

PetCare: A Smart Pet Care IoT Mobile Application

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ABSTRACT

Pet ownership has become an interesting addition in the lives of the Filipino families. Keeping domesticated pets has been a practice around the world and taking good care of them is already part of our humane culture. With the advancement in the development of Internet of Things (IoT), taking good of our pets can already be done remotely. The use of microcontrollers and sensors, designed to connect in an Internet, made the monitoring of pets through a mobile application. In the developed system, the researchers designed a remote activated smart pet door, defecation pad, food and water dispenser. The project also has the potential commercial viability, especially in urban lifestyle living, compared from other means of taking care and monitoring your pets through pet facilities. The developed mobile application provides the virtual presence of pet owners by acquiring information of pets' eating time schedule, music activation with pet-parent voice activation, room temperature sensing and camera service monitoring through a web cam. The mobile app has been successfully tested and proven effective on the course of delivery on what has been promised.

CCS Concepts

- Human-centered computing → Ubiquitous and mobile computing → Ubiquitous and mobile computing systems and tools

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Keywords

IoT; Android mobile app; Sensors; Microcontrollers; Pet Care.

1. INTRODUCTION

Internet-of-Things (IoT) made physical monitoring of living matters possible with just a click of a mobile application interface. It made devices connected and communicate, through the availability of Internet, with a very minimal human intervention. Various systems have been applied for both living and non-living subjects and IoT never stops evolving. Real time virtual monitoring applications have been made through different objects like plants, household appliances and with domesticated animals [1]. House pets are part of the family. Dogs and cats serve as human's four-legged friend, a playmate that never aged, a companion that never complains, a protector that will never abandon someone on the sight of danger, a cheerer who will never let you down and with a long and endless reasons why they are part of human's life and existence. These special creatures possess great intelligence and cherish their owners by showing emotions, loyalty and provides comfort to their human families. Every part of the family has the right to be taken care of, anytime, anyway, even they are miles away. It follows the belief of the researchers of this project that, "No Pet Should be Left Behind" [2].

The Internet of Things (IoT), the kind of network that could connect gadgets to the internet based on required protocols through sensor equipment steer information exchanges and communications for the goal of smart recognition, position tracking, monitoring and many more. It is known for its fundamental characteristics— Interconnectivity, Things-related services, heterogeneity, adoption to dynamic changes, scalability, safety, connectivity. The IoT architecture serves to deploy in different scenarios varying in scalability, modularity, and the configurations of IOT deployments [3].

Mobile users in the Philippines has exponentially grow over the years. Studies showed that there is a compound annual growth rate of free and paid mobile app downloads worldwide from 2012 to 2017. It is estimated that paid mobile app market is projected to grow at 180 percent while free apps will grow up to 256 percent [4]. There are 149.3 billion apps in downloaded in 2016 and there are 2.8 million apps available in Google Play Store alone 2017 [5].

Domesticated animals are like humans too. They have the same physiological needs like food, water and attention. But pet owners cannot take their animal friend at work nor always bring them wherever they. On certain occasions and avoidable circumstances, they need to leave their pets at home. Leaving pets, as part of human family is hard, and can provide anxiety for both parties [6]. This system is developed to provide a system that pet owners can trust, and use anytime and anywhere.

1.1 Objective of the Study

The project is about a smart pet care assistant in mobile application through the Internet of Things (IoT) implementation. The project aims to develop an embedded system for house pet monitoring and care. The project includes eating time remote scheduling, camera service monitoring, room temperature and light sensing, smart pet door control, defecation pad cleaning, remote music and voice commands activation at home while pet owners are at work or doing outdoor activities [3].

1.2 Scope of the Study

The project is based on an Android OS version 6.0 Marshmallow. It also uses the microcontroller Raspberry Pi Model B+ as the central brain for all the sensors being used in the project and the medium to the internet for the mobile application. The development of this project used the platform service of Cayenne and Xamarin. “Cayenne” is to communicate with the application programming interface (API) of Raspberry PI and deliver any sensor data that the device would receive from its sensors. Xamarin, is a cross-platform library that enables the developer to create one application to several platforms like Android, iOS and Windows platform. The system architecture is shown in Figure 1.

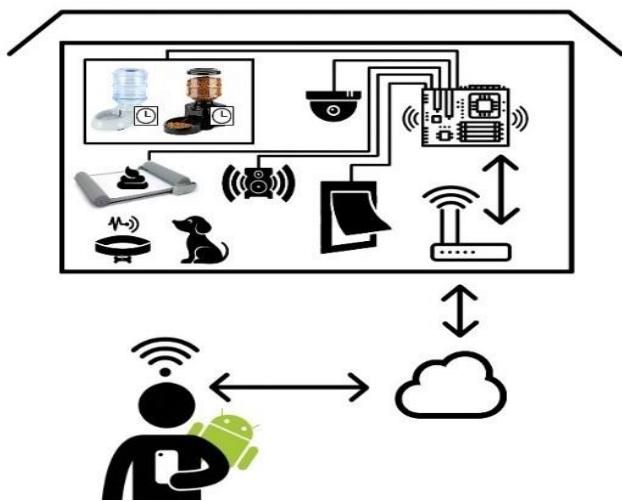


Figure 1. System Architecture of the Study.

2. RELATED LITERATURE

Application areas in IoT are vast that it is so versatile to use in almost about everything. Its capability to connect the various gadget in one network via Internet, through sensors, are making remarkable formula to achieve the goal of smart recognition, position tracking, monitoring and other mean of exchanging ideas [4].

Animal identification using biometrics has been the traditional use radio frequency identification (RFID) in major research issue

animal management. The method of animal identification marks the return of its accuracy through permanent tattoo or microchip implant. But this traditional way has a backlog of providing security to pets. Though systems previously developed are created with known algorithms, a need is still required to fully automate animal recognition [5].

The context of Internet of things (IoT) and Web of object (WoO) has inspired a lot of smart home facilities and development. Presented method for automatic connection of appliances and applied coordination in a smart environment has been tested and proven to have significant impact to human lives to the cooperation applied to various WoO-based smart building and energy monitoring, with data analysis. Developed IoT architecture implemented to smart environment provides level of accuracy in its performance [6] [7].

The pervasive IoT era today has been possible due to connection of multiple object in a Web-based facility. The duplication and redundancy of control has been limited to one, with cooperation, due to the availability of an architecture of Web of Objects platform. Microservices has been established through the principle of reusability of objects in multiple IoT application domains through central objects repository [8].

3. MATERIALS AND DESIGN

This project is composed of seven modules as follows:

Automated Feeding System. This module handles the consumption of the pet, assisted with time schedules and the right amount of food to serve. Controls are made available through the mobile application and both the feeding system and mobile app is connected to the internet. Figure 2 shows the design mock-up of food dispenser.

Defecation routine. The defecation pad can automatically clean up the feces of the pet and contain them in a box for the owner to pick up and throw the waste. Pad can be monitored if the pet has used it or not on the mobile application. Figure 3 shows the defecation pad mock up.

Pet-parent method. This gives the pet owners the ability to have video chat with their pets allowing them to have an online interaction with their beloved ones.

Remote Music Activation. Gives the option to play music for your pets to enjoy their stay at home listening to music.

Room Temperature System. A module that is responsible for the temperature checking of the place where the pet is staying. Through the mobile application the user can check the room temperature to know if the pet is comfortable or not.

Smart door scheme. It gives the pet the access to go in and out of the pet door and to also avoid letting other pets inside the apartment. The sensor is attached to the collar of the pet and the door can sense if the pet is near. Pet owner can activate whether the smart door can open on its own through the pet collar or not.

Surveillance System. Real time access to watch the web camera set up on the house to observe pet behavior when user is away from home. It can be watched through the mobile application [9].

Report Generation. This module collects the data of all sensors for the day and keeps track of its activities for the user to monitor. It can tell how much you've fed the pet, how many times the pet

went in and out of the smart door, can tell the number of times the pet has defecated, and the average of the temperature.

The materials used for this project are the following: Raspberry Pi Model B+ with a RPi T-Cobbler and a full-size breadboard to extend the pins of the Raspberry Pi. Data is received in this module sent by the mobile app and transferred to the designated connected hardware or sensor as enumerated [10].

DC Gear Motor. 6V 77RPM-SGM25-370 is the low powered motor that runs only on 6V but can lower the voltage to 3V. This is used for the rotation of the dispenser fins for the automated food with time schedules. The motor will turn once it is time for it to turn or that the user manually turns it on [11]. This gear is also used for the conveyor belt of the automated defecation pad. It rolls the belt when the pet is done defecating and stops once the waste is packed up on the disposable container



Figure 2. Food Dispenser Design Mock Up.



Figure 3. Defecation Pad Design Mock Up.

Plastic Water Solenoid Valve. 12V - 1/2" NPS is used a hardware used to control the flow of water. The automated feeder comes with, not only for solid food, but also for water to keep the pet hydrated. It requires minimum water pressure and it only flows in one direction [12].

Door Locking System. FS90 Micro Servo acts as the rotating lock for the smart pet door. It is connected to the proximity sensor and that once it detects the pet collar, which is with another proximity sensor, the servo will unlock the pet door and that the pet can now pass through. [13]. Figure 4 shows the door locking interface of the mobile app. Figure 5 shows the Main Menu screen while Figure 6 is the mobile app interface.

Distance sensor. 10CM-80CM Sharp IR Infrared GP2Y0A21YK0F this is the sensor used for measuring short distances. This is used on the smart pet door to detect whether the pet is near the door or not [14].

Barometer. Pressure/Temperature/Altitude Sensor BMP180 used for temperature sensing. This will detect the room temperature and that the user will know if their pet is comfortable with the temperature condition [15].

Camera. This webcam is used a surveillance camera to observe your pet while inside the house. The live feed can be watch through the mobile application [16].

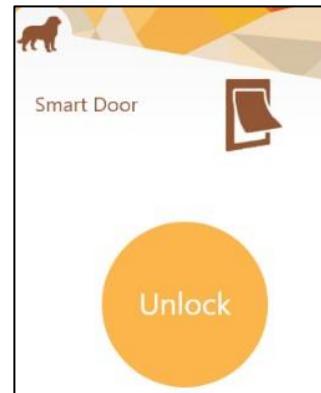


Figure 4. Door Locking Screenshot.



Figure 5. Main Menu Screen.

4. Implementation and Testing

The project's goal is to implement an Internet of Things (IoT) based system to provide a way for pet owners to interact and manage their pet's needs wherever and whenever from a mobile device with an internet connection.

The mobile application is developed for Android platform on version 6.0 (Marshmallow). With this device, the user can control

the system with the given options on the mobile application. Table 1 shows on which version of Android the software has been tested. Based from the results given, the developed mobile application will work best in Marshmallow Android version.



Figure 6. Mobile App Interface Screenshot.

Table 1. Compatibility of the Mobile Application.

Android OS	Nougat (7.0)	Marshmallow (6.0)	Lollipop (5.0)
Performance	High	High	Medium
Smooth transition	Medium	High	Negative
Graphics	High	High	Negative
Responsiveness	Medium	High	High

The Raspberry Pi microcontroller is connected to the household's Internet connection, where in best case scenarios would be online the whole time. Consistency of wireless connectivity from the microcontroller to the internet connection would be unreliable at times due to either on the internet service provider's side or all the bandwidth of the connection is currently being used at the same time when using the application where the command either gets a delayed response or failure to receive the command itself. A solution for the problem was to connect the microcontroller with a direct Ethernet cable to a modem or server to ensure it is consistently connected to the internet. Table 2 shows the connection consistency testing result.

Table 2. Connection Consistency Testing Result.

Testing Method	Result
Wireless commands iteration results	81/90 Command Received
Wired commands iteration results	85/90 Command Received

5. CONCLUSION

The project aims to provide a mobile app where a pet owners can use in taking good care and monitoring the needs of their domesticated animals. Based from the created mobile app design,

the project is able to deliver what has been promised proved with successful Android operating system testing and Internet connectivity. Therefore, it is concluded that this system is successfully implemented with its given purpose.

The project may be of use to anyone who has pets and it requires Internet connection for it to function. The pets will also be common households such as a dog or a cat. However, the project is not accountable to train the pets on using the hardware but assured that the hardware provided will be pet oriented and of ease for the pet owner.

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