International Journal of Creative and Open Research in Engineering and Management
ISSN: **3108-1754 (Online)**
Volume 02 Issue 06 June-2026 | Impact Factor: 3.5

Secure E-Health Record Management System for Pet Care and Adoption

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The Abstract—The increasing use of digital technologies in veterinary healthcare and pet adoption has created a demand for a secure and centralized platform capable of managing pet medical records efficiently. In many existing systems, pet health information is stored in separate clinics or manual records, making it difficult to access complete medical histories, vaccination details, and adoption-related information when needed. This lack of integration can lead to delayed treatments, repeated medical procedures, and poor communication between veterinarians, shelters, and pet owners. To address these challenges, this paper presents PetCareEHR, a Secure Electronic Health Record Management System for Pet Care and Adoption. The system combines pet medical record management, vaccination alerts, checkup scheduling, and adoption status tracking within a single web-based application. The platform is developed using Node.js, Express.js, and MySQL, and supports three major user roles: veterinarians, pet owners, and adopters. Role-based access control is implemented to ensure that only authorized users can access or modify sensitive information. Security features such as bcrypt password hashing, token-based authentication, and audit logging are incorporated to improve data protection and accountability. The system also provides real-time updates across dashboards, allowing medical and adoption information to remain synchronized among users. Experimental testing of the application showed reliable system behavior, secure record handling, and smooth database performance during multi-user operations. The proposed system provides a practical and scalable solution for improving pet healthcare management and adoption workflows through a secure digital environment.

Keywords— *Electronic Health Records; Pet Healthcare; Veterinary Management System; Role-Based Access Control; Authentication; Audit Logging; Vaccination Alerts; Adoption Management; MySQL; Node.js; Web Application Security.*

I. INTRODUCTION

The increasing number of companion animal owners and the growing importance of proper veterinary care have created a need for a secure and organized digital system for managing pet health records. In many veterinary clinics and shelters, pet-related medical information is still maintained using separate software systems, handwritten records, or physical vaccination cards. As a result, complete medical histories are often difficult to access when pets move between clinics, owners, or adoption centers. Missing or incomplete records can affect treatment quality, delay medical decisions, and create difficulties during the adoption process.

The lack of a centralized platform also creates challenges for veterinarians and adoption agencies. Veterinary professionals often spend additional time verifying past treatments, checking vaccination details, and managing incomplete records from different sources. Similarly, adoption agencies and potential adopters may not always receive accurate medical information about pets before adoption, increasing the possibility of future health-related complications. In addition, weak access control mechanisms in some existing systems can expose sensitive medical data to unauthorized access or accidental modification.

To address these problems, PetCareEHR is proposed as a secure and centralized electronic health record management system for pet care and adoption. The platform is designed to manage pet registration, medical records, vaccination tracking, checkup scheduling, and adoption status management within a single web-based application. The system supports three major user roles: veterinarians, pet owners, and adopters. Veterinarians are responsible for adding and updating clinical records, while pet owners are provided with read-only access to their pets' health information. Adopters can access limited medical summaries to support informed adoption decisions. Security features such as bcrypt password hashing, token-based authentication, and audit logging are incorporated to improve data protection, accountability, and controlled access to sensitive information.

The remainder of this paper is organized as follows: Section II discusses related work in veterinary healthcare systems and electronic record management. Section III explains the system architecture, modules, and database design. Section IV presents the implementation details along with interface screenshots. Section V discusses the system results and evaluation, while Section VI concludes the paper and outlines possible future enhancements.

II. RELATED WORKS

In recent years, many researchers have focused on developing digital systems for managing veterinary healthcare records, pet monitoring, and secure sharing of medical information. These studies helped in understanding the importance of centralized healthcare management and influenced the design of the PetCareEHR system.

[1] Al-Kutti and Al-Naemi (2019) developed a cloud-based veterinary management system that stores animal medical records, vaccination details, and treatment history in a centralized database. Their work emphasized secure access control and authenticated data retrieval, which are also important features implemented in PetCareEHR for managing owner-linked pet information securely.

[2] Gupta, Shukla, and Bose (2020) created a mobile application that reminds pet owners about upcoming and overdue vaccinations. Even though the application mainly focused on sending reminders, it highlighted the importance of automated notification systems in improving vaccination management. This idea influenced the vaccination and checkup alert modules included in PetCareEHR.

[3] Flores and Hardy (2021) proposed an IoT-based animal monitoring system that collects health-related data through sensors and displays it through a cloud dashboard accessible to veterinarians and pet owners. Although their approach depends on hardware devices, the concept of maintaining continuously accessible health information is similar to the centralized medical record management approach used in PetCareEHR.

[4] Rahman, Silva, and Perera (2018) introduced a web-based animal shelter management system that supports pet profiles, adoption management, and medical reporting. Their work identified the challenges caused by maintaining adoption records and medical records separately, which motivated the integration of healthcare and adoption management features within PetCareEHR.

[5] Park, Lee, and Kim (2022) explored blockchain-based techniques for securing electronic health record systems. While their research mainly focused on human healthcare applications, concepts such as secure access

control, audit logging, and protected data sharing influenced the security mechanisms implemented in PetCareEHR through role-based access control and audit tracking.

[6] Verma and Sahu (2020) proposed a centralized animal healthcare registry that allows veterinarians, owners, and authorized organizations to access verified vaccination and disease-related records. Their study emphasized the importance of maintaining a unified database to reduce fragmented healthcare information and improve the reliability of veterinary records.

[7] Patel and Verma (2022) discussed decentralized approaches for protecting electronic health records from unauthorized modifications while still allowing access to authorized users. Although PetCareEHR uses a centralized database structure, similar principles of secure authentication, controlled access, and activity monitoring are implemented within the system.

[8] Thompson and Fernandez (2020) studied the role of audit trails in healthcare information systems and showed that maintaining activity logs can improve accountability and reduce unauthorized system usage. This supports the implementation of the audit_logs table in PetCareEHR, where veterinarian activities are stored along with timestamps and action details for monitoring purposes.

Overall, the reviewed studies show the increasing importance of secure and centralized healthcare management systems in veterinary and adoption environments. However, many existing systems focus only on specific functionalities such as healthcare monitoring, vaccination management, or adoption workflows separately. PetCareEHR aims to combine these features within a single platform that supports pet healthcare management, medical record storage, vaccination tracking, and adoption processes in an integrated and secure manner.

III. SYSTEM DESIGN

The architectural foundation of PetCareEHR is structured as a multi-tier, modular pipeline that facilitates a coherent progression from user authentication through role-differentiated data access to real-time dashboard rendering. The system is organized into five primary functional modules, each encapsulating a discrete set of responsibilities while sharing a common MySQL database backend. This modular decomposition enhances separation of concerns, simplifies maintenance, and enables independent extension of individual components without disrupting core system behavior.

Fig. 1. Overall System Block Diagram for PetCareEHR

A. System Modules

Owner Module (owner.js)

The Owner Module manages pet owner registration, login authentication, and dashboard-related functionalities within the system. Upon login, the module retrieves all pets linked to the authenticated owner's email address and renders them within a personalized dashboard. Owners may view vaccination alerts, medical histories, and nearby veterinarian listings in read-only mode. The module additionally supports the adoption workflow by enabling owners to flag individual pets as available for adoption, triggering an immediate status update propagated to the adopter interface.

Veterinarian Module (vet.js)

The Veterinarian Module constitutes the primary clinical interface of the system. Authenticated veterinarians may search for patients by owner email, register new pets linked to existing owner accounts, and perform the full range of medical recordkeeping operations—including diagnosis entry, vaccination scheduling, checkup alert generation, and vaccination status updates. All clinical write operations are automatically logged to the audit trail with actor identity and timestamped descriptions, ensuring complete traceability of medical data modifications.

Adoption Module (adopter.js)

The Adoption Module presents adopters with a dynamically filtered listing of pets whose owners have activated the adoption flag. Adopters may apply species and age filters to refine the listing and access limited medical summaries for individual pets, providing sufficient health context to support informed adoption inquiries. Direct adoption communication is facilitated offline through owner contact information surfaced within the pet profile view.

Notification Module (notifications.js)

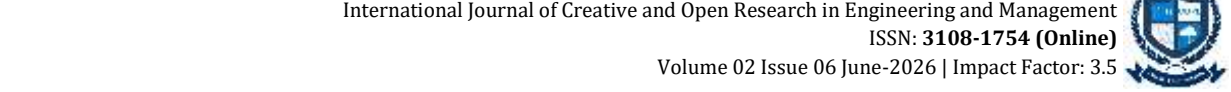
The Notification Module manages time-sensitive alert delivery for vaccination schedules, upcoming checkup appointments, and adoption status changes. The module classifies alerts as upcoming, overdue, or completed based on stored dates and dynamically surfaces the appropriate status to owners. Queued notifications are delivered upon reconnection to ensure zero alert message loss across network interruptions.

Database Module (db.js)

The Database Module provides a secure, pooled connection to the MySQL database and manages all CRUD operations through prepared statements, thereby eliminating SQL injection vulnerabilities. The module handles owner registration, pet creation, medical record persistence, adoption status transitions, and alert generation. Connection pooling with ten parallel connections sustains consistent query performance under concurrent multi-role access.

B. System Architecture and Data Flow

Fig. 2. Actor–System Interaction Diagram for PetCareEHR



System interaction is initiated when a user accesses the web application through a supported browser. Submitted credentials are validated by the Express.js backend, which performs bcrypt-based password verification and assigns an authentication token encoding the user's role. The token is subsequently used by all downstream API routes to enforce access control decisions. Backend request handling encompasses business logic evaluation, role authorization checks, and the construction of parameterized SQL queries directed at the MySQL database. Pet entities are consistently linked to their respective owners via the owner email field, which serves as the cross-module relational anchor ensuring coherent data retrieval across dashboards. Veterinarian-initiated write operations trigger concurrent insertion into both the target clinical table and the audit_logs table, maintaining a synchronized and tamper-evident activity record. The processed response is returned to the frontend for role-specific dashboard rendering.

C. System Workflow

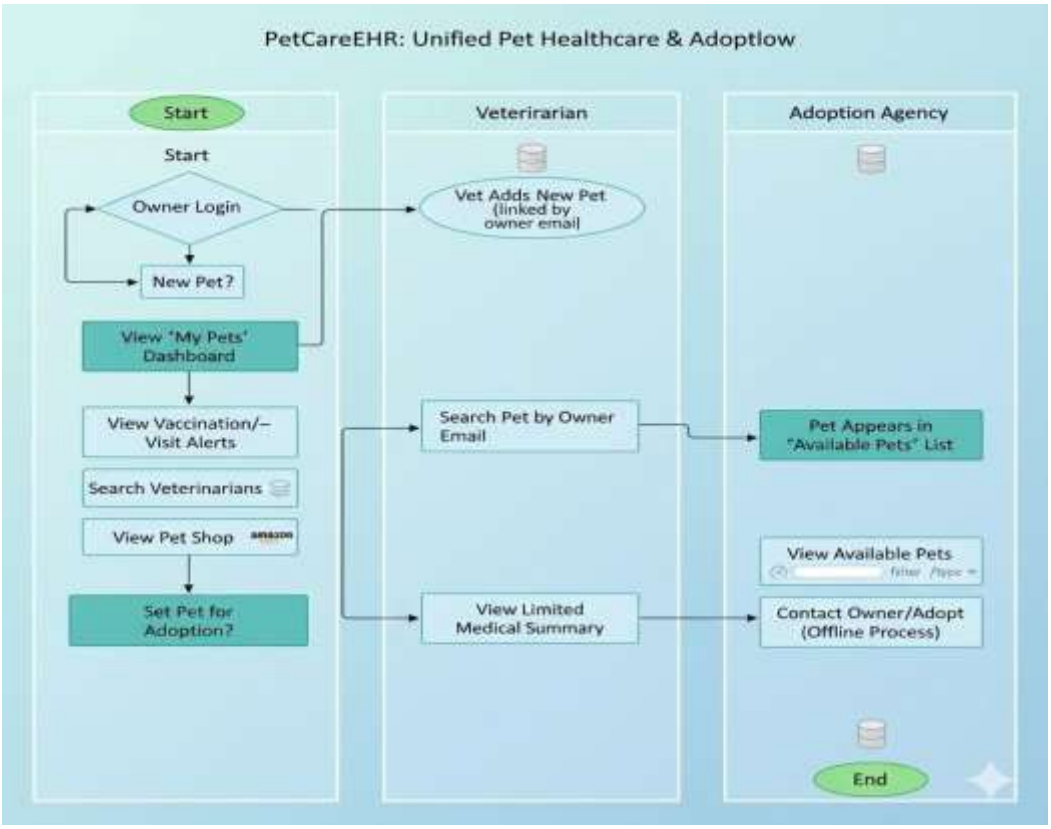


Fig. 3. System Flow Diagram for PetCareEHR

Upon successful authentication, the system redirects each user to a role-appropriate dashboard. Pet owners access a consolidated view of their registered animals, including vaccination alert classifications and adoption status controls. Adopters receive a real-time listing of adoption-enabled pets with filterable attributes and access to limited medical summaries. Veterinarians interact with a search-driven clinical workspace enabling patient lookup by owner email, full medical profile access, and write operations across medical records, vaccination schedules, and checkup alerts. All veterinarian actions are committed to the audit log prior to confirmation, ensuring atomicity between clinical record updates and their corresponding activity entries.

D. Database Design

The PetCareEHR database schema is implemented in MySQL and comprises nine principal relational tables: owners, veterinarians, adopters, pets, medical_records, vaccination_alerts, checkup_alerts, pet_products, and audit_logs. The pets table maintains a foreign key reference to the owner email field of the owners table, establishing the primary relational anchor used for cross-dashboard data retrieval. The medical_records table stores diagnosis entries, treatment notes, visit dates, and treatment types, and is indexed on both pet_id and vet_id to support efficient lookup by either patient or practitioner. The vaccination_alerts and checkup_alerts tables store information related to scheduled and completed healthcare activities, with status values marked as pending, completed, or overdue. The

audit_logs table records important details such as the type of action performed, veterinarian identity (vet_id), related record identifiers, timestamps, and activity descriptions for every update made by veterinarians. This helps maintain proper tracking and accountability for all clinical data modifications within the system.

IV. SYSTEM IMPLEMENTATION

PetCareEHR is implemented as a full-stack web application. The backend is constructed with Node.js and Express.js, providing a RESTful API layer that mediates all interactions between the frontend interface and the MySQL database. Authentication is handled through a token-based mechanism wherein a signed token encoding the user's role is issued upon successful credential verification and subsequently validated by role-guard middleware on every protected API route. Password storage employs bcrypt hashing with a configurable cost factor, ensuring that even in the event of a database breach, raw credentials remain unrecoverable. The frontend is rendered as a browser-based interface with role-specific dashboards, constructed using HTML5, CSS3, and JavaScript without an external frontend framework, supporting cross-browser compatibility across Chrome, Firefox, Edge, and Safari.

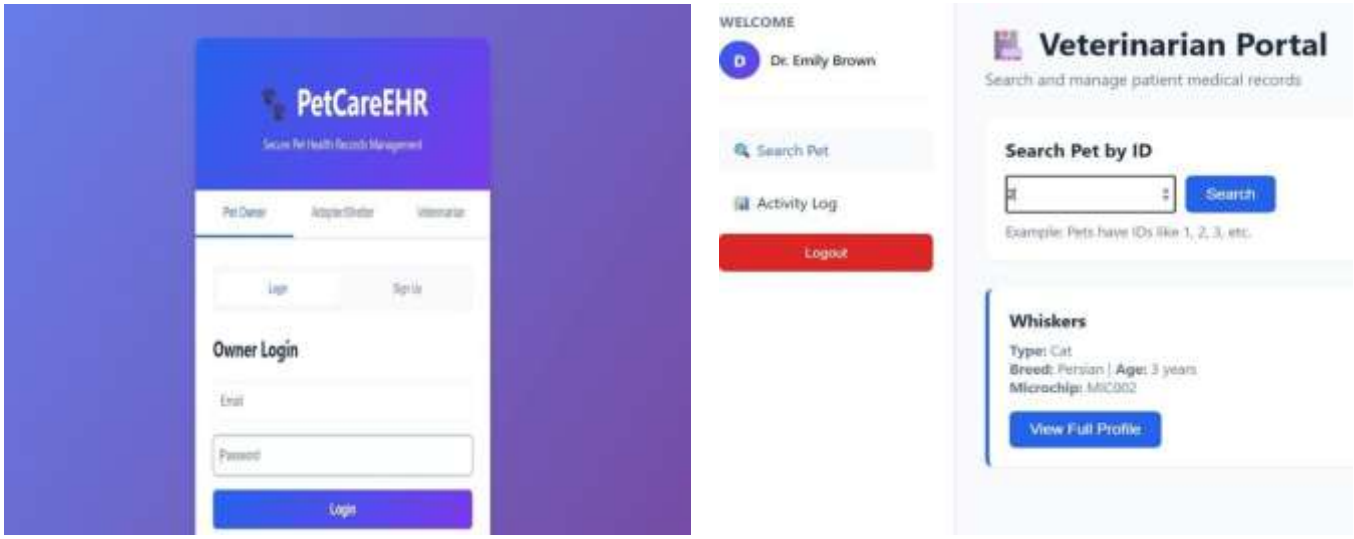


Fig. 4. Login Interface (1) and Veterinarian Portal Dashboard (2) of PetCareEHR

The PetCareEHR login interface presents three role-specific entry points—Pet Owner, Adopter/Shelter, and Veterinarian—beneath a unified application header. Role selection prior to credential submission allows the backend to direct the authentication request to the appropriate user table and issue a correctly scoped session token. The veterinarian portal dashboard, shown in the lower panel of Fig. 4, enables patient lookup by numeric pet ID and presents a compact profile card for the retrieved animal, including species, breed, age, and microchip identifier, with a 'View Full Profile' action to access complete clinical records.

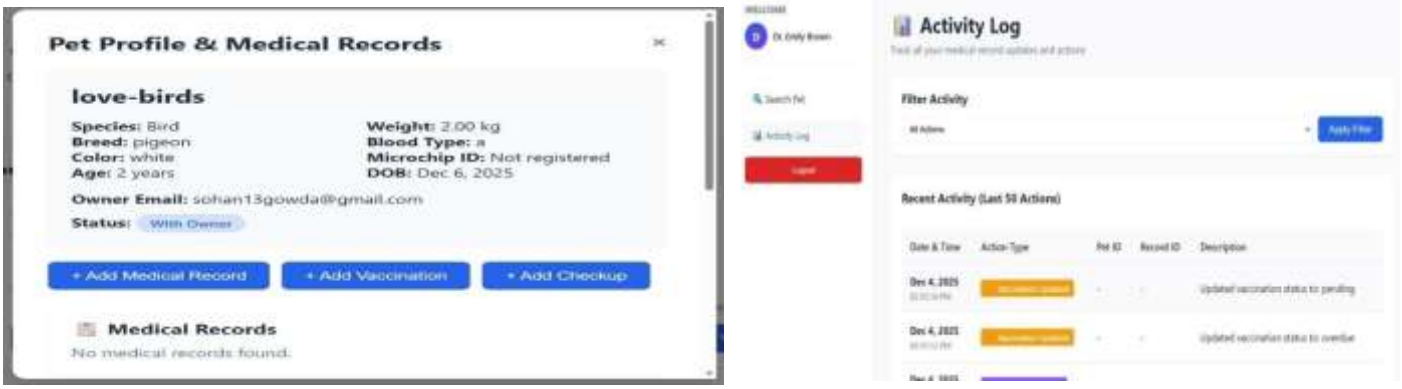
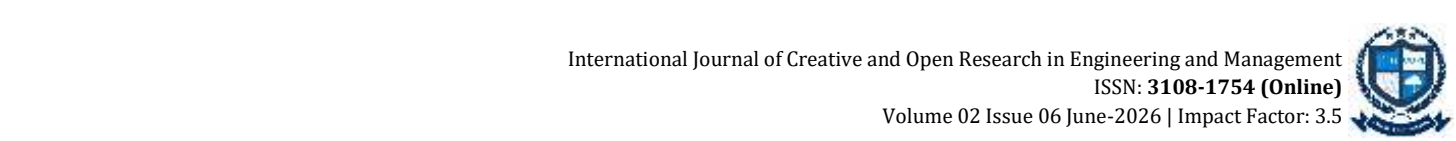


Fig. 5. Pet Profile with Medical Records Panel (1) and Veterinarian Activity Log Dashboard (2)



The pet profile view, illustrated in the upper panel of Fig. 5, consolidates all pet-level information within a modal interface that renders species, breed, weight, blood type, microchip status, date of birth, owner email, and adoption status alongside inline action buttons for adding medical records, vaccination entries, and checkup alerts. In the absence of existing clinical records, the system renders a contextual placeholder indicating that no medical records have been created, prompting veterinarians to initiate the clinical history. The veterinarian activity log, shown in the lower panel, presents a timestamped audit trail of all clinical operations classified by action type, with color-coded event badges distinguishing vaccination updates, medical record additions, and checkup modifications.

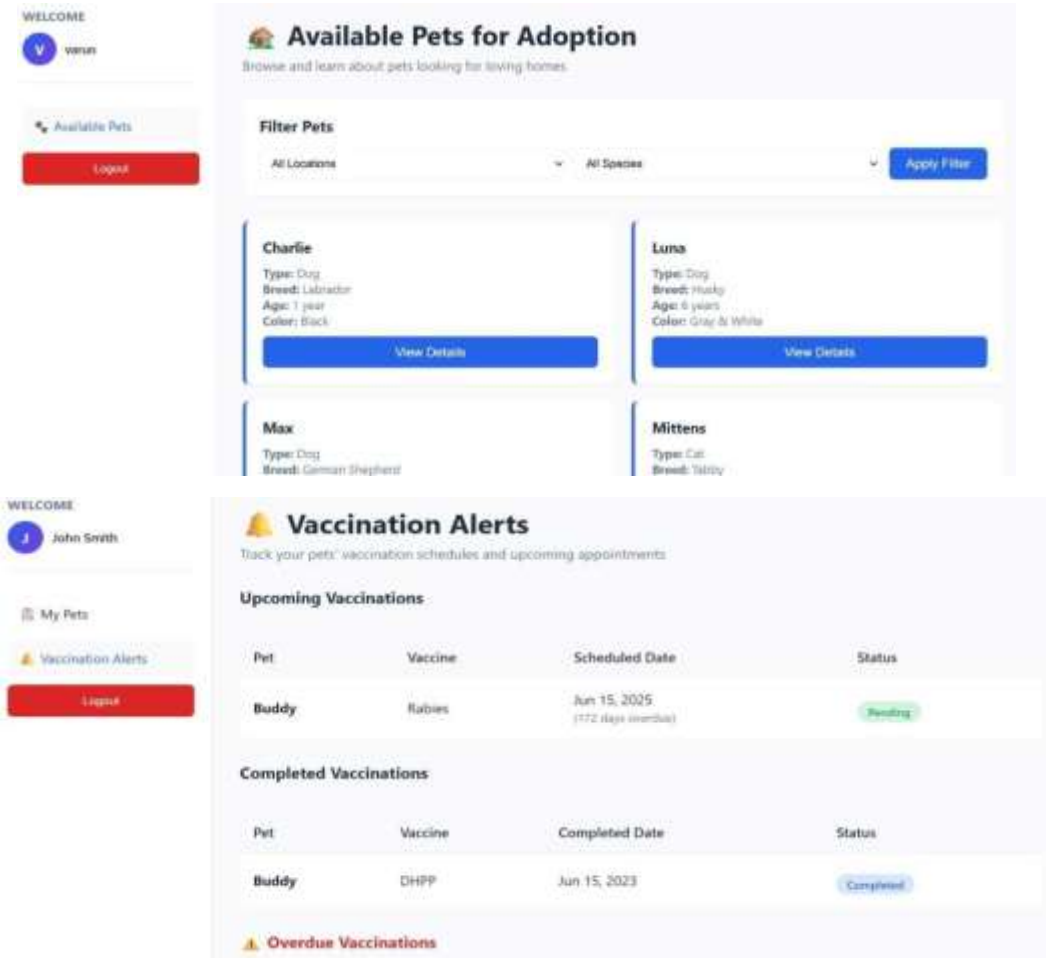


Fig. 6. Owner Vaccination Alerts Dashboard (top) and Available Pets for Adoption Listing (bottom)

The vaccination alerts dashboard, accessible to pet owners, classifies each pet's vaccination entries into three status categories—Upcoming, Completed, and Overdue—displayed in tabular format with pet name, vaccine type, scheduled or completed date, and a color-coded status badge. The adoption listing interface, rendered to authenticated adopters, presents a card-based grid of pets whose owners have activated the adoption flag. Each card discloses the pet's name, species, breed, age, and coat color, along with a 'View Details' action that surfaces the owner contact information and a limited medical summary to support pre-adoption health assessment.

Fig. 7. Pet Profile View in Read-Only Mode for Pet Owners

The owner-facing pet profile, shown in Fig. 7, renders a read-only view of the selected pet's complete clinical information. A contextual notification banner clearly communicates the access restriction, reinforcing that medical record modification is exclusively reserved for veterinarians. The Medical History section presents a columnar breakdown of recorded visits with date, diagnosis, treatment, and attending veterinarian fields. This design ensures transparency in health data while preserving the clinical integrity enforced by the RBAC layer.

V. CONCLUSION

This paper presented PetCareEHR, a secure web-based platform developed to simplify pet healthcare record management and adoption workflows within a unified digital environment. The system combines medical record management, vaccination tracking, checkup scheduling, and adoption status handling while supporting different user roles such as veterinarians, pet owners, and adopters. By implementing role-based access control with token-based authentication and bcrypt password hashing, the platform ensures that sensitive medical information is accessed only by authorized users. The audit logging feature further improves accountability by maintaining a record of important medical operations performed within the system.

System testing demonstrated reliable handling of pet medical records, smooth dashboard functionality, secure role-based access, and effective synchronization of information between users during multi-user operations. The use of Node.js, Express.js, and MySQL provided a stable backend architecture capable of supporting secure data storage and efficient record management. The project successfully addresses the problem of fragmented pet healthcare information by offering a centralized and user-friendly solution for veterinary clinics, shelters, and pet owners.

Future enhancements may include multi-factor authentication for stronger account security, mobile application support for Android and iOS devices, automated SMS and email reminders for vaccinations and appointments, and improved communication features between adopters and pet owners. Additional integrations such as tele-veterinary consultation services and advanced reporting modules can further improve the practical usefulness of the system in modern pet healthcare management.

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