Research Article
Volume 14:1, 2023

Journal of Veterinary Science & Technology

ISSN: 2157-7579 **Open Access**

Developing Self-Learning Knowledge Based System for Predominant Chicken Diseases Diagnosis, Prevention and Management

Diriba Girma[1]*, Worku Jimma[2] and Chala Diriba[2]

[1]Department of Information Science, Wollega University, Nekemt, Oromia, Ethiopia,
[2]Department of Information Science, Jimma University, Jimma, Oromia, Ethiopia

Abstract

Poultry diseases remain one of the major threats to poultry production worldwide. Chicken disease need to be observed intensively because of its impact on the health and quality of chicken production. Chicken disease becomes one of the problems that are very detrimental to chicken farmers. In attempt to solve this problem, knowledge based system is identified as a powerful tool with extensive potential in alleviating agricultural and medical problems. This study aims at developing knowledge base system for diagnosing, prevention and management of predominant chicken diseases. Design science research method was used to develop the prototype system. The domain experts were selected by purposive sampling technique from Jimma University College of Agriculture and Veterinary Medicine and from Kito Furdisa Poultry Farm of Jimma University for knowledge acquisition. The knowledge was acquired using both structured and unstructured interviews. The acquired knowledge was modeled and represented using decision tree and production rules (If-Then-Action). Backward chaining algorithm was used in this study. At the end performance of the system was evaluated and produced a result of 83%. In addition, user acceptance of the developed system was found to produce 83.4%. Thus, the average performance of the prototype system was 83.2%. The prototype system achieves a very good performance and meets the objectives of the study. And thus it is strongly recommended that the stake holders take part in deploying the developed system.

Keywords: Kowledge based system • Self-learning • Chicken disease • Rule based system • Poultry farm • Prevention & management

Introduction

One of the important reasons for failure in the poultry industry is disease. Various types of poultry diseases can cause serious loss in the poultry farming business. Diseases occur due to lack of proper care and management. The diseases of chickens need to be observed intensively because of its impact on the health and quality of chickens as poor monitoring system will reduce the productivity and increase its mortality rate.

Poultry diseases have highly destructive effects around the world and these diseases have affected both human and chickens. In Ethiopia, the poultry sector has been adversely affected by a variety of constraints; of these poultry diseases continues to play the major role hampering its development. Poultry mortalities due to diseases are estimated to range from 20 to 50%, but it may rise as high as 80% during epidemics. In Ethiopia and different developing countries constant presence of disease can lead not only to illness and death but also reduce productivity of chickens.

Controlling and prevention of chicken diseases from the beginning is necessary because once they got sick, the success in healing them is quite low. Most chicken diseases are caused by virus, especially the epidemic ones and so far it is not possible to treat most viral diseases. The ability to treat the chickens as early as possible is important in today's commercial production systems because the chickens grow very fast. Therefore, prevention isthe major mechanisms for controlling the chicken diseases [1-5].

The immediate sick chicken treatment methodsare isolation (culling), vaccination, biosecurity and treating them until recovery is very important. In the management of poultry, probably one of the most difficult phases is the management of the chickens. Diseases can be transmitted *via* humans, other birds, newly introduced chickens, or contaminated equipment.

Chicken disease becomes one of the problems that are very detrimental to chicken farmers. This was assessed because of the lack of knowledge of farmers in handling conditions that occur in chicken. Accurate information about handling chicken disease among farmers is still difficult to obtain. Some of the things that make chickens affected by the disease include negligence in giving vaccines, lack of nutritional intake, and also the lack of maintaining the cleanliness of the chicken coopand the rapid spread of the virus. Farmers sometimes do know that their chickens are affected by a disease, but cannot know what type of disease is attacking the chicken. One of the last options for farmers, if they cannot cure the chicken, is contacting veterinary medicine professionals. However, the scarcities of number of professionals become an obstacle for farmers and it can be minimized by using knowledge-based systems.

Knowledge Base System (KBS) is a branch of Artificial Intelligence (AI) that helps to represent expert's knowledge in artificial way. It is a computer program that replicates the problem solving abilities of human beings and developed to overcome difficulties in solving complex problems.

KBSs use reasoning techniques like Fuzzy logic, Case based reasoning and Rule based reasoning to provide significant performance in the area of diagnosis. A rule-based system is handling problems from a well-defined knowledge base that contains facts and rules. It is evident that rule based technique of AI is appropriate methodology for all medical domains and tasks.

The proposed KBS assists the experts easily and timely diagnose, prevent and manage chicken diseases. Therefore, this study was initiated with the main aimto develop knowledge based system for predominant chicken diseases diagnosis, prevention and management [6-10].

***Address for Correspondence:** Diriba Girma, Department of Information Science, Wollega University, Nekemt, Oromia, Ethiopia, E-mail: diribagirma2@gmail.com*

Received: 16 January 2023, Manuscript No. jvst-23-87200; **Editor Assigned**: 18 January 2023, PreQC No. P-87200; **Reviewed:** 01 February 2023, QC No. Q-87200; **Revised:** 07 February 2023, Manuscript No. R-87200; **Published:** 15 February 2023, DOI:10.37421/2157-7579.2023.14.162

To the end, this study attempt to answer the following research questions.

Which knowledge is required to develop knowledge based system for diagnosing, prevention and management of predominant chicken diseases?

How to diagnose, prevent and manage chicken diseases using knowledge based system?

How to design a self-learning knowledge-based system that automatically updates its knowledge?

To what extent is the proposed system acceptable by professionals?

Objectives of the Study

General objectives

The general objective of this study was to develop a self-learning knowledge based system for predominant chicken disease diagnosis, prevention and management.

Specific objectives

To extract knowledge from experts and poultry disease manuals, journal articles and books on how to provide diagnosis, prevention and management for predominant chicken diseases.

To model and represent the acquired knowledge using knowledge representation technique.

To develop knowledge based system that can learn by memorization (self-learning) and assist experts during chicken disease diagnosis, prevention and management.

To test and evaluate the performance of the prototype system with the help of professional experts in the field [11-15].

Research Methodology

Research design

Design science research typically involves the creation of an artifact and/or design theory as a means to improve the current state of practice as well as existing research knowledge. Design science refers to an explicitly organized, rational and wholly systematic approach to design; not just the utilization of scientific knowledge of artifacts, but design being in some sense a scientific activity itself. Thus for this study design science research design was employed.

Study area

The study sites for this study wereCollege of Agriculture and Veterinary Medicine (JUCAVM) and Kito Furdisa Poultry Farm (KFPF). These two areas were selected due to the fact that large numbers of highly qualified experts are available. In addition, the prevalence of predominant chicken disease ishigh in the study area.

Sampling techniques and sample size

Purposive sampling techniques was used for this study because it is one of the most common sampling techniques in qualitative research in which participants group are decided to pre-selected criteria relevant to a particular research question.

This technique assists the researchers to select domain experts based on their educational qualifications related to the domain area, year of experience and willingness [16-25].

Knowledge acquisition

In this study explicit and tacit knowledge was acquired from both codified (documented) sources as well as non-codified (non-documented) sources. Non-codified sources of knowledge were acquired from Veterinary doctors who work in the JUCAVM and KFPF by using interview and critique knowledge elicitation methods to filter the acquired knowledge. Similarly, codified sources of knowledge such as poultry disease manuals, journal articles and books were acquired by using document analysis technique.

Knowledge modeling and representation methods

In this study, after the knowledge was extracted from codified and non-codified sources, it was modeled using decision tree. Decision trees models by constructing a tree based on training instances with leaves having class labels was used and easy to interpret. For this research, production rule knowledge representation was used because it clearly demonstrates the domain knowledge. Production rule method is more appropriate to represent and demonstrate the real domain knowledge. It is easy for a human expert to read, understand and maintain. Production rules contain simple syntax that is flexible and easy to understand and are reasonably efficient in diagnosing problems of the form: IF (condition), THEN (conclusion).

Implementation tools

SWI prolog (PROgramming in LOGic) programming language was used as a tool to develop KBS. It is the most popular logic programming language within the realm of KBS.

Testing and evaluation of the system

Once the prototype was developed, the performanceand user acceptance of the system should be tested. For this purpose, the performance comparison parameters such as precision, recall and F-measure were used to measure the accuracy of the prototype system. Issues of user's acceptance testing were also done using visual interaction method to see the quality of advice and to access to what extent the KBS satisfies the domain experts.

Implementation and experimentation

The implementation includethe real construction of the prototype system for diagnosis, prevention and management of predominant chicken diseases. The knowledge has been extracted from its sources i.e., tacit knowledge from experts and explicit knowledge through document analysis. After the necessary knowledge is represented using a rule-based knowledge representation technique, the next step is coding the represented knowledge using prolog programming language into a suitable format that is understandable by the inference engine. For this study, SWI-Prolog editor tool is used to construct the prototype system. Besides, architecture design was done in this study, which incorporates the knowledge base (facts and rules), explanation facility, inference mechanism and the user interface [26-35].

Architecture of the prototype system

Architecture is a blueprint showing how the components of the prototype self-learning KBS interacts and interrelates. Figure 1 illustrates the architecture of the prototype system (Figure 1 and Tables 1-3).

Discussion

There are some challenges encountered during the study which limits the prototype system to register a better performance for diagnosis, prevention and management of predominant chicken disease. These are discussed as follows: Even though tacit knowledge about the diagnosis and treatments of chicken disease is extracted from the domain experts using interviewing method in order to have detail understanding of the domain knowledge, it is challenging to extract the necessary knowledge due to the personal nature of tacit knowledge [36-40].

Training was given to the domain experts on how the system functions and on how to use and interact with the system. However, from six evaluators, two of them are not satisfied by the user interface of the prototype system. The two evaluators responded that, they want to insert their queries to the user interface in their local language and also want the decisions provided

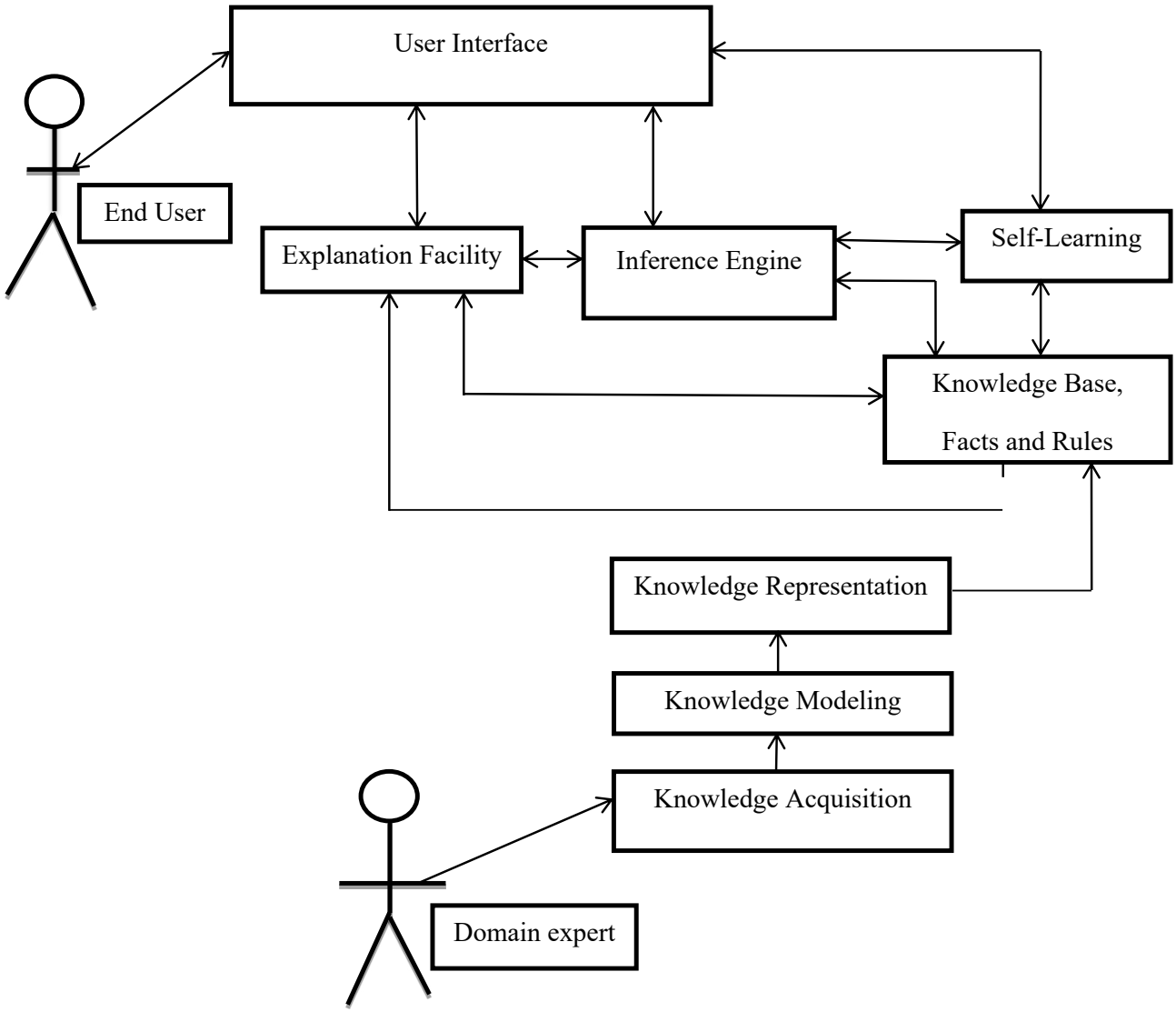

Figure 1. Architecture of the prototype self-learning knowledge-based system.

Table 1. Confusion matrix of the prototype system.

KBS Suggestion			
	Actual correctly diagnosis cases	**Actual incorrectdiagnosis cases**	
Predicted correct by the prototype system	6	1	Experts Suggestion
Predicted incorrect by the prototype system	1	4	
Total	7	5	

Table 2. Accuracy of the prototype system.

	TP Rate	**FP Rate**	**Precision**	**Recall**	**F-Measure**
Results	0.83	0.167	0.83	0.83	0.83

Table 3. Performance evaluation by domain experts.

Evaluation parameters	**Performance Value**						
	1	2	3	4	5	**Average**	**Percent**
Accuracy of the prototype system in diagnosis , prevention and management of chicken disease	0	0	2	1	3	4.17	83.4%
Attractiveness of the prototype system	0	0	2	2	2	4	80%
Relevance of the prototype system	0	1	2	0	3	3.83	76.6%
Resource adequacy of the prototype system	0	0	2	1	3	4.17	83.4%
Does the prototype system have significance contribution for the domain area?	0	0	0	1	5	4.83	96.6%
Efficiency of the prototype system in time	0	0	0	4	2	4.33	86.6%
Is the system accurate in analyzing facts and decision making?	0	0	1	2	3	4.33	86.6%
The ability of the prototype system in making right conclusions and recommendations	0	1	0	2	3	4.17	83.4%
Simplicity to use and interact with the prototype system	0	0	3	2	1	3.67	73.4%
Average						4.17	83.4%

by the system in their local language so as to understand the decisions made by the system. Due to this reason, two evaluators replied as good rating value for the simplicity to use and interact with the prototype system criteria of evaluation [41-45].

During coding the represented knowledge about chicken disease using the SWI-Prolog editor tool, the facts base of the prototype system is able to update its knowledge automatically. However, the researcher encountered a challenge to update the rules of the knowledge base of the prototype system automatically (Figures 2-4).

The developed system has the capability to update new facts and/or rules if necessary. In other words the proposed knowledge based system makes the right decision and appropriately advice during predominant chicken disease diagnosis, prevention and management. When comparing the performance of knowledge based system for predominant chicken

```
1 ?- start.
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

                         JIMMA UNIVERSITY INSTITUTE OF TECHNOLOGY

                         DEPARTMENT OF INFORMATION SCIENCE

                 WELL COME TO PREDOMINANT CHICKEN DISEASE DIAGNOSIS,

                      PREVENTION  AND MANAGEMENT KNOWLEDGE BASE SYSTEM

                              THANK YOU FOR CHOOSING US

                              DEVELOPED BY DIRIBA GIRMA

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%&&&&&

Copyright (C) 2019
No rights reserved, use it as you wish!

To get general information please enter your name ?
|: john.

Hello,john! The following general information is about chicken disease.

chicken disease is a disease that affect chickens and  disturb daily movement/activity
of chicken by injuring either internal or external part of their body.

Are you familiar with chicken disease?(yes/no/what): what.


There are many types of chicken disease and it helps u?(yes/no/why): why.


Because understanding chicken disease and their types is the most important for knowing
the cause of disease and how to prevent and manage it.
```

Figure 2. User Interface of the system.

```
To get general information please enter your name ?
|: john.

Hello,john! The following general information is about chicken disease.

chicken disease is a disease that affect chickens and  disturb daily movement/activity
of chicken by injuring either internal or external part of their body.

Are you familiar with chicken disease?(yes/no/what): yes.


Chicken Disease Diagnosis,Prevention and Management System....

To use it, just answer the questions the systems asks you.


Does the infected chicken has torticollis?(y/n)y.

Does the infected chicken has severe_tracheitis?(y/n)y.

Does the infected chicken has pulmonary_congestion?(y/n)y.

Does the infected chicken has mild_conjunctivitis?(y/n)y.

Does the infected chicken has rales?(y/n)y.

Does the infected chicken has nervous_sign?(y/n)y.

Does the infected chicken has sneezing?(y/n)y.

Does the infected chicken has swollen_eye?(y/n)y.

Does the infected chicken has fever?(y/n)y.

The infected chicken disease could be newcastle_disease
```

Figure 3. Sample dialogue that uses symptoms to identify the disease.

```
Hello,sara! The following general information is about chicken disease.

chicken disease is a disease that affect chickens and  disturb daily movement/activity
of chicken by injuring either internal or external part of their body.

Are you familiar with chicken disease?(yes/no/what): yes.


Chicken Disease Diagnosis,Prevention and Management System....

To use it, just answer the questions the systems asks you.


Does the infected chicken has torticollis?(y/n)n.

Does the infected chicken has bluish_combs?(y/n)n.

Does the infected chicken has ocular_discharge?(y/n)y.

Does the infected chicken has chronic_sinusitis?(y/n)y.

Does the infected chicken has nose_smelling_discharges?(y/n)y.

Does the infected chicken has conjunctivitis?(y/n)y.

Does the infected chicken has wheezing?(y/n)y.

Does the infected chicken has mucoid_discharge?(y/n)y.

Does the infected chicken has eye_inflammation?(y/n)y.

Does the infected chicken has swollen_wattle?(y/n)y.

Does the infected chicken has reduced_feed?(y/n)y.

The infected chicken disease could be coryza
```

Figure 4. Sample dialogue that uses symptoms to identify the disease.

```
To get general information please enter your name ?
|: john.

Hello,john! The following general information is about chicken disease.

chicken disease is a disease that affect chickens and  disturb daily movement/activity
of chicken by injuring either internal or external part of their body.

Are you familiar with chicken disease?(yes/no/what): yes.


Chicken Disease Diagnosis,Prevention and Management System....

To use it, just answer the questions the systems asks you.


Does the infected chicken has torticollis?(y/n)y.

Does the infected chicken has severe_tracheitis?(y/n)y.

Does the infected chicken has pulmonary_congestion?(y/n)y.

Does the infected chicken has mild_conjunctivitis?(y/n)y.

Does the infected chicken has rales?(y/n)y.

Does the infected chicken has nervous_sign?(y/n)y.

Does the infected chicken has sneezing?(y/n)y.

Does the infected chicken has swollen_eye?(y/n)y.

Does the infected chicken has fever?(y/n)y.

The infected chicken disease could be newcastle_disease

    ========== EXPLANATION ==========

Newcastle disease (NCD) is a contagious viral disease of poultry caused by a Paramyxovirus.

    ====== PREVENTION AND MANAGEMENT =========

a.Good sanitation and implementation of a comprehensive biosecurity program are necessary to prevent Newcastle disease.

b.Well-designed vaccination schedules, using low-virulence live vaccines, give very effective immunization results

c.Do not use sawdust, litter high in bark content, or shavings that have been wet

d.Isolate the infected chicken from others

e.Pest control in flocks

f.Control of access to poultry farms
```

Figure 5. Sample dialogue that provides diagnosis, prevention and management for Newcastle disease.

```
Hello,sara! The following general information is about chicken disease.

chicken disease is a disease that affect chickens and  disturb daily movement/activity
of chicken by injuring either internal or external part of their body.

Are you familiar with chicken disease?(yes/no/what): yes.


Chicken Disease Diagnosis,Prevention and Management System....

To use it, just answer the questions the systems asks you.


Does the infected chicken has torticollis?(y/n)n.

Does the infected chicken has bluish_combs?(y/n)n.

Does the infected chicken has ocular_discharge?(y/n)y.

Does the infected chicken has chronic_sinusitis?(y/n)y.

Does the infected chicken has nose_smelling_discharges?(y/n)y.

Does the infected chicken has conjunctivitis?(y/n)y.

Does the infected chicken has wheezing?(y/n)y.

Does the infected chicken has mucoid_discharge?(y/n)y.

Does the infected chicken has eye_inflammation?(y/n)y.

Does the infected chicken has swollen_wattle?(y/n)y.

Does the infected chicken has reduced_feed?(y/n)y.

The infected chicken disease could be coryza

    ========== EXPLANATION ==========

coryza is an acute respiratory disease of chickens caused by the bacterium Haemophilus   paragallinarum [gallinarum].
Chronically ill or healthy carrier chickens are the reservoir of infection.
Transmission is by direct contact, airborne droplets, and by contamination of drinking water.

    ========== PREVENTION AND MANAGEMENT ==========

1.Good management and sanitation are the best ways to avoid infectious coryza.

2.Use Antibiotics and sulfa drugs

3.Appropriate biosecurity measures will limit the possibility of introducing infection
  on to breeding and commercial egg production farms

4.Cull the infected chicken
```

Figure 6. Sample dialogue that provides diagnosis, prevention and management.

```
Type names entirely in lower case, followed by period.

This is a program that add new chicken symptom to knowledge base and learn from experience

Type "stop." to quit.
% chicken.pl compiled 0.00 sec, 19 clauses

Please enter new chicken Symptom? gurgling.
I do not know the diseases of this symptom.

Please tell me the disease name for this symptom.

Disease? newcastle_disease.
Thank you.
```

Figure 7. Sample dialogue that learns from experience.

```
Type names entirely in lower case, followed by period.

This is a program that add new chicken symptom to knowledge base and learn from experience

Type "stop." to quit.
% chicken.pl compiled 0.02 sec, 20 clauses

Please enter new chicken Symptom? gurgling.
The chicken has newcastle_disease disease.

Please enter new chicken Symptom? stop.
Saving the knowledge base...
Done.
```

Figure 8. Sample dialogue that save the knowledge and learn from experience.

disease diagnosis, prevention and management result 83.2%. (which is the average of user acceptance and system performance result) with other knowledge based system result (expert system to diagnose chicken diseases with certainty factor based on android where the evaluation testing result of the diagnosis of the disease there are several groups of research results show 3 groups with a good preference for the application of expert systems with a range of values of 63% to 82%, said good and very good categories and an information technology enabled poultry expert system: perceptions of veterinarians and veterinary students, the evaluation result was not specified. Hence, from these two knowledge based systems, the performance of knowledge based system for predominant chicken disease diagnosis, prevention and management we developed is better than the previous knowledge based system (Figures 5 and 6).

Based on the review of literature, it is clear that each of the existing system have one weakness or the other. This research work is expected to come up with a better system that save the knowledge base and update the knowledge. The new system uses prolog programming language and it learns from experience by memorization (self-learning). Again, Most of the existing systems were not evaluated. In the very few ones that were evaluated, experts in the field were not directly involved. The new system comes up with better evaluation method that involves expert from the field. This help to really determine the actual performance of the system by the users. As stated in the review of related works previous research works were done on poultry but they do not done specifically on chickens and it does not learn from experience to update its knowledge (Figures 7-9).

The current work dealt specifically on chickens and prevention issues

```
Does the infected chicken has(gurgling)(y/n)y.

Does the infected chicken has torticollis?(y/n)y.
Does the infected chicken has severe_tracheitis?(y/n)y.
Does the infected chicken has pulmonary_congestion?(y/n)y.
Does the infected chicken has mild_conjunctivitis?(y/n)y.
Does the infected chicken has rales?(y/n)y.
Does the infected chicken has nervous_sign?(y/n)y.
Does the infected chicken has sneezing?(y/n)y.
Does the infected chicken has swollen_eye?(y/n)y.
Does the infected chicken has fever?(y/n)y.
The infected chicken disease could be newcastle_disease
    ========== EXPLANATION ==========
Newcastle disease (NCD) is a contagious viral disease of poultry caused by a Paramyxovirus.
    ====== PREVENTION AND MANAGEMENT =========
a.Good sanitation and implementation of a comprehensive biosecurity program are necessary to prevent Newcastle disease.
b.Well-designed vaccination schedules, using low-virulence live vaccines, give very effective immunization results
c.Do not use sawdust, litter high in bark content, or shavings that have been wet
d.Isolate the infected chicken from others
e.Pest control in flocks
f.Control of access to poultry farms
```

Figure 9. Sample dialogue that provides description, prevention and management after new symptom is added.

```
1 ?- start.
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
                         JIMMA UNIVERSITY INSTITUTE OF TECHNOLOGY
                         DEPARTMENT OF INFORMATION SCIENCE
                 WELL COME TO PREDOMINANT CHICKEN DISEASE DIAGNOSIS,
                      PREVENTION  AND MANAGEMENT KNOWLEDGE BASE SYSTEM
                              THANK YOU FOR CHOOSING US
                              DEVELOPED BY DIRIBA GIRMA
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%&&&&&
Copyright (C) 2019
No rights reserved, use it as you wish!

To get general information please enter your name ?
|: john.

Hello,john! The following general information is about chicken disease.

chicken disease is a disease that affect chickens and  disturb daily movement/activity
of chicken by injuring either internal or external part of their body.

Are you familiar with chicken disease?(yes/no/what): what.


There are many types of chicken disease and it helps u?(yes/no/why): why.


Because understanding chicken disease and their types is the most important for knowing
the cause of disease and how to prevent and manage it.
```

Figure 10. Sample „"what‟ and „"why‟ explanation facility.

are discussed deeply because of chickens diseases are uncured since they are caused by virus and fungus and also the life span of the chickens are short that‟s why this study focus on diagnosis, prevention and management of predominant chicken disease. The new system learns from experience and updates its knowledge. Thus, in this study an attempt is made to design a learning KBS that can update its knowledge through experience. Additionally, enough rules are used to identify the type of diseases [46-50].

The prototype system developed can also be taken as a stepping-stone for conducting research to further come up with other approaches than adopted in this work to design and implement knowledge based system for predominant chicken disease diagnosis, prevention and management (Figure 10).

Generally, all the evaluation and testing results of the prototype show encouraging finding for further research work to fully implement and apply knowledge based systems technology in diagnosis, prevention and management of predominant chicken diseases. The result and finding of this study was encouraging because of many reasons. The first one is that this study was done with higher quality and during the knowledge acquisition relevant information was acquired from domain experts. The second was that the system save knowledge, update the knowledge and learn from experience. The third one was that the system was evaluated thoroughly by the domain experts. The fourth reason was since chicken diseases were caused by fungus and virus mostly and the diseases were not curable the issue of prevention were discussed in this study. Therefore, from the research findings, it is possible to conclude that the research achieve its objectives that were they designed for [51-56].

Conclusion

Knowledge based system is widely used in the area of medical fields, especially for diagnosis and treatment. In this study KBS is developed for diagnosis, prevention and management of predominant chicken disease, namely, Newcastle disease, marek's disease, infectious coryza, fowl cholera, chicken mite, coccidiosis, aspergillosis and favus.

Hence, in this study an effort has been made to design and develop a prototype of a self-learning (i.e., learning by memorization) KBS that can provide advice for experts to facilitate the diagnosis, prevention and management of predominant chicken disease.

In this study, the applicability of KBS for predominant chicken disease diagnosis, prevention and management has been proved. And the prototype KBS is promising and applicable in the domain area. The feedback and suggestion of domain expert reveals that the knowledge based system gained user acceptance.

The system provides explanation, prevention and management automatically on the bases of predominant chicken disease after the disease is diagnosed. Knowledge is represented in the form of "if – then" rules generated from the decision tree. In the developedKBS, an attempt was made to dynamically update the fact base in working memory. Thus, can be concluded that, it is possible to make system to learn from the user response and permanently remember the new knowledge.

Generally, the prototype system achieves a "very good performance" and meets the objectives of the study. However, in order to make the system applicable in the domain area for diagnosis, prevention and management of predominant chicken diseases, some adjustments like automatically updating the rules in the knowledge base of the system, incorporating a well-designed user interface and a mechanism of NLP facilities are needed.

Recommendation

Currently, KBS are receiving attention in many fields. With availability of advanced computing facilities and other resources, attention is now turning to more and more demanding tasks, which might require intelligence.

It is recommended that, improved extension services and the government should formulate a policy that improves the level of poultry disease management. And also it is recommended that every individual should have to give attention for environment protection to reduce the morbidity and mortality of chickens. In view of the above, the following recommendations are suggested:

The scope of the knowledge based system should be extended to include others diseases categories of chicken since this system is limited to only 8 major diseases which are predominant today.

It is recommended that the stake holders take part in deploying the developed system.

Government, researchers and developmental organizations should give attention to poultry sector and its development.

To fully provide better service, the KBS should be integrated with local languages to facilitate the interaction between the user and system.

The system needs to be integrated with other languages like C#, VB, or Java. Net to have a more attractive look (user interface). Therefore, further research should be done to integrate KBS with other programming languages.

Acknowledgments

The researchers would like to acknowledge Jimma University for the fund to carry out this study as well as for allowing this research to be conducted at Jimma University College of Agriculture and Veterinary Medicine and its KitoFurdisa Poultry farm. We are grateful for the domain experts for their significant input to this study. It is my pleasure also to express my thanks to all my beloved family members for their encouragement and love. Especially, I would like to express my gratitude to my beloved wife Talile Alemu and my brothers Bikila Girma and Segni Reta for their patience, love and support which was instrumental for accomplishing this research work.

References

1. Abdulkerim, Mohammed. "Towards integrating data mining with knowledge based system: The case of network intrusion detection." *PhD diss., AAU*, 2013.
2. Abraham, Ajith (2005). Rule-based Expert Systems. In: Peter, H., Sydenham and Richard T. (eds.) Handbook of Measuring System Design. Oklahoma: John Wiley & Sons, Pp. 909-919.
3. Mohammad, Adel Hamdan and Nedhal Abdul Majied Al Saiyd. "A framework for expert knowledge acquisition." *IJCSNS* 10 (2010): 145.
4. Anumba, C. J. and D. Scott. "Performance evaluation of a knowledge-based system for subsidence management." *Struct surv* (2001).
5. Arné, Pascal, Simon Thierry, Dongying Wang and Françoise Féménia, et al. "*Aspergillus fumigatus* in poultry." *Int J Microbiol* 2011 (2011).
6. Abdeta, Dirriba. "Application of knowledge based system for sustainable agricultural development in Ethiopia."
7. Riise, J. C., A. Permin and K. N. Kryger. "Strategies for developing family poultry production at village level–Experiences from West Africa and Asia." *Worlds Poult Sci J* 61 (2005): 15-22.
8. Kahsu, Daniel. "A case based reasoning system for diagnosis of malnutrition for under-five year children: The case of tiruneshe bejing." *PhD diss., StMU*, 2022.
9. Sitanggang, Delima, Anita Christine Sembiring, Saut Parsaoran Tamba and Irwan Budiman, et al. "Diagnosing chicken diseases using fuzzy Tsukamoto web-based expert system." IOP Conf Ser: Mater Sci En, IOP Publishing (2019).
10. Owoc, Bonner Richard F. Galant Violetta and L. Mieczyslaw. "On features of decision trees as a technique of knowledge modelling." Proc Int Conf Comput Sci Netw Technol CSIT (1999).

11. Josephson, Cassandra D., Leon L. Su, Krista L. Hillyer and Christopher D. Hillyer. "Transfusion in the patient with sickle cell disease: A critical review of the literature and transfusion guidelines." *Transfus Med Rev* 21 (2007): 118-133.
12. Kaboudi, Khaled, Ahmed Rejeb, Moncef Bouzouaia and Umar Sajid, et al. "Outbreak of respiratory aspergillosis in backyard duck flock in Tunisia." *Int J Livest Res* 8 (2018): 361.
13. Conway, Donal P. and M. Elizabeth McKenzie. Poultry coccidiosis: diagnostic and testing procedures. John Wiley & Sons, 2007.
14. Cross, Nigel. "From a design science to a design discipline: Understanding designerly ways of knowing and thinking." *In Design research now, Birkhäuser Basel*, 2007.
15. Tadesse, Desalew, Wondmeneh Esatu, Mekonnen Girma and Tadelle Dessie. "Comparative study on some egg quality traits of exotic chickens in different production systems in East Shewa, Ethiopia." *Afr J Agric Res* 10 (2015): 1016-1021.
16. Moges, Fisseha. Indigenous chicken production and marketing systems in Ethiopia: Characteristics and opportunities for market-oriented development. *ILRI (aka ILCA and ILRAD)*, 2010.
17. Emberey, Clive L., N. R. Milton, J. P. T. J. Berends and B. Vermeulen, et al. "Application of knowledge engineering methodologies to support engineering design application development in aerospace." In 7th AIAA ATIO Conf, 2nd CEIAT Int'l Conf on Innov and Integr in Aero Sciences, 17th LTA Systems Tech Conf; followed by 2nd TEOS Forum, p. 7708. 2007.
18. De Kock, Erika. "Decentralising the codification of rules in a decision support expert knowledge base." *PhD diss*., *University of Pretoria*, 2005.
19. Guesh, D. (2012). Designing aknowledge based system for blood transfusion. MSC thesis. Addis Ababa: Addiss Ababa University.
20. Msami, H. "Good biosecurity practices in non integrated commercial and in scavenging production systems in Tanzania." *Rome: FAO* (2008).
21. Hamra, C. F. "An assessment of the potential profitability of poultry farms: A broiler farm feasibility case study." *PhD diss., Univ of Tennessee at Martin*, (2010).
22. Hevner, Alan, Samir Chatterjee and Juhani Iivari. "Twelve theses on design science research in information systems." *Inf Syst Res: Theory Pract* (2010): 43-62.
23. Horrox, N. "Countering immunosuppression." *Int J Poult Sci* 8 (2000): 812.
24. Ihsan Sarita, Sri Hartati & Retantyo Wardoyo. (2013). Development of Knowledge Base in Expert System using Dempster's Rule of Combination. International Journal of Scientific & Engineering Research, Volume 4, (Issue 5), 1173-1177.
25. Kesarwani, P. and Misra, A. (2013). selecting integrated approche for knowledge representation by comparative study of knowledge representation schemes. International Journal of Scientific and Research Publications, 1-5.
26. Krishnamoorthy, C. S., W. F. Chen and S. Rajeev. Artificial intelligence and expert systems for engineers. *CRC press*, 2018.
27. Lamma, Evelina, L. Maestrami, Paola Mello and Sergio Storari, et al. "Rule-based programming for building expert systems: A comparison in the microbiological data validation and surveillance domain." *Electron Notes Theor Comput Sci* 59 (2001): 397-411.
28. Chan, Felix TS, Niraj Kumar, Manoj Kumar Tiwari and KL1140 Choy. "Global supplier selection: A fuzzy-AHP approach." *Int J Prod Res* 46 (2008): 3825-3857.
29. Lüdtke, Dirk and Satoshi Sato. "Fast base NP chunking with decision trees-experiments on different POS tag settings." In Computational Linguistics and Intelligent Text Processing: 4th International Conference, CICLing 2003 Mexico City, Mexico, February 16–22, 2003 Proceedings 4, pp. 136-147. *Springer Sci Rev*, (2003).
30. Lifschitz, Vladimir, Leora Morgenstern and David Plaisted. "Knowledge representation and classical logic." *Found Artif Intell* 3 (2008): 3-88.
31. Duc, N.V. and Long, T., 2008. Poultry production systems in Vietnam. *Rome: FAO*.
32. Leake, David, Xiaomeng Ye and David J. Crandall. "Supporting case-based reasoning with neural networks: An illustration for case adaptation." In AAAI Spring Symposium: Combining Machine Learning with Knowledge Engineering (2021).
33. Singh, Rashandeep, Inderpreet Singh, Ayush Kapoor and Ankit Gupta, et al. "co-yudh: A convolutional neural network (CNN)-Inspired platform for COVID handling and awareness." *SN comput sci* 3 (2022): 241.
34. Marangon, S. and L. Busani. "The use of vaccination in poultry production." *Rev sci tech Off Int Epizoot* 26 (2007): 265.
35. Aniba, Mohamed Radhouene, Sophie Siguenza, Anne Friedrich and Julie Dawn Thompson, et al. "Knowledge-based expert systems and a proof-of-concept case study for multiple sequence alignment construction and analysis." *Brief Bioinform* 10 (2009): 11-23.
36. Slassie, L. G., Melesse Aberra, Banerjee Sandip and Beyene Gebremedhn. "Characterization of village chicken production system under traditional management in Gantaafeshum district of Eastern Tigray, Ethiopia." *Livest Res Rural Dev* 27 (2015).
37. Mobley, R. and T. Kahan. "Practical management of health issues in a poultry production system: Symptoms." Sources and Prevention of Common Diseases, Florida A&M University, Tallahassee, Florida (2007).
38. Nalepa, Grzegorz J. "Methodologies and technologies for rule-based systems design and implementation. Towards hybrid knowledge engineering." *Knowledge-Driven Computing*: *Knowl Eng Comput Intell* (2008): 183-198.
39. Okafor, Eric C. and Charles C. Osuagwu. "The underlying issues in knowledge elicitation." *Interdiscip J Inf Knowl Managment* 1 (2006): 95.
40. Owaied, H. H.A. (2010). Application of Knowledge Based System. International Journal of Computer Science and Networ Security, 10.
41. Pal, Sankar K. and Simon CK Shiu. Foundations of soft case-based reasoning. *John Wiley & Sons*, 2004.
42. Peffers, Ken, Tuure Tuunanen, Marcus A. Rothenberger and Samir Chatterjee. "A design science research methodology for information systems research." *J Manag Inf Syst* 24 (2007): 45-77.
43. ADUGNAW, BANCHALEM. "Knowledge based system for diagnosis of under nutrition status of children under five." *PhD diss*., 2020.
44. Akerkar, Rajendra and Priti Sajja. Knowledge-based systems. Jones & Bartlett Publishers, 2009.
45. Prasad, T. V. "Hybrid systems for knowledge representation in artificial intelligence." *arXiv preprint arXiv*: 1211.2736 (2012).
46. Kayis, Berman and Putu Dana Karningsih. "SCRIS: A knowledge-based system tool for assisting manufacturing organizations in identifying supply chain risks." *J Manuf Technol Manag* 23
47. Mohamed, Mohamed A., Ahmed M. El-Dokhmasey and Moheeb E. Ibrahim. "Expert system for simulation of litigation outcome in breaching the administrative construction contracts."
48. Shadrick, Scott B., James W. Lussier and Robin Hinkle. "Concept development for future domains: A new method of knowledge elicitation." (2005).
49. Sharma, Tilotma and Deepali Kelkar. "A tour towards knowledge representation techniques." *Int J Comput Technol Electron Eng* (IJCTEE) 2 (2012): 131-135.
50. Seblewongel, E. "Prototype knowledge based system for anxiety mental disorder diagnosis." Unpublished Master Thesis: Addis Ababa University., AA, EThiopia (2011).
51. Influenza, Avian. "An HSUS report: Human health implications of intensive poultry production and avian influenza."
52. Salmanpour, Mohammad R., Mojtaba Shamsaei, Abdollah Saberi and Arman Rahmim, et al. "Optimized machine learning methods for prediction of cognitive outcome in Parkinson's disease." *Comput Biol Med* 111 (2019): 103347.
53. Dessie, Tadelle, Million Tadesse, Alemu Yami and Kurt J. Peters. "Village chicken production systems in Ethiopia: 1. Flock characteristics and performance." *Livest Res Rural Dev* (2003).
54. Mekonnen, S., A. Kgasi, W. Mureithi and G. Zena, et al. "Ethiopian veterinary journal." (2004).
55. Habte, Tadiose, Alemayehu Amare, Judy M. Bettridge and Paul Wigley, et al. "Guide to chicken health and management in Ethiopia: For farmers and development agents." *ILRI Manual* (2017).
56. Tanwar, Poonam, T. V. Prasad and Mahendra S. Aswal. "Comparative study of three declarative knowledge representation techniques." *Int j comput sci* 2 (2010): 2274-2281.

How to cite this article: Girma, Diriba, Worku Jimma and Chala Diriba. "Developing Self-Learning Knowledge Based System for Predominant Chicken Diseases Diagnosis, Prevention and Management." *J Vet Sci Techno* 14 (2023): 162.