

# Implementation of Smart Pet Care Applications in an IoT Based Environment

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**Abstract** - The idea of Information Technology and machines has become a rising demand, leading to the concept of interconnection between humans and machines. This concept has adopted a negative impact on human lives and their well-being. Because of this negativity, people tend to adopt pets to get emotional support. Pets require extra care and it is not easy as it used to be with today's busy lifestyle. As a result, one of the significant challenges has been figuring out how to grow pets in a simple manner. The best solution for this kind of problem is to use new innovative technologies. For this matter, an IoT-based solution should be included. The question that led to this research was, "How to implement a Smart Pet care Application within a proper IoT based Environment?". Implementation of a smart pet care application that satisfies every requirement of petting would ensure greater comfort and peace of mind for pet owners. This paper discusses the characteristics and technologies of the latest smart Pet Care applications and proposes solutions that satisfy the current requirements of pet owners. Before implementing this smart pet care application, a study was performed to identify features and facilities of existing pet care applications using related research papers. This research explores the impact of the IoT concept on the potential of smart Pet Care applications across modern technologies to facilitate human contact with pets. The outcome is an IoT-based mobile application that satisfies users' requirements by analyzing data.

**Keywords:** *pet care, Internet of Things (IoT), smart pet care system, monitoring systems*

## I. INTRODUCTION

In this rapidly developing world, societies cultures and economics are becoming complicated day by day. As a result, every human being is dealing with some sort of problem in life.

As their demands increase, innovative citizens come up with solutions that solve these problems. Ninety-nine percent of these solutions are based on information technology, in which data is taken as input and processed into information, resulting in meaningful and useful outputs. These IT concepts have the ability to make the connection between humans and machines. Any innovation has the potential to make mankind's work easier, but it can also have a negative influence. In this situation, the connection between humans and technology has resulted in a distraction from the real world. It also leads to a strong attachment to their emotional needs. An experiment was carried out to uncover relevant strategies to aid with this problem, and one of the outcomes revealed that owning a pet is one of them.

Keeping a pet has been practised worldwide and taking good care of them is already part of our human culture. Every year, approximately 600,000 pets are adopted. Having a pet might provide emotional comfort, but it can also be a difficult experience. Many pet owners struggle with several major issues that can arise when adopting and caring for a pet. The best solution for this kind of technological problem is to use new innovative technologies. In this matter, IoT-based solution is one of the major solutions.

IoT means not only one technology, but all the systems used to create a wireless infrastructure that manages the data obtained from a lot of sensors. Therefore, in the 21st century, we should refer to IoT as a modern Internet notion. To make the IoT services more appealing to users, sensors are needed. However, the way to process the data collected from sensors is becoming essential. Therefore, the concerns about how we should capture sensor data and process the data compelled us to learn about the latest network and data processing architecture: cloud computing and big data.

With the ideas and innovations discussed earlier in our heads, we have begun to dream of new services quickly incorporated into our real lives. We are now going to reach a lot of people living with their dogs. And as lifestyle shifts, the number of single households is rising. And most single households, when they are away from home, require a way to deal with their dogs. While we find personal pet care facilities surrounding us, they take more resources and time for faith. Here we can see the potential for personal comfort that IoT services can offer. We need to think about verifying pet status with the owner's mobile and how to provide proper pet facilities to take care of pets and pet owners smartly.

## II. LITERATURE REVIEW

Utilizing the pet implementation of the capability of location-awareness and helping pet owners easily teach their pets about behavior and feeding management, several works have discussed the enhancement. The analysis displayed the great progress of the pet monitor device interested in the Internet of Things (IoT) ideas and satisfied the criteria of pet owners who were seeking jobs without any issues. That goal was to enable pet owners to automate simple things like monitoring and feed controls. Finally, they suggested that a SOAP-based web service mechanism is an ideal choice for managing various devices and devices in a home environment. Different sensors are used to monitor different pet activities, for example, an IR sensor to check if there is food available on the plate. An RFID tag used in the pet collar allows the pet to communicate its identity. The Arduino serves as a gateway for sending the collected data to cloud storage, where it may be retrieved and viewed via a cell phone number or other electronic devices. Because the entire network was wireless, no data loss was possible. Finally, the research suggested adding RTC to the feeder (Subaashri et al., 2017).

This research has suggested a new pet care system. Remote feeding, remote automatic defecation, CCTV service, and a smartphone app that could offer control information for the above services were the basic services of the proposed smart pet care system. The system can feed the pets while the owners are away, follow their whereabouts and status, and operate the defecation pad using the owners' smartphones.

In terms of IoT technology, the suggested system stands out since it uses sensors and wireless connectivity. As a result, the suggested system is not limited in terms of space or time if a wireless connection is available (Kim, 2016).

The cat is a clean animal free of najis but keeping one at home takes effort and attention. As a result, utilizing a webcam and a stepper motor coupled to a Raspberry Pi as the main controller, this study constructed a monitoring system for an automated cat feeder. With the webcam and ancon functions, the camera captured images (pictures or movies) stored on the Raspberry Pi. The stepper motor will switch the supply valve using a General-Purpose Input Output (GPIO) pin and a program on the Raspberry Pi. The Raspberry Pi is then connected to the internet and a cloud network, allowing remote device monitoring via a web browser or smartphone app. The overall function of the machine, either immediate or planned, as well as tracking images or videos around the food in the form of feeding the cat. Finally, it is proposed to upgrade the monitoring system used to feed cats using a high-resolution camera. In addition, the use of a large stepper motor makes the revolution more powerful and faster when feeding the cat (Anggraini et al., 2020).

Cyber-physical systems are a modern generation which, by several new methods, blends machine and physical capabilities and can communicate with individuals. This thesis explored the ability of technology for computing, connectivity, and regulation to strengthen human relationships with pets. Many experiments have sought to have a normal and informative approach to requesting facilities that they point out. Attractive technologies for the future are also present in the emerging pattern in combining pet control and CPS technology. This thesis introduces an intelligent method of pet care based on Internet definition. They suggested a mobility-aware algorithm to allow digital home technologies for pets, including an intelligent pet door and a pet feeder. Its documented deployment has demonstrated that conventional goods can transcend the limitations of the method and satisfy pets' needs (Own, 2012).

This research investigated the potential of the computer, connectivity, and control systems through the Internet of Things technology to facilitate human contact with pets. It could have a modern operating process, the underlying

vision behind the Internet of Things. The research presented the substantial change in the pet care infrastructure involved in the modern Internet of Things process and answered the requirements of owners who are out without a hitch for work. The proposed framework, including the smart pet door and pet food dish, is also based on smart home technologies. As a next move, they will attempt to bring into their setup the other pet grooming tools, including litter boxes, pet monitors, etc. This will satisfy the owners' varied desires as well as concerns of wellness, surveillance, and entertainment. Anything for dogs is protected (Own et al., 2013).

The VetCompass Australia service gathers clinical evidence from veterinary practices in real-time and collects it for questioning by researchers. It provides Australian academics with long-term, cost-effective access to authoritative data from hundreds of veterinarians around Australia and new prospects for international collaboration with comparable initiatives in the United Kingdom and elsewhere. There are three phases in VetCompass Australia. Next to the rollout of the VetCompass program to gather medicinal veterinary data from Australia. Secondly, coding platform creation and enrichment (data presentation). They were eventually developing a world-first, natural language processing (NLP) application real-time monitoring interface. Advances in the processing and exchange of information from various practices would enable veterinary practitioners to provide pet animals with dramatically improved standards of treatment, enhancing their quality of life (McGreevy et al., 2017).

In veterinary medicine, veterinarians believe there is a strong demand for mobile devices, and this technology would enable them to exercise more efficiently. In this report, a veterinarians' online survey took a sample and investigated whether they felt that using mobile devices would boost their use. The findings revealed that among veterinarians, mobile devices are popular and widespread. Veterinary software and other electronic technologies have been encouraged to increase the quality and delivery of clinical veterinary medicine by providing veterinarians with a greater understanding of mobile technology. While this study was able to assess mobile technologies' current use and attitudes, further research needs to be conducted to

determine which factors prevent full use of mobile technology. Finally, the biggest shortcoming they found was that veterinarians were aware of the options available and found more widely used technologies to improve the field (Andrews et al., 2015).

The Pet Care Framework, which is based on the Android program, was introduced in this post. The goal of this framework was to have a non-exhaustive way based on a smartphone application to care for your pet. The paper explains this system's architecture methods and practical elements. The system was developed by pet experts. This paper proposes designing a mobile application based on an Android system to provide a user-friendly way for people to pet and make money. However, in future experiments, they hope to add a new feature such as pet breed recognition and improve the application using other advanced methods to improve the project and use the tool to manipulate the application (Saswadkar, 2018).

As pet ownership increases every year so does the demand for higher quality pet grooming products. This has encouraged the growth of this sector of the Internet of Things (IoT) technology. Using IoT technologies, pet owners can monitor the activities and position of their pet, remotely monitor the welfare of their pet, or even interact with their pet. In the everyday lives of pet owners, all these smart pet care items play an important role. This study's major purpose is to activate an integrated system that includes the three basic elements that pet owners should be worried about whether they are busy or not. The pet food bowl, drink dispenser, and litter box are all included. With Arduino Uno boards and Wi-Fi modules, these three subsystems are connected to the local network. In addition, the information gathered by each sensor is processed and displayed on a smartphone app. Through a single interface, pet owners may access all information on their pet's food and water consumption, as well as the timing, duration, and frequency of excrement. In addition, the application also has a control feature enabled for pet owners to provide food anytime, anywhere. A general statistical diagram with the mentioned values is presented in the application and is updated from time to time (Chen and Elshakankiri, 2020).

Mobile innovations have a huge effect on our lives globally, helping end-users enable new forms of healthcare services with advanced

technology and rule-based expert systems. In particular, the availability of the more user-friendly Android OS-based interface and economical smartphones offer new possibilities for continuous monitoring of pets' health status, such as healthy dogs/cats, toxic ingestion, and ingestion. In health management and clinical practice, the recommended technologies also help to provide users with similar services addressed here are wide and important. The pet smartphone app should be used to stop pet disease attacks. We may contact the pet expert in case of an emergency by making an appointment online with this app. This app helps locate the closest hospital for dogs. This study addresses pet health issues based on mobile phones (Kumar et al., 2017).

In Filipino, pet ownership has become an interesting addition to life. With advancements in the Internet of Things (IoT) development, doing well with pets can be done remotely. Pets can be monitored through a mobile application using microcontrollers and sensors designed to connect to the internet. The researchers designed a remotely activated smart pet door, defecation cushion, food, and water dispenser in the developed system. This project also has the potential for commercial viability, especially in the urban lifestyle, compared to other ways to care for and monitor pets through pet facilities. The developed mobile application provides the virtual presence of pet owners by collecting information about the feeding schedule of pets, music activation with voice activation of pet parents, room temperature measurement and camera surveillance via a webcam. The mobile app has been successfully tested and proven effective in delivering what has been promised (Luayon et al., 2019).

Pet monitoring in smart cities is a challenging issue. The classic approach to identifying animal tracking methods, such as airbags, GPS, and RFID, has the disadvantage of providing full monitoring and tracking of pets. Such devices have many limitations and are very expensive. The massive improvement of the Internet of Things (IoT) in smart cities can be used to provide human control and interaction with pets using the Internet and its technologies. This paper presents an approach to video tracking pets to identify and categorize the object of interest using in-depth learning skills (Hammam et al., 2018).

It is almost difficult to provide full-time attention to the pet due to the demanding work life with most pet owners and not being able to share the caring assignment with others. This paper seeks to build an intelligent and collaborative method to resolve the distance between the pet and the pet owner to address the previously described dilemma. This study is based on the IoT idea using the Linux operating system and the Raspberry Pi board as a development tool. The suggested device provides the pet owner with a mobile program that can connect with the pet over the Internet in real-time. The user will use the vision module of the machine as a feed module to provide a view of their pet and monitor the servo motors of the handheld computer on the pet for feeding as an output module. They hope that this technology can be improved and used by pet owners for real-time contact with their remote pets in the future, where they can physically be in the same place (Shih et al., 2016).

### III. METHODOLOGY

The title of this research paper is "Implementation of Smart Pet Care Applications in an IoT based Environment" and the question that led to this study was "How to implement Smart Pet Care Applications within a proper IoT based Environment?" This research paper aims to analyze the features and usages of the technology of the current smart Pet Care applications. This study was performed using secondary data. A systematic approach was performed to gather data from published research studies on the Smart Pet Care Applications.

The following steps were used in the process of paper selection. At first, the related research was found according to keywords. Then both manual and automatic searches were performed to find the most suitable research. In the searching process, special attention was given to research found from ResearchGate, IEEE and ACM digital library. The next step was to eliminate duplicate research. Then read all the papers' abstracts and keywords. The study that was not linked to my research topic was then removed using the exclusion criteria. Finally, inclusion criteria were followed to select recent papers that can be applied to the study area.

As the next step, research papers were analyzed and summarized the findings from those papers in the tabular format. It is an easier method to represent the findings from the literature review. In this context, it helped to identify the Impact of the IoT concept on smart Pet Care applications over time, it thus allowed to suggest new possibilities for implementation of Smart pet care applications.

#### IV. ANALYSIS

Based on the literature review of research papers, these are some characteristics and technologies of the latest smart Pet Care applications that apply to help pet owners give well-being to their pets.

Table 1: Analyzing existing features.

| Research Title   | Research outcomes   |
|--|---|
| Automatic Pet Monitoring and Feeding System Using IoT (Subaashri et al., 2017)                         | <ul style="list-style-type: none"> <li>RFID tag (Pet collar)</li> <li>IR sensor (Checking for food availability)</li> <li>Arduino(gateway)</li> <li>Mobile application</li> <li>Suggestion- RTC to the feeder</li> </ul>                          |
| Smart Pet Care System using Internet of Things (Kim, 2016)   | <ul style="list-style-type: none"> <li>CCTV service</li> <li>Remote feeder</li> <li>Remote automatic defection</li> <li>Mobile application</li> </ul>   |
| Mobile-based monitoring system for an automatic cat feeder using Raspberry Pi (Anggraini et al., 2020) | <ul style="list-style-type: none"> <li>Webcam &amp; stepper motor (Remote feeder) Raspberry pi(gateway)</li> <li>Mobile &amp; web-based application</li> <li>Suggestion- high-resolution camera &amp; large stepper motor</li> </ul>              |
| For the Pet Care Appliance of Location Aware Infrastructure on Cyber Physical System (Own, 2012)       | <ul style="list-style-type: none"> <li>CPS (Cyber Physical System) technology Smart pet door</li> <li>Smart pet feeder</li> <li>Numerous networking devices</li> <li>Mobile application</li> <li>Suggestion-litter boxes &amp; pet cam</li> </ul> |

|  |  |
|--|--|
| The study and application of the IoT in Pet systems (Own et al., 2013)                                     | <ul style="list-style-type: none"> <li>Smart pet door</li> <li>Smart pet food bowl</li> <li>Suggestion-pet grooming devices</li> </ul>   |
| Pet Care System Based on Android Application (Saswadkar, 2018)   | <ul style="list-style-type: none"> <li>Mobile application</li> <li>Real-time dashboard</li> <li>Suggestion-pet breed</li> <li>recognition</li> </ul>   |
| Implementation of an IoT based Pet Care System (Chen and Elshakankiri, 2020)                               | <ul style="list-style-type: none"> <li>Arduino Uno board</li> <li>Wi-Fi modules</li> <li>Mobile application</li> <li>Health/activity monitors</li> <li>Pet monitors and interactive camaras</li> </ul>   |
| Health experts for pet monitor system with IOT (Kumar et al., 2017)  | <ul style="list-style-type: none"> <li>Mobile application</li> <li>Real-time dashboard</li> <li>GPS tracking</li> <li>History and trends overview</li> </ul>   |
| A smart pet care IOT mobile application (Luayon et al., 2019)  | <ul style="list-style-type: none"> <li>Mobile application</li> <li>Camera surveillance</li> <li>via a webcam</li> <li>Room temperature measurement</li> </ul>  |
| A Pet Animal Tracking System in Internet of Things using Deep Neural Networks (Hammam et al., 2018)        | <ul style="list-style-type: none"> <li>Air tag</li> <li>GPS &amp; RFID</li> <li>Deep learning capabilities (detect and classify the object of interest)</li> </ul>                                       |
| Internet of Things for human - Pet interaction (Shih et al., 2016)   | <ul style="list-style-type: none"> <li>Linux OS and Raspberry Pi board (development platform)</li> <li>Mobile application</li> <li>Servo motors of the portable device on the pet for feeding</li> </ul> |
| VetCompass Australia: A National Big Data Collection System for Veterinary Science (McGreevy et al., 2017) | <ul style="list-style-type: none"> <li>Real-time clinical data</li> <li>Mobile application natural language processing (NLP) technology</li> </ul>   |
| Mobile Technology in Veterinary Clinical Medicine (Andrews et al., 2015)                                   | <ul style="list-style-type: none"> <li>Veterinary mobile application</li> <li>Clinical veterinary medicine</li> <li>Improve the quality and delivery of veterinary clinical medicine</li> </ul>          |

## V. CONCLUSION AND FUTURE WORKS

When analyzing this research, it can evaluate patterns within the content. We can see that the existing research papers have touched all most all the technologies. Especially most of the research mainly focused on IoT-based devices for Smart Pet Care applications. We can see there are many kinds of IoT devices used for many different purposes. And almost all the research focused on a mobile application because that is the most effective and easiest way to handle human interaction with pets.

Several research projects have tried to address the need for services in a typical and practical manner. Exciting features brought out the new concept of merging pet care with various technologies. The findings show the most significant breakthrough in technology in the pet care system, but they also meet the needs of pet owners. It is simple to meet the many needs of owners using modern technologies like IoT, and the well-being, monitoring, and enjoyment of pets are all protected.

This review aims to provide future recommendations that will help develop the IoT-based mobile application for improving the interaction between pet owners and pets. The expected mobile application will help pet owners care for pets so that pets get better care and save people time and effort. With the help of this solution, the overall aim is to focus on various issues related to pets and find suitable solutions for pet problems.

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