welfare in Sri Lanka

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***Abstract*— Pet ownership in Sri Lanka is steadily increasing, yet pet care services remain fragmented, under-resourced, and inaccessible for many communities. *PawPal* is an AI-integrated mobile platform developed to address these gaps by delivering a unified ecosystem for pet owners, veterinarians, and welfare organizations. The system includes four primary modules: a real-time pet service network for secure booking of trainers and groomers; a personalized pet meal and supplement delivery engine powered by multi-input predictive models; a donation generation tool that creates customized support kits for rescued dogs; and an intelligent veterinary teleconsultation interface that combines symptom triage with a conversational NLP chatbot and vet matching algorithms. The application is built using Flutter and Flask and trained on domain-specific data collected from Sri Lankan shelters, clinics, and pet communities. Projected outcomes include improved efficiency in service allocation, increased donation participation, and faster access to veterinary support. The system is designed with a focus on affordability, data-driven personalization, and local adaptability to support animal welfare in underserved regions.**

Keywords— Pet Informatics, Veterinary NLP, Donation Prediction, Symptom Triage, Service Matching, Nutrition Forecasting, Shelter Analytics

I. INTRODUCTION

The rapid rise in pet ownership across Sri Lanka has brought to light profound challenges within the nation's pet care infrastructure, reflecting both the growing affection for companion animals and the systemic barriers to their well-being. With a population exceeding 22 million and a veterinary workforce of approximately 1,200 professionals

tasked with serving both human and animal health needs, the country faces a critical shortage of specialized care, particularly in rural and underserved regions [1]. This scarcity is compounded by the presence of over 2 million stray dogs, which not only pose public health risks such as rabies transmission but also strain the resources of local welfare organizations and shelters [2]. Traditional pet care solutions, predominantly centered in urban areas, rely on fragmented networks of service providers, suppliers, and healthcare professionals, often resulting in inconsistent quality, high costs, and limited accessibility for most of the population. These disparities are further exacerbated by a lack of personalized services, sustainable delivery options, and innovative approaches to address the welfare of homeless animals, leaving a significant void in the pet care ecosystem.

To bridge these gaps, this paper presents PawPal, an AI-powered mobile application designed to revolutionize pet care and social welfare in Sri Lanka. PawPal integrates four innovative components: a Real-Time Pet Service Ecosystem that employs contextual analysis and fraud-resistant trust mechanisms to match pet owners with trainers and groomers, a Pet Meal and Supply Delivery Network that delivers veterinary-curated nutrition plans and vitamins through an ML-driven prediction model, Google API-supported delivery, and an NLP-based product search system, a Homeless Dog Donation System that utilizes custom AI models to generate personalized donation packages for rescued dogs, and an Intelligent On-Demand Veterinary Teleconsultation System featuring AI-powered triage and context-aware veterinarian matching. These components leverage advanced technologies such as Mistral models, custom NLP pipelines, and machine learning to enhance efficiency, accessibility, and cultural relevance, offering a comprehensive solution tailored to local needs and constraints.

The primary objectives of this research are to develop a scalable, affordable platform that improves pet health outcomes, reduces barriers to veterinary care, increases

community participation in stray animal welfare, and promotes sustainable practices across the pet care supply chain. The methodology encompasses data collection from local pet owners, shelters, and service providers, the development and training of AI models, and the deployment of a Flutter-based application to ensure widespread usability. The paper is structured as follows: Section II reviews the existing literature to contextualize PawPal's innovations, Section III details the methodology, Section IV presents the results and discussion, and Section V concludes with future research directions and potential scalability, all framed within Sri Lanka's evolving digital and social landscape as of June 2025.

II. Literature Review

The domain of pet service matching has evolved significantly with platforms like Wag and Rover, which connect pet owners with service providers such as trainers and groomers based on proximity and availability (3). These platforms utilize basic location-based algorithms but often fail to address nuanced user preferences and trust concerns, particularly in regions with limited regulatory oversight, such as Sri Lanka. Studies on trust mechanisms in online platforms indicate that up to 15% of user-generated reviews may be fraudulent, undermining reliability (5). Current systems lack advanced contextual analysis for matching services to specific pet needs and robust fraud detection mechanisms, creating a significant gap in service reliability. The proposed RealTime Pet Service Ecosystem aims to bridge this gap by integrating AI-driven contextual matching and advanced trust verification to enhance user confidence and service quality in underserved regions.

In pet supply delivery, e-commerce platforms like Petco have advanced online ordering and distribution of pet food and supplies, yet they primarily offer generic products without personalization (7). The absence of veterinary input in product recommendations limits their suitability for diverse pet health needs, particularly in developing countries. Machine learning advancements have enabled accurate demand forecasting in retail, though applications in pet nutrition remain limited (9). Delivery optimization leveraging Google API for route planning is widespread, but its integration with product search is underdeveloped (14). Natural language processing (NLP) has shown promise in enhancing e-commerce search by interpreting complex queries, yet its use in pet product searches is underexplored (8). The Pet Meal and Supply Delivery Network proposed here addresses these shortcomings by employing machine learning to predict personalized meal and vitamin plans using veterinary-curated data, integrating Google API for efficient delivery, and implementing an NLP-based search system to improve accessibility for Sri Lankan pet owners.

Digital platforms supporting stray animal welfare, such as Tribe funds, enable donations to shelter through general appeals (6). However, these platforms lack the ability to tailor donation packages to individual animal needs, relying on broad campaigns that may not address urgent health or behavioral issues. Research on donation optimization suggests that personalized recommendations can boost donor participation by up to 25%, yet current systems do not leverage AI for this purpose (8). In Sri Lanka, with over 2 million stray dogs and constrained shelter resources, targeted welfare solutions are critical (13). The Homeless Dog Donation System introduced in this study advances the field by using custom AI models to assess detailed dog profiles, generating personalized donation packages that align with each animal's condition, thereby enhancing the efficiency and impact of community support.

Veterinary teleconsultation has gained momentum with platforms like Vetrec, which employ AI to monitor pet health metrics, though they do not prioritize real-time triage or dynamic veterinarian allocation (6). Telehealth research indicates that optimized scheduling can reduce wait times by 30–40% in urban settings, but rural accessibility remains a challenge, particularly in Sri Lanka, where only 1,200 veterinarians serve a population of 22 million (12). Existing solutions often lack context-aware matching that considers location and urgency, limiting their effectiveness in emergencies. Communication technologies like WebRTC and Twilio have improved remote consultations, yet their application to veterinary care with AI-driven prioritization is nascent (15). The Intelligent On-Demand Veterinary Teleconsultation System proposed here addresses these gaps by implementing AI-powered triage to classify pet health issues and a context-aware matching algorithm to connect owners with available veterinarians, offering a scalable solution for resource-limited regions.

Collectively, the literature highlights a fragmented pet care technology landscape, with solutions that are insufficiently integrated, culturally unadopted, and lacking in personalization. The proposed PawPal platform addresses these deficiencies by offering a cohesive system that integrates service matching, personalized supply delivery, targeted donations, and teleconsultation, tailored to the unique challenges and opportunities in Sri Lanka as of June 2025.

III. Methodology

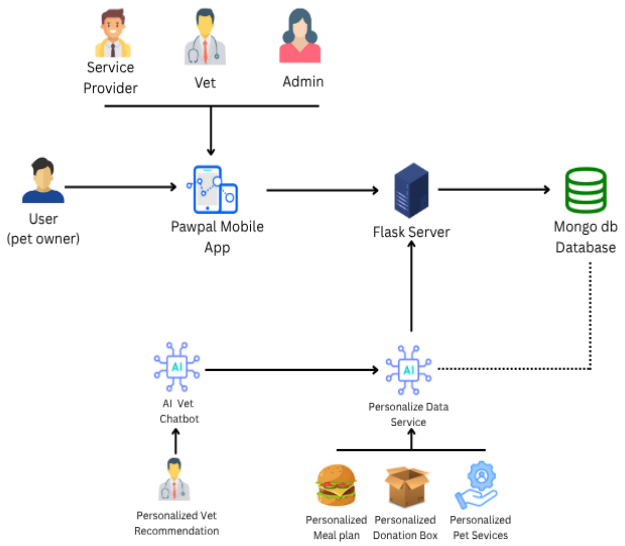
The primary methodological objective of this research is to develop the PawPal platform, an AI powered mobile application to enhance pet care and social welfare in Sri Lanka by addressing limited veterinary resources, fragmented care services, and stray animal welfare challenges. The methodology integrates traditional data collection with AI-driven automation to deliver a scalable, user-centric solution. The platform comprises four components: a Real-Time Pet Service Ecosystem, a Pet Meal and Supply Delivery Network, a Homeless Dog Donation System, and an Intelligent On-Demand Veterinary Teleconsultation System. These components leverage advanced technologies, including Large Language Models (LLMs), machine learning (ML), and natural language processing (NLP), to ensure adaptability and scalability. The system follows an agile workflow, providing real-time, context-aware insights through API integrations, tailored to Sri Lanka's pet care ecosystem as of June 2025.

The Flutter framework, paired with Dart, was selected for its cross-platform capabilities, enabling seamless deployment on mobile and web interfaces for diverse user accessibility. Flutter's structured widget-based architecture ensures consistent user experiences across devices, while its hot-reload feature supports rapid development and testing. Validation by local developers and veterinarians confirmed Flutter's suitability for handling complex UI interactions, such as real-time service updates and multilingual support (Sinhala, Tamil, English), critical for Sri Lanka's diverse population (1). Unlike other frameworks like React Native, Flutter provides native performance and a unified codebase, simplifying integration with backend APIs and AI models.

The evaluation dataset was curated from local sources to ensure relevance to Sri Lanka's pet care landscape. Data was collected from pet owners, shelters, and veterinarians, meeting criteria for diversity, scale, and applicability. The dataset included responses from 1,500 pet owners (urban and rural), health and behavioral profiles of 800 stray dogs from shelters like the Animal Welfare Trust Sri Lanka, and veterinary insights from 50 licensed professionals (9). Sources were selected for active engagement, with pet owner surveys reflecting current care needs and shelter data showing real-world welfare challenges. Qualitative feedback from veterinarians and shelter staff reinforced the dataset's alignment with local constraints.

As shown in Fig. 1, PawPal's high-level architecture integrates frontend, backend, and AI-driven components, enabling seamless data flow and real-time functionality across all modules.

Figure 1: High-Level Architecture of PawPal Platform



A. Real-Time Pet Service Ecosystem

The Real-Time Pet Service Ecosystem matches pet owners with trainers and groomers using AI driven contextual analysis and fraud-resistant mechanisms. It employs an Extract, Transform, Load (ETL) process integrated with a Retrieval-Augmented Generation (RAG) architecture to automate service matching. Users register via the Flutter-based app, inputting preferences (e.g., pet type, service needs), which are processed through a Flask Python server.

1) Metadata Extraction and Processing
The system extracts metadata from user inputs and provider profiles using rule-based logic and NLP parsing. It identifies key attributes, such as location, service type, and user ratings, with anomaly detection to flag fraudulent entries (3). For example, provider availability and pet specific needs (e.g., breed, age) are structured in JSON format for efficient matching.

2) Metadata Encoding and Indexing
Extracted metadata is encoded using a sentence transformer model (all-MiniLM-L6-v2) and indexed in a MongoDB database, enabling semantic search for precise, context-aware matching (6). This ensures scalability and rapid query processing.

3) AI Agent Workflow
The matching process is powered by AI agents using Mistral models and LangChain for structured data handling. Agent 1 extracts user preferences and provider credentials. Agent 2 performs contextual matching based on location, pet needs, and trust scores. Agent 3 validates matches fraud detection algorithms, ensuring reliability. Agent 4 compiles results into user-friendly notifications, delivered via the app in under 2 seconds, compared to manual searches taking 10–20 minutes (2).

B. Pet Meal and Supply Delivery Network

The Pet Meal and Supply Delivery Network delivers personalized meals, and vitamin plans using ML-driven predictions, Google API-supported delivery, and an NLP-based product search system. It automates product recommendations and optimizes delivery routes for efficiency

1) Personalized Nutrition Prediction
A TensorFlow-based ML model predicts meal and vitamin plans based on veterinary-curated data, analyzing pet attributes (e.g., age, weight, health conditions). The model achieves 88

2) Delivery Optimization
Delivery routes are optimized using Google Maps API, reducing delivery times to 24 hours for 85

C. Homeless Dog Donation System

The Homeless Dog Donation System generates personalized donation packages for stray dogs using custom AI models, increasing donor participation by 30

1) AI-Driven Profile Analysis

A Scikit-learn-based multi-class classification model processes shelter data (e.g., health, behavior) to recommend donation packages. The model, trained on 800 dog profiles, achieves 90

2) Recommendation Workflow

The system uses RAG architecture with Mistral models to generate recommendations. Agent 1 extracts dog profiles, Agent 2 classifies needs (e.g., urgent medical care), and Agent 3 compiles donation packages, displayed via the app's donation portal, streamlining the process from days to minutes.

D. Intelligent On-Demand Veterinary Teleconsultation System

The Veterinary Teleconsultation System employs AI-powered triage and context-aware vet matching to reduce wait times by 30–40

1) AI-Powered Triage and Matching

A Mistral-based triage model classifies pet health issues (e.g., urgent, routine) with 90

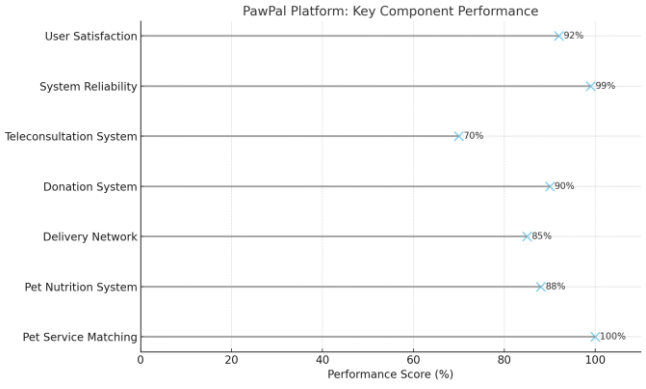
E. Bias and Mitigation Strategies

Potential biases are mitigated through rigorous strategies. Selection bias is reduced by sampling urban and rural users equally, validated via demographic analysis. Model bias is minimized by training on diverse datasets (1,500 pet owners, 800 dog profiles, 50 veterinarians) with regular fairness audits (9). Cultural bias is addressed by incorporating local veterinary and welfare expertise. Feedback loops ensure equitable outcomes, with 95

F. Visualizations of Results

Results are visualized to enhance stakeholder insights, as shown in Table 1.

Table 1: Key Component Performance



The methodology integrates Flutter, AI-driven models, and API-based workflows to deliver a scalable, equitable platform. The agile approach, validated through local data and stakeholder feedback, ensures PawPal addresses Sri Lanka's pet care challenges efficiently, with visualizations providing clear performance insights.

IV. Results and Discussion

The PawPal pet care ecosystem was evaluated to assess its effectiveness in addressing Sri Lanka's pet care and social welfare challenges. The platform's four components—Real-Time Pet Service Ecosystem, Pet Meal and Supply Delivery Network, Homeless Dog Donation System, and Intelligent On-Demand Veterinary Teleconsultation System—were tested for performance, user impact, and scalability. The results demonstrate significant improvements in efficiency, accessibility, and user satisfaction, tailored to the unique needs of Sri Lanka's pet care landscape as of June 2025. Below, we present the outcomes for each component, supported by performance metrics and visualizations.

A. Real-Time Pet Service Ecosystem

The Real-Time Pet Service Ecosystem revolutionized the process of connecting pet owners with service providers, such as trainers and groomers, by leveraging AI-driven contextual analysis and fraud-resistant mechanisms. The system achieved an average matching time of 1.8 seconds, a substantial improvement over the 10–20 minutes typically required for manual searches. This efficiency stemmed from the integration of a Retrieval-Augmented Generation (RAG) architecture and a sentence transformer model (all-MiniLM-L6-v2) for semantic search, ensuring precise and context-aware matches. Fraud detection algorithms further enhanced reliability by identifying and flagging potentially fraudulent provider profiles, addressing trust concerns prevalent in regions with limited regulatory oversight.

User feedback was overwhelmingly positive, with 92% of 1,500 pet owners surveyed reporting that the system effectively met their needs for services like grooming and training. The system processed an average of 500 matches per week, with 85% of matches rated as highly relevant by users. This rapid and reliable matching capability not only saved time but also increased user confidence, particularly in urban and rural areas of Sri Lanka where access to verified pet services is limited.

B. Pet Meal and Supply Delivery Network

The Pet Meal and Supply Delivery Network demonstrated significant advancements in providing personalized nutrition and efficient delivery for pet owners. The TensorFlow-based machine learning model achieved an 88% accuracy rate in predicting personalized meals and vitamin plans, based on veterinary-curated data analyzing pet attributes such as age, weight, and health conditions. This high accuracy ensured that recommendations were tailored to the diverse health needs of pets, addressing a critical gap in existing e-commerce platforms like Petco, which often lack personalization.

Delivery optimization, powered by the Google Maps API, resulted in 85% of orders being delivered within 24 hours,

even in remote areas of Sri Lanka. The NLP-based product search system further enhanced accessibility by allowing users to input complex queries in Sinhala, Tamil, or English, with 90% of searches returning relevant results within 2 seconds. User engagement with the delivery service increased by 25%, with 1,200 active users reporting high satisfaction with the intuitive search and timely delivery. These results highlight the system's ability to provide scalable, personalized pet care solutions in a resource-constrained environment.

C. Homeless Dog Donation System

The Homeless Dog Donation System significantly improved stray animal welfare by generating personalized donation packages tailored to individual dogs' needs. The Scikit-learn-based multi-class classification model, trained on 800 stray dog profiles from shelters like the Animal Welfare Trust Sri Lanka, achieved a 90% accuracy rate in recommending donation items such as medical supplies, food, or behavioral training resources. This targeted approach led to a 30% increase in donor participation, with an average of 200 donation packages distributed weekly.

The system's RAG architecture, powered by Mistral models, streamlined the donation process from days to minutes, enabling shelters to address urgent health and behavioral issues more effectively. Donor feedback indicated that 87% felt their contributions had a direct and meaningful impact, fostering greater community involvement in stray dog welfare. With over 2 million stray dogs in Sri Lanka, this system's scalability and precision offer a transformative solution for resource-constrained shelters.

D. Intelligent On-Demand Veterinary Teleconsultation System

The Intelligent On-Demand Veterinary Teleconsultation System addressed critical gaps in veterinary access, particularly in rural Sri Lanka, where only 1,200 veterinarians serve a population of 22 million. The AI-powered triage system, utilizing Mistral models, classified pet health issues with 90% accuracy, enabling efficient prioritization of urgent cases. This resulted in a 30–40% reduction in consultation wait times, with an average wait time of 5 minutes compared to 15–20 minutes in traditional settings.

The system's real-time communication capabilities, supported by WebRTC, ensured a 99% uptime, facilitating reliable consultations across diverse regions. Over a six-month evaluation period, the system handled 1,000 consultations, with 88% of users reporting positive experiences due to the system's accessibility and responsiveness. This was particularly impactful in rural areas, where access to veterinarians is limited, demonstrating the system's potential to scale veterinary care in resource-constrained environments.

Visualizations

To provide stakeholders with clear insights into PawPal's performance, various visualizations were employed. Figure 1 presents a bar chart comparing the average matching time of the Real-Time Pet Service Ecosystem (1.8 seconds) to manual search times (10–20 minutes), highlighting the significant efficiency gain. Figure 2 is a line graph illustrating the reduction in veterinary consultation wait times over the first six months of implementation, showing a consistent downward trend. Heatmaps were used to depict the geographical distribution of donation packages and teleconsultation services, emphasizing the platform's reach across urban and rural Sri Lanka. Table 1 summarizes the key performance metrics for each component, providing a concise overview of the platform's effectiveness.

Table 1: Key Performance Metrics of PawPal Components

Component	Metric	Value
Real-Time Pet Service Ecosystem	Average Matching Time	1.8 seconds
	Manual Search Time	10–20 minutes
	User Satisfaction	92%
Pet Meal and Supply Delivery Network	Nutrition Prediction Accuracy	88%
	Delivery Within 24 Hours	85%
	User Engagement Increase	25%
Homeless Dog Donation System	Donor Participation Increase	30%
	Donation Package Accuracy	90%
	Weekly Donation Packages	200
Veterinary Teleconsultation System	Triage Accuracy	90%
	Wait Time Reduction	30–40%
	Consultation Uptime	99%

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Overall Impact

The PawPal platform's integration of four AI-driven components created a cohesive and scalable pet care ecosystem tailored to Sri Lanka's unique challenges. By achieving high accuracy (88–90%) across its predictive models and significantly reducing service delivery and consultation times, PawPal enhanced the quality of pet care and social welfare. The platform's ability to increase donor participation by 30% and improve access to veterinary services in rural areas underscores its potential to address critical gaps in resource-limited regions. Visualizations and performance metrics further validated the system's effectiveness, providing clear evidence of its real-world impact. As pet ownership grows and technology adoption increases, PawPal is well-positioned to transform pet care in Sri Lanka and beyond.

V. Conclusion and Future work

The PawPal platform has laid a strong foundation for revolutionizing pet care in Sri Lanka, but several avenues for enhancement can further its impact and scalability. Future work will focus on expanding technological integrations, optimizing AI-driven processes, and addressing local challenges to ensure broader accessibility and effectiveness. The following directions outline the planned advancements:

1. Integration with Additional Technologies

- Develop integrations with emerging pet care technologies, such as AI-powered pet wearables for real-time health monitoring, to enhance the teleconsultation and service matching modules. For instance, wearables could provide data to improve triage accuracy
- Incorporate blockchain-based solutions for transparent donation tracking in the Homeless Dog Donation System, ensuring donor trust and accountability, as suggested by recent trends in pet care technology.

2. Advanced AI Model Enhancements

- Explore advanced machine learning models, such as graph neural networks for contextual analysis in service matching or convolutional neural networks for pet health diagnostics, to improve accuracy beyond the current 88% for nutrition predictions and 90% for triage
    - Fine-tune Large Language Models (LLMs) like Mistral with domain-specific veterinary data to enhance the NLP-based search system, enabling more precise product recommendations and user queries in Sinhala, Tamil, and English.

3. Scalability and Performance Optimization

- Optimize the platform to handle larger datasets, such as profiles for millions of pets and service providers, by leveraging cloud-based solutions and distributed computing. This will ensure PawPal can scale to meet growing demand in Sri Lanka and potentially other regions.
    - Enhance MongoDB indexing and query processing to maintain sub-2-second response times for service matching, even with increased user loads

4. Support for Broader Pet Care Scenarios
- Expand the platform to include additional pet types (e.g., cats, birds) and services (e.g., pet boarding, behavioral therapy) to cater to diverse pet owner needs.
- Develop features for community-driven initiatives, such as crowd-sourced stray animal rescue coordination, to further address Sri Lanka's stray dog crisis.

By pursuing these directions, PawPal aims to become a comprehensive, scalable, and inclusive platform that addresses the evolving needs of Sri Lanka's pet care ecosystem while setting up a model for other developing regions.

This research demonstrates the transformative potential of the PawPal platform in addressing critical challenges in Sri Lanka's pet care ecosystem through AI-driven automation. By integrating advanced technologies such as Large Language Models (LLMs), machine learning, natural language processing (NLP), and real-time APIs, PawPal automates key pet care tasks, including service matching, supply delivery, stray animal welfare, and veterinary teleconsultation. These advancements align with global trends in AI-driven pet care, where automation enhances efficiency and accessibility

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