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Ad-hoc Pet Dog Healthcare Diagnosing System using Machine Intelligence

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Abstract. In this paper, we developed an ad-hoc pet dog health diagnosis system with ART2 neural network and standardized database of symptoms/diseases associations. This system is for the pet owner who does not have deep knowledge on the pet diseases nor computer technology. The unsupervised ART2 learning system checks the similarity between the input and stored diseases to generate three most probable diseases. The system's performance is verified by veterinarian as adequate and it can stimulate the owner's attention on the dog's abnormality in time such that appropriate professional treatment is given in its early stage.

Keywords: pet dog, health diagnosis, ART2, symptom-disease association, unsupervised learning.

1 Introduction

In recent days, dogs are not just working animals living around human beings but are almost family members of their owners. There are pet shops and veterinarians to take care of these new kinds of non-human family members. In particular people who feel disconnected from society tend to substitute social contacts by pets, including supportive anthropomorphic traits [1]. For health care point of view, however, those pet-attached people may have emotional loss from pet dog's disease or sudden death and also there has been an increasing risk of transmission of microorganisms between humans and their dogs [2]. Usually a pet dog gives a sign to its owner by expressing unusual behavior or by the change of its body when its health is at risk or having a disease. However, without deep knowledge about the pet dog's disease, owners tend to neglect such signs but only depend on the regular check by veterinarians only to make the situation worse.

Our motivation of this research is thus to develop an ad-hoc pet dog health diagnosis/monitoring system with artificial intelligence that can be easily checked by

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dog owners without deep knowledge of computer technology nor dog diseases. The proposed system in this paper requires dog owner's only symptoms they found from their pets then the system answers some number of most probable diseases pets may have with computed confidence rate. This is a form of ad-hoc pre-diagnosis so that the owner may go to the veterinarian in time for appropriate treatments.

Technologically the system requires a database for symptom-disease associations and the inference system from that database with given symptoms recognized by pet owners. There exist few known studies but a recent study also look at the feasibility of neural network application to recognize the lameness of dogs [3]. However, when the system like [3] targets single disease recognition, the accuracy of its predictability is the main issue as a pre-diagnosis but our goal is to develop a system capable of giving ad-hoc prediagnosis for as many standardized dog diseases as possible.

2 Intelligent Ad-hoc Pet Dog Health Diagnosis System

2.1 Disease-Symptom Data Collection

For the pet dogs' disease-symptom data, we used two books [4,5] by veterinarian's recommendation to obtain 180 representative symptoms of 105 frequently found diseases with respect to 13 body parts that those symptoms occur - whole body, head, abdomen, leg, hip, eye, nose, mouth, ear, hair, skin, temper, and excretion. Those symptoms are associated with diseases and verified by veterinarians. Some representative symptoms associated with a certain disease also creates other queries to user for further considerations. Figure 1 shows a typical symptoms-diseases association in diagram.

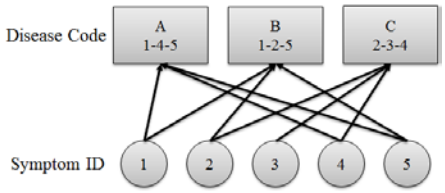

Fig. 1. Symptom-Disease Association

2.2 Overall Procedure

The system starts with asking representative symptoms currently a dog suffers from the user. This symptom input procedure is carefully designed to minimize misleading input. First, the system asks the most obvious symptom that the owner can observe barring the possibility of misleading excessive input. With that most obvious symptom, the system generates related symptoms and asks user if the owner's dog shows that symptom.

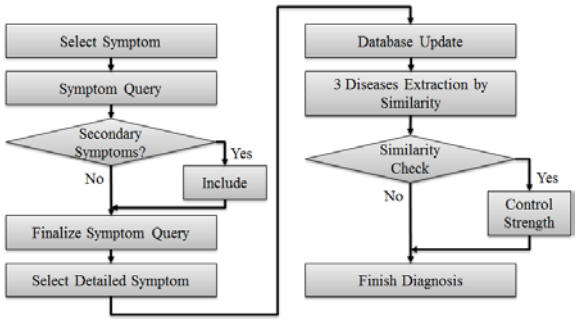

Fig. 2. Overall Procedure of Proposed System

This procedure is done twice (taking another representative symptom as input) to be more accurately gathering symptom information.
Then the system accesses learning result table to select three most probable diseases that is already learned.

The learning procedure is performed whenever new disease/symptom data is added to maintain the stability and accuracy of the diagnosis in real time.
The overall system procedure is as shown in Figure 2.

3 Experiment and Analysis

An IBM compatible PC with Intel Pentium IV 3 GHz CPU and 512M RAM is used with JDK 6.0 and Oracle 9.2.0.1.0 are used in implementation and the system is available for on-line environment. As described earlier, our database contains 105 different diseases, 180 different representative symptoms associated with 13 different body parts of a dog.

After the user selects detailed symptoms, they are formed as an input vector of ART2 and the most similar (probable) three diseases are chosen to display. The similarity is based on usual Euclidean distance.

Fig. 3. Final Diagnosis Example

Fig. 4. Diagnosis with Secondary Symptom

Figure 3 shows an example of final display of three most probable diseases with confidence level. In this particular example, the user selected “dirty eye edges due to tears and dirty hair around the nose” and “always wet eye” as detailed symptoms and the result shown in Figure 3 is galactorrhea(50%), corneitis(25%), and external otitis(11%).

However, this result may be misled by very particular symptom of “dirty eye edges due to tears and dirty hair around the nose” that filters a lot of other candidate diseases. Thus, the system asks secondary representative symptoms to expand the search space. In this particular example, when the user adds “faint image on the

retina", other symptoms related to different diseases came out. In the detailed symptom input phase, the user selects "lame", "frequently lost toys", "bumped to obstacles like furnitures", "foggy comea" in addition to previous three detailed symptoms, the system gives more confident result as shown in Figure 4.

The refined result shows cataract as the most probable with 72% confidence followed by corneitis(25%) and galactorrhea(23%).

However, there are some diseases sharing many symptoms thus the system cannot differentiate them easily with such simple input symptoms. The user selects even seven symptoms but three viral diseases show similarly high confidence level. In such case, the dog owner should go to the veterinarian for further diagnosis and treatment. Thus, we recommend that the magnitude of the confidence in this ad-hoc diagnosis is important and informative.

4 Conclusion

In this paper, we introduce an ad-hoc pet dog health diagnosis system using artificial intelligence technique. In our system, it has standardized symptoms-diseases associations as the form of database and a self-organizing neural network ART2 technology is used to infer most probable diseases with respect to the input symptoms the owner gives. ART2 learning procedure checks the similarity of various diseases from user input and generates three most probable diseases to be displayed.

In this experiment, 105 diseases and 180 related symptoms on 13 different pet dog's body parts are considered and the data collection is done from two common textbooks with field expert's guidance. The testing result was also verified by the veterinarian.

However, the role of this system is not replacing veterinarian's diagnosis but stimulating owner's attention to pet dog's abnormality in nature. There are several similar diseases with very similar symptoms that an ad-hoc observation cannot see the difference. Also, some diseases have different symptoms with respect to the progress of the disease. In those cases, veterinarian's care is "must".

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