Application of Forward Chaining Method Expert System in Diagnosing Rabies in Pets

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ABSTRACT

Rabies is an animal-borne disease posing a significant risk to pet owners. Due to pet owners' inadequate understanding of disease types and treatment options, coupled with the financial burden of frequent veterinary visits, the developed expert system aims to assist pet owners in diagnosing diseases afflicting Persian cats, specifically Rabies, Renal Failure, Panleukopenia, Feline Infectious Peritonitis, and Feline Calici Virus. This study seeks to evaluate the application of an expert system forward chaining approach to diagnose rabies in pets. The research approach used was a literature review that utilized books and previous research publications as data sources. The results of the study show that using the forward chaining method in an expert system for pet disease diagnosis is highly effective for identifying rabies and significantly improves the understanding and treatment of pet diseases through an information technology framework.

Keywords: expert system, forward chaining, rabies, pets

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INTRODUCTION

Rabies, often known as mad dog disease, is an acute infectious disorder of the central nervous system caused by the rabies virus. Rabies is an acute viral disease caused by Lyssavirus that attacks the central nervous system and is fatal; it can infect all warm-blooded animals and humans. The disease is zoonotic, which means it can spread from animals to humans through the bite of a rabies-infected animal (Republik *et al.,* 2019).Each year, about 55,000 people die from rabies, mainly in Asia and Africa. Forty percent of people bitten by animals that transmit rabies are children under the age of fifteen (Subdit Zoonosis, 2023).

Many people underestimate rabies because the initial symptoms are similar to common illnesses. However, if not treated promptly, the condition will worsen; so, it is imperative to increase knowledge about rabies and be vigilant to the signs that appear. Therefore, there is a need for technology or systems to analyze rabies based on the symptoms exhibited by an individual, with the aim of facilitating public assessment of rabies for rapid intervention and better treatment outcomes. Technology is often used as an auxiliary tool in various human endeavors. The current role of technology facilitates information processing, as such processing is essential to make the resulting information useful to its users (Fitri Amelia Sari Lubis, 2023)**.**

In 2021, Rakuten Insight Center, a survey firm based in the United States, reported that the most owned pet in Indonesia is a cat, with a prevalence of 47% (Center, 2021). This finding is in line with a survey conducted by Licorice, which showed a figure of 41.8%. With these statistics, it makes sense that these animals could carry diseases that endanger their owners, such as rabies. The Ministry of Health noted that in

2021, only eight provinces in Indonesia are rabies-free, and cats are among the animals capable of transmitting this disease (Kokom, 2021).One of the animals included in the pet group is the cat. Cats are very popular animals in the community, considered as family pets and are very loved (Mahreza, 2022). Similar to humans, cats are also susceptible to diseases that can affect their health and quality of life. Cats can develop diseases caused by viruses, germs and parasites. Diagnosing disease in cats is an important aspect of their care; however, sometimes the process can be quite challenging (Candra, 2022).

Diseases often experienced by pets include health problems such as rabies, which is a disease caused by a virus that attacks the brain and spinal cord of all animals, whether cats, dogs, or humans. Rabies is caused by a single-stranded RNA virus belonging to the genus Lyssavirus which belongs to the Rhabdoviridae family. Renal failure, Panleukopenia in cats caused by parvovirus, Peritonitis caused by Feline Coronavirus and Feline Calicivirus caused by viruses of the Caliciviridae family. To overcome this problem, an expert system was developed to diagnose diseases in Persian cats through a web-based forward chaining approach.

Inaccurate diagnosis and late treatment can have devastating effects on pets, including dogs, cats and other animals. Veterinarians often express regret when pets brought to the clinic are in very poor condition or die. This is due to the considerable distance from the residence to the clinic. As a result, there is a need for web-based technology that can be accessed on a desktop or mobile device, allowing veterinarians and pet owners to diagnose diseases and offer treatment solutions anytime and anywhere. This research develops a system capable of diagnosing diseases in pets based on observed symptoms. Utilizing data about diseases, symptoms, and solutions. Utilizing the forward chaining approach to diagnose cat diseases based on established knowledge base rules.

Expert systems are a subset of artificial intelligence designed to integrate human knowledge into computers, combining knowledge bases with inference mechanisms to replicate the role of an expert in problem solving (Arfida, 2022). Expert systems are pragmatic applications that use heuristic solutions developed by humans to solve certain problems, because of their knowledge-based nature and quality (Ginting, 2023). This web-based disease diagnosis system uses the forward chaining method, which is usually used in decision support systems and expert systems. This algorithm operates effectively when the process begins with the aggregation or synthesis of information, followed by drawing conclusions from the data. This system has the ability to draw conclusions from minimal data (Yuliyana, 2019).

Previous research referenced in this study, specifically "Expert System for Diagnosing Cat Diseases Using *Web-Based Certainty Factor Method*," utilized blackbox testing and usability assessment, which achieved an application usability rate of 93.2% (Wardana, 2023). The next topic was "Android Application for Detecting Cat Diseases Using Forward Chaining Method", which reported that the implementation and testing of 14 specific symptoms identified 3 diseases: worms, rabies, and otitis (Yulianto, 2023). The next research is entitled "Expert System for Diagnosing Cat Diseases Using the *Web-Based Dempster Shafer* Method", which achieved 88.88% accuracy (Cisillia,

2021). The next research is entitled "Expert System for Diagnosing Web-Based ENT Diseases Using the Forward Chaining Method at Tomang Clinic", which utilizes 49 symptoms and 21 diseases (Rifa, 2023). This study, entitled "Expert System for Android Application to Diagnose Cat Skin Diseases Using the Forward Chaining *Method*", aims to develop an expert system to overcome the lack of information regarding sensitive cat skin care and offer solutions to reduce mortality in cats (Rifa, 2023).

METHODS

This research uses a qualitative methodology by utilizing library research techniques. According to Adlini (2022) library research or literature study is carried out methodically to collect, analyze, and synthesize data by utilizing certain methodologies and strategies to overcome the problems faced in library research. Desk research refers to the systematic collection of data or scientific articles related to specific research objectives, which involves a critical and comprehensive examination of relevant library materials. The rationale for using desk research lies in the need for researchers to obtain data from a variety of literature sources, including books and journals of previous research, as a foundational element of their investigation. This approach entails conducting literature searches at the world and national levels by utilizing the Google Scholar search engine. This research utilized the keywords "expert system, forward chaining" for papers produced between 2019-2024.

RESULT AND DISCUSSION

Forward chaining is a mechanism used by expert systems to derive answers by navigating challenges. It evaluates facts that then lead to conclusions derived from those facts. Forward chaining, sometimes referred to as bottom-up reasoning, involves deriving higher-level conclusions based on basic data and facts at lower levels. The forward chaining algorithm is one of the two main reasoning procedures, used by decision-making engines (inference engines), and can also be described as the iterative application of inference rules. The forward chaining approach facilitates early disease diagnosis by monitoring the signs or symptoms shown, making it very effective for this purpose. The implementation of this expert system is expected to serve as an alternative for detecting animal diseases. Implementation is defined as actions taken by private and government entities that are specifically directed at achieving a set of objectives that are sustainable in established policy decisions (Erni, 2023).

A system is a network of interrelated processes organized to perform a task or achieve a specific goal. Many clinical decision support systems, including expert systems, can be used to improve medical diagnosis. Expert systems have structures, components, and functions that increase the total decision-making capacity for disease diagnosis (Cucu, 2018). Expert systems consist of two main components: the development environment and the consultation environment (Christoffel, 2017). Expert systems consist of three distinct components: the knowledge base, the observation base, and the inference base. Expert systems are often called knowledge-based systems. These systems operate using predefined knowledge and analytical procedures by specialists in their respective domains. The observation base serves as the foundation for combining all the information needed to derive

conclusions in the expert system. The inference base is the algorithm or inference engine used in the expert system (Noviardi, 2020).

Expert systems are part of Artificial Intelligence (AI) that use specialized knowledge to solve problems at the level of human expertise (Maulida, 2023). Based on Maulida's research (2023) entitled "Expert System for Diagnosing Rabies in Dogs", the developed expert system helps people in diagnosing rabies in pet dogs. The current expert system can provide guidance in treating rabies in dogs bitten by rabid dogs. Kelung's (2017) research titled "Expert System to Recognize and Treat Diseases in Dogs in Manado" uses the forward chaining inference method to analyze inputted disease data based on symptoms and characteristics that can be observed in dogs, which ultimately determines the disease suffered by the animal. The expert system increases time efficiency in acquiring knowledge about dog diseases, their treatment, and reduces costs associated with consulting veterinarians and veterinary clinics.

Sukiman's research (2020) in a thesis entitled "Web-Based Expert System for Diagnosing Dog Diseases" shows that researchers point out that many challenges continue to exist in the advancement of artificial intelligence, especially in expert systems, which significantly complicate implementation. This is due to the limitations of the system, both hardware and software, in carrying out large-scale data processing, although the main advantage of an expert system is its extensive knowledge base and rule base covering a wide variety of data. Therefore, the researcher conducted this study with the aim of helping dog owners and other layers of society in recognizing dog disorders. An expert system is an instrument designed to increase a person's limited knowledge by utilizing expert information encoded in a computer (Kiswanto *et al.*, 2022).

Many cat-focused studies use forward chaining methodology, as exemplified by Ravenelli's work in diagnosing dermatological conditions (Ravanelli *et al.*, 2023), similar to the research conducted by Pangestu and Nurajizah (Pangestu, Aditya Sugih Tanamal, 2020). Butsianto's study used Angora cats (Butsianto & Riyanti, 2019), while Zen included four disease categories in his study (Zen *et al.*, 2021). Ridwansyah identified 8 disease types (Ridwansyah *et al.*, 2020), Alfathanori identified 10 disease types in his study (Alfathanori & Maslihah, 2022), and Kiswanto used a different methodology, specifically backward chaining (Kiswanto *et al.*, 2022). This study improves on previous research by incorporating Rabies, Renal Failure, Feline Infectious Peritonitis and Feline Calicivirus, which were previously excluded.

CONCLUSION

The conclusion drawn from this journal article is that the forward chaining method can be applied to diagnose diseases in pets. Its implementation through an online platform facilitates quick and precise diagnosis for pet owners and veterinarians, while offering customized treatment solutions for each disease. By developing an expert system application for diagnosing diseases in Persian cats utilizing this web-based forward chaining approach, consultations with veterinarians can be expedited, and customer data can be organized more efficiently, thus minimizing the risk of loss.

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Author Contribution

All authors participated to all aspects of this work, including preparation, data collecting and analysis, manuscript drafting, and publication approval.

Competing Interest

None.

Ethical Approval

Not applicable.

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