Smart Dog Caring System

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Abstract- Regardless of the mobile applications available in smartphones, the veterinary hospitals in Sri Lanka still use the manual books to fill the vaccination schedule and keep track of pet care. This research is an attempt to change this tradition by introducing a smart system for dogs. The system can be used both by dog lovers and veterinary doctors. In this study, new proposed application plan is to replace the traditional method with a method that can store the information into a system and make it available for the users to take care of the dog. Since the dog's birth, the information can be stored and it will assist the pet owners. Unlike other applications available, the advantage of this application is that the user can choose applications to be used individually or integrated according to their choice.

Index Terms- machine learning, web scraping, IoT, image processing

I. INTRODUCTION

The system's purpose is to make a leap from manual to the automated system that can have the information about the dogs. The application focuses on four main features to build up an overall application that can work on smartphones.

Health care is essential for any living being. Considering all the factors breed, age, weight, Gender, and height; exercises, vaccinations, and nutrition plans are generated to suit individual dogs. The owner will be notified through notification alerts when the dates for vaccinations are nearby.

When dogs get skin diseases most of the time, the owners do not have an idea about it and are unaware that some of the skin diseases can transmit to humans. The studies say warm countries like Sri Lanka have a high risk of spreading skin disease quickly, primarily ringworm which spreads by fungus.

Finding the right dog breed is the first and most important decision for dog lovers. Only the dogs registered in the system are allowed to go through selling or for cross purposes. The system improves buyers' reliability by providing dogs' medical history with certification from the veterinary doctor. The chat box helps users with the information. Dog lovers can know the originality of the breed. Sellers can sell dogs conveniently through scraping websites platforms. The app will help build a bridge between dog sellers and buyers in a more productive way.

Finally, introducing the dog tracking system makes owner's lives much more comfortably, especially during a busy schedule. Using the automated feeding machine, the owner can feed their dogs anytime from anywhere using their mobile phones. This automated system can also help owners monitor their dog's diet. The overall system mainly focuses on helping users take care of their dogs at fingertips through smartphones with the help of the information fed by the user.

II. RELATED WORK

There are mobile applications available in smartphones, but veterinary hospitals still practice the manual method by filling the books. The studies in the following four different fields have been combined in together this proposed system.

A. Predicting the dog's health and generating plans

According to the research paper which has written by S. K. Helmink , E. A. Leighton and R. D. Shanks highlighted that the existing variety [1].An adult dog guide is 18 to 32 in weight. The weight of German Shepherd male and female dogs were checked between the birth and 18 months of age, ensuring that at least one record of weight after 290 days of age. The construction of growth curves were done using 10,484b observations from 880 dogs. And Gompertz function in the form Wt=Wmaxexp (-e[-(t-c)/b]), is used to construct that curves. In this Wt is weight at time t, Wmax is mature body weight, b is proportional to duration of growth, c is age at point of inflection, and t is age in days. The body mature estimations show that it is 2.4+-0.3 kg higher for Labrador retrievers than for German shepherd dogs and 4.7+-0.2 kg higher for males than females. It is shown that the Male Labrador retrievers were the closest to upper limit of desirable weight. It is an average of 31.4+-0.3 kg.4b+c the duration of growth not different. But, estimation is, for males it is 8+5d longer than for females. While the female Labrador retrievers had the 329+-6 days of shortest estimation for growth. While estimation for age for point of infection was not different between breeds, it is 3.6+-1.2 d greater for males than the females. It may be helpful that a better reading and understanding of the growth curves in estimating mature weights at young age. Therefore, the allowing of earlier breeding and training decisions to be taken and the generic changing incretion per year.

In the research [2]. Which is done by Amanda J. Hawthorne, Derek Booles, Pat A. Nugent, George Gettinby and Joy Wilkinson. Dogs are quite unique. Body weight changes drastically from breed to breed where dogs such as mastiffs can weigh up to 125kgs while dogs like chihuahuas weigh only 1kg. Growth period and rate of growth of puppies vary exponentially from breed to breed.

To prevent making growing puppies' under-weight or over-weight standardized feeding plans are to be introduced. Over nutrition will cause obesity in dogs while

musculoskeletal diseases will be triggered in large breeds. Feeding plans available at the moment only provide data that only uses a single equation.

Variations in coat, size and temperament may result in breed specific growth patterns with varying levels of energetic requirements. A study based on puppies from 6 breeds showed different levels of energy requirements even though some had similar body weights. Such as the difference between Newfoundland and great-Danes and that of Labradors and Briards. Information available on breed specific growth of puppies is scarce. These patterns only provide limited data on single breeds. Ex 8 - 34 month old and 6 - 20 week old Labrador retrievers and 12 week old germane shepherds. Other studies are restricted by the use of data from other breeds which makes it difficult to differentiate data from different age groups. Complete growth curves of 12 different sized dog breeds were studied and compared to deduce a scientific and mathematical based feeding plan to dogs.

B. Dog buying and selling platform

There are lots of dog breeds worldwide. There are lots of pure dog breeds among good breeds. Finding the right dog breed is the first and most important decision for dog lovers. When buying a dog, you should have good knowledge to find an exact original breed. According to the survey conducted lots of people response was no.

"Dog species were original, found from candies, native, to a nation or geographical area, and breeding, breeds were chose for phenotypic behavior, such as coat color, size, coat color and structure. Later, breeds were in turn built up from, existing breeds, each substructure, breed giving a phenotypic, trait that species true. Based, on available breed chronicle, the majority of extant dog breeds were developed in the 19th century". A well-groomed dog's breed can be recognized easily. However, looking at a puppy, it is challenging to find the breed. That is the main problem. There are lots of unique features, and those are different from breed to breed [3]. There are lot of buying and selling platforms [4]. But there is no specific selling platform for dogs like this. Most give only some information. This is a specific selling platform for dogs. Here, dogs that are only registered and maintained by the system or their registered puppies are allowed to sell or make advertisements on crossing purposes. Dog lovers (buyers) can see a lot of details and be clear about the originality of the breed. All the past details. All the actual photos, medicines, nutrition plans, health, etc. can be seen. There is no opportunity for misunderstanding. It cannot be deceived. All the updates are going with doctor's supervising.

There is another problem for users when selling dogs. The way of selling dogs conveniently. In a situation when using a different application, there is a problem with finding buyers. There is a lot of buying and selling platforms. But those are using traditional methods to find buyers through advertisements or promotions. Here, system solutions can be generated from using scraping algorithms. Web scraping or web data extraction is data scraping used for extracting data from websites. Find out data through websites platforms about the users' needs and related platforms. Using a scraping algorithm analyzes the advertisements (who need dogs) from related websites. It is handy for sellers and buyers. This helps to build a bridge between dog sellers and buyers in a more productive way.

C. Automatic pet feeder project

According to the project by Yixing Chen and Maher Elshakankiri, were proposed an automatic pet feeder using IOT and it was a food storage container and a pour-out-food container, a double feeding dish, and a Tower Pro SG90 Micro Servo as the actuator. According to this automation pet feeder, users will be able to give foods to their pets the right amount. [5].

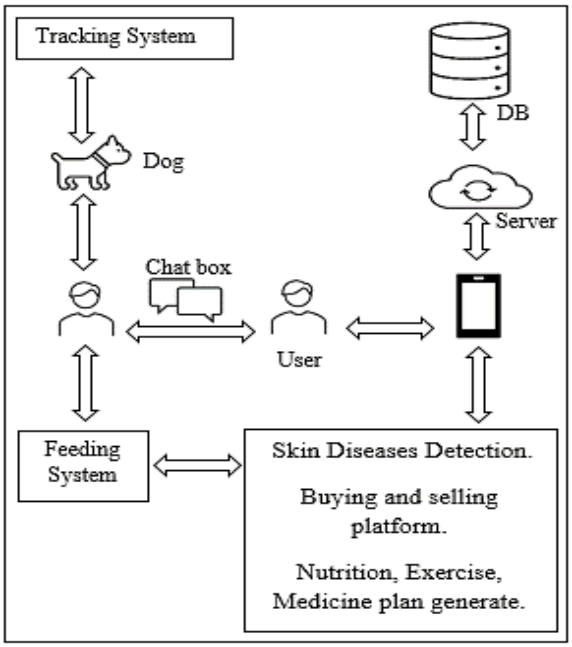
Smart Child Safety Wearable Device is a Global Positioning System (GPS) tracker that gives a solution for kids. What is special about this is the gadget empowers association between the youngster and parent through the WIFI module cooperation utilizing IOT. The parent can get to the kid data intermittently by interfacing through this device [6].

D. Detecting skin diseases

With the collected information in 2020, image processing is growing in many fields, yet its growth in identifying skin diseases is comparably lower than in other fields. Researches have been done using image processing to identify human skin diseases and plant leaf diseases. Image-processing requires a certain amount of pictures to give an accurate result. There are no data sets available for dog skin disease to continue research in image processing. Creating a data set and coming up with classifications is also good progress since there is no specific solution to find out about dog skin disease through image processing. Skin diseases identifying systems for dogs are still under research. There are skin disease identification methods available for humans and plants [7].

The response taken from 43 people who love dogs, more than 25 people welcome the idea of image processing to give a solution. There is no research in the field of dog skin disease to give comparable feedback about this system. Helping a user find out the basic idea of a dog skin disease through image identification might be an excellent hurdle to cross.

Figure 1: Component diagram.



III. METHODOLOGY

The system that is proposed in our research consists of a mobile application. The mobile application is built using flutter. The mobile application can be used by android and IOS environment.

A. Predict the dog health and generating plans

This section describes how details are gathered and generate plans in order to maintain the dog's health. First the doctor examines the dog and enters the details of the dog to the system. Details such as breed, weight, height, gender, dog's body type, birthday, name, adult or puppy are taken into consideration. The dog will be registered on the system and a profile will be created. This profile contains vital information about the dog. Information about the medicinal vaccines and nutrition prescribed to the dog will be recorded on the system. According to the details mentioned above we plan to use an algorithm to generate plans for each and every dog's needs**.**

A dog is classified mainly into two categories as adult and puppy based on information provided by a government approved veterinary doctor. The one tables below depicting were designed according to the information provided by the veterinary doctor.

Table 1: Adult Body Weight and Height

Breed	Height(cm)	Weight(kg)
German-Spitz	27-37	8-15
Doberman	65-69	30-35
Labrador	54-57	25-34
Boxer	53-63	25-32
Great Dane	71-76	46-55
Pomeranian	23-30	2-3

The data related to Dobermans, German Spitz (pom in India), Labrador, Boxer, Great-Dane and Pomeranian breeds were gathered under two major categories. Data from each breed was further categorized into two subdivisions. Adult canine data were analyzed under height and weight whilst puppy data were analyzed under age and weight.

The health of a canine can be determined with the help of machine learning algorithms and deep learning algorithm when the above-mentioned data is entered into the system. Changes in exercises and supplement plans are informed to the user by the system based on the results (overweigh, underweight or normal) derived from the algorithms.

By careful analysis of scatter plots for data sets of adult dogs it was observed that they were scattered linearly. Hence the data sets for adult dogs were trained using Support vector (SVM) which is a machine learning algorithm. The accuracy levels reached was high. The output will be health of the dog whether its over-weight, under-weight or normal. The above output determined by checking whether the dog has a weight respective of their height.

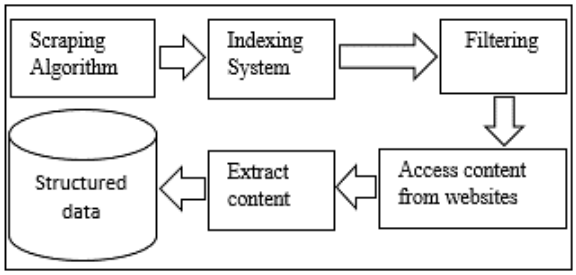
Scatter plots related to the data sets for the puppy dogs were analyzed. Using a machine learning algorithm to train data sets for this kind of scatter was difficult due to the low accuracy levels reached. Later high levels of accuracy were obtained by using fully connected deep networks. The output will be health of the dog whether it's overweight, underweight or normal. The above output determined by checking whether the dog has a weight respective of their age (number of month).

B. Buying and selling platform

This is a specific selling platform for dogs. In here, only the dogs that are registered and maintained by the system or their registered puppies are allowed to be sold or can be advertised for crossing purpose. Users must follow the standards. Anyone can easily register and see the breeds available to sell. All the details will be there. Dogs' medical history and data of veterinary doctor's certifications can be seen and users can prove the originality of the breeds. Filtered data are retrieved from the database. Filtered data will not affect the security of the dog. When posting an add users can add photos and details on their own. Users can select the add type (selling or crossing purpose). Chat box helps contact users after posting an advertisement. After selling a dog, users can transfer ownership to the new owners with all of the past details. New owners can continue from there.

Web scraping helps to find who needs dogs and make the selling convenient. Extraction should be matched with users' data from related web sites. Web scraping is the procedure of extracting model data from web sites and creating structured data. Using scraping algorithm can be extracted by matching data without extracting incorrect data. [8]

Figure 2: Scraping algorithm

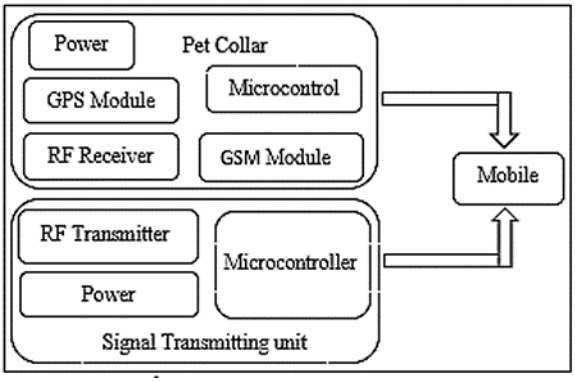


C. Dog tracking and feeding system

1. Automated feeding system

System describes Arduino based dog feeding automation which can automatically serve food to dog timely. System consists 16*02 Liquid Crystal Display (LCD) is to display the time using DS1302 Real Time Clock (RTC) Module. Servo motor is used to rotate the container to provide the food. The owner can set the container opening duration according to the food quantity to serve the dog. Using 4*4 keypad to manually set up the time for feeding the dog as well as this can set by using the mobile application.DS1302 RTC Module, which used to set the time and date on which the dog should be given food. As a result of this set up the time according to the dog's eating schedule, the device drops or fill the food bowl automatically. By using Global System for Mobile communication (GSM) module, it receives the text message that includes the amount of food from the database. This shield enables Arduino to send and receive data from anywhere in the world with a GSM connection. It is responsible for connection between mobile and Microcontroller.

Figure 3: Feeding system



2. Tracking system

Proposed tracking system is a wearable device for the dog and also a signal generating point for Geo-Fencing purpose. The hardware component consists with a GPS module to get the GPS coordinates from the satellites above. When the user wants to know the location of his pet, he can request it from the mobile application via a Short Message Service (SMS). This SMS will be received for the GSM module at the device attached in dog's collar and it will send a reply massage for user's application by including current longitude and latitude information which identified through GPS module.

Geo fence functionality is working through Radio Frequency signal communication method and this needs a separate Radio Frequency (RF) signal transmitter unit placed in garden. Theory behind this is as follows. This RF transmitter always transmits a unique signal in a particular time interval. There is a RF receiver at the hardware device which is attached to dog's collar. This receiver always checks that transmitted signal for it's availability. If receiver could not find that transmitted signal, that means the dog has moved to a far location away from the home. Here at this situation, hardware device will send a massage massage for user by informing it. This massage will contain the current location data of the dog.

D. Detecting skin disease through image processing

Skin disease Identification for dogs, the users in the front end will have a user-friendly interface to input the picture taken by the user and upload it to the mobile application, and the trained data model will compare the picture that uploaded with the trained data set, which used the Convolutional neural networks (CNN) to train.

CNN model is famous for the automatic detection of images like how human brains work. There are four main steps in CNN those are Convolution (REL Layer), Pooling, Flattening, and Full Connection. Detect features of image through CNN is not new but applying it to all new classification is a new step taken here. The 3*3 matrix is used here to summarize the features in the image. In the first step through applying filtered features map to the image break up the linearity of that image using the function rectifier. Then the image become ready for the pooling step where the purpose will be providing CNN with the faculty of "spatial invariance". After ending up pooling feature map the image will get flatten and added into artificial neural network [9].

IV. RESULTS AND DISCUSSION

As a result of asking Data related to 10 German shepherd puppies (1 month - 13 months), they were taken into the research by visiting the veterinary hospital, and they were analyzed to check whether they had a proper body weight and their age. An error rate of 2.17 was observed by analyzing data of 10 puppies.

The discussion with the veterinary doctor helped understand the zoonotic diseases that can be spread to humans. Got familiar to medical terms with the help of the experience gained by visiting the veterinary hospital.

A. Predict the dog health and generating plans

Data sets of adult dogs were trained using the Support Vector Machine algorithm. The results obtained after using Breed, height and weight as inputs are shown below.

Normal = 0
Weight-loss = -1
Over-weight = 1

Table 2: Adult Boxer prediction output

Height (cm)	Weight (kg)	Output
53	35	1
55	28	0
52	20	-1
63	35	1

Data sets of puppy dog were trained using the fully connected deep networks. The results obtained after using Breed, age in month and weight as inputs are shown below.

Table 3: Puppy Pomeranian prediction output

Months	Weight (kg)	Output
6	2.5	1
3	0.5	-1
8	1.9	0
1	0.7	0

Table 4: Model algorithms' accuracy for adult dogs

[1]	Algorithm Tested	[2]	Support Vector Machine	[3]	Fully Connected Deep Network	[4]	Logistic Regress-ion
[5]	Accuracy Level	[6]	96 %	[7]	60 %	[8]	40 %

Table 5: Model algorithms' accuracy for puppy dogs

Algorithm Tested	Support Vector Machine	Fully Connected Deep Network	Logistic Regress -ion
Accuracy Level	55 %	90 %	45 %

V. CONCLUSION AND FUTURE WORK

The research was done in one year of a period, limited time limits the research area and stop the research to go wider range. Sri Lanka is a country with different language-speaking people living together, in order to make the system user-friendly can add Sinhala and Tamil language instructions and make it optional for users to choose. Use a motion sensor that can detect and calculate the footstep of the dogs and use the information for the exercise and nutrition generating plan in the future.

Implement a bot that can maintain the auto channeling and doctor's appointment booking. Spreading disease detection system using the tracking system. If the same disease is spreading in a specific location, it can be identified and notified to the users and doctors. Enhance the system by adding different pets into the system-version control with error detection to continuously maintain the app.

The application has a weakness of having less data collection; in the future, there is a possibility to come with more accurate results. Advance development of the human environment makes them need to get accurate information in less time. Having more research teams in these sections can improve applications to stand independently and act without human interference.

VI. ACKNOWLEDGEMENT

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