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Original Research Paper

Pet Feeding System

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Abstract: The study is to design an IoT (Internet of Things) that can enhance pets care and monitoring. Keeping pets has become a popular among people at the present and one of the best companions that available at home. Taking care pets need effort and time and most of the owner having problem because of their busy schedules. By utilizing the microcomputer and internet, this study will be able to feed and monitoring the pets when owner is away from their pets. We develop the prototype of food dispenser modified with servo motor, webcam, and raspberry pi. A web application is developed to control the servo motor and webcam by sending signal to the raspberry pi. To conclude, from the research we found out 79% respondents strongly agree that pet feeding system are useful and 61% want to buy the system. In future, we hope that feeding system can be apply to animals in the zoo, pet shop, and wildlife department.

Keywords: Internet of Things, Pet feeding System, Raspberry Pi.

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1. Introduction

Pets or the definition name is companion animals that have owner to take care them and keeps company to them such as dogs and cats. Nowadays, the implementation of technologies in daily life is very common. Almost all tasks and activities are done using technologies. Taking care pets also can be done using technology. This show technologies play a very important role, and it is impractical to not use them. Internet of things (IoT) are one of the popular technologies that are being using now [1] [2] [3] [4] [5] [6] [7]. IoT can help owners to take care pets efficiently and do not have to worry with busy schedule. With IoT, owner can monitor their pets at home wherever they are.

Based on the IoT concept, this research will consist of three subsystem that will be combine each other and work together. The subsystem are the performing unit, server, and mobile application. Performing unit consist of vision module and raspberry pi. Owner can view their pet and raspberry pi play the important role to trigger the servo motor to rotate spinner and released the pet food. As important as that, a server for receiving control signal from mobile application was built and deployed in the raspberry pi. Owners use the mobile application to operate the system.

Home automation can be defined as a mechanism removing as much human interaction as technically possible and desirable in various domestic processes and replacing them with programmed electronic systems [8]. Taking care of pets at home using IoT will become popular because most of human nowadays will have at least one pet at their home.

Pets are a big part of life in many parts of the world, and a growing economy often means a growing pet population. Dogs and cats are the most popular pets around the world. At least a household have a cat or dog. Humans most commonly get pets for companionship, to protect a home or the attractiveness of the animals. A Canadian study found that the foremost common reasons for not owning a pet were need of ability to care for the pet when traveling (34.6%), need of time (28.6%) and need of reasonable lodging (28.3%), with dislike of pets being less common (19.6%) [9]. Based on the percentage we can conclude that humans want to keep pets but they afraid cannot pay full attention as they have other activities and time difficulty as they are away from home. Thus, there is so many risks encountered by leaving the pets alone such as obesity, stress, negative interaction. At the same time, pet's daycare may not be suitable with our pet's behavior and that places are usually fully booked in holiday time. Using IoT for intelligent home system to take care small pets such as cats and dogs are the main topics of this study.

For the past years, many companies had built pet feeder but cannot meet the pet owner requirements. This is because the existing pet feeder cannot be control remotely and cannot view the real-time monitoring. These two requirements are the most important because owner get busier with their lives and sometimes forget to take so good care of their pet's time to eat and need some help to relieve their burden. Most commercial pet feeders are stationary machines. Owner cannot control the machines to set feeding time and watch pets' condition from other places.

Having pets at home takes time and effort, the study will apply IoT into the system to enable the pet feeder to become home intelligent system that can be control by owner through their mobile application because the animal owner had trouble dividing the owner's activity time and feeding the pet. The webcam features can take pictures (photographs or videos) processed with the fswebcam and the avconv functions on the Raspberry Pi. The stepper motor can rotate the feed valve by utilizing a General-Purpose Input Output (GPIO) pin and a program which is inserted into the Raspberry Pi. Next, the Raspberry Pi will be connected to the Internet and a server network so that the system control can be done remotely by using a web browser or web view on a mobile. The overall function of the system in the form of feeding the pets either directly or scheduled, as well as monitoring of photographs or videos around the feed.

This Pet Feeding System is design to dispense pet food and monitor the pet. Servo motor and webcam that connected to the Raspberry Pi which will be able to control by a web application.

2. Literature Review

2.1. The Importance of Applying Iot in Pet Feeder

The work presented by Shih et al. [10] stated that pet owners cannot share their caring task with other and it is impossible to pay full attention due to the busy work. Next, Wicaksono et al. [9] state that pet owners cannot care their pets optimally because they not always with them. Pets that are being leave alone can encounter the risks of having obesity, stress, negative interaction with other animals, etc. The other problem stated were our pet behavior maybe not suitable with pet daycare and that places are usually fully booked in holiday time. Wang [11] stated that pet owner cannot take care of the pet

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remotely and the professional pet cases and feeding device on the market cannot meet the requirements of remote control and real-time monitoring. Lastly, Anggraini et al [12] stated that keeping pets at home need efforts and times. Based on the problems stated above, all the researchers come out with solution to build Pet Feeding System with the implementation of Internet of Things (IoT).

2.2. Previous Research

Provious research related to the Pet Feeder System listed in Table 1.

Table 1. Provious Research Related to the Pet Feeder System

Author	Title	Problem	Method
Wicaksono, et al [9]	Development of Cat Care System Based on Internet of Things	Cat owners cannot be always together with their cat, so cat care cannot be carried out optimally. Thus, there is so many risks encountered by leaving the cat alone such as obesity, stress, negative interaction with other cat, etc. At the same time, cat daycare may not suitable with our cat behavior and that places are usually fully booked in holiday time.	Hardware, software, and communication, as an aspect of internet of things, are considered to build the entire system. The system is divided into several sub-system that is cat feeder, cat playmate, automatic cat door, cat monitor, and mobile apps.
Wang [11]	Design of Mini Pets Feeding Intelligent Home System Based on IoT	Pet owner cannot take care of the pet remotely and the professional pet case and feeding device on the market cannot meet the requirements of remote control and real-time monitoring.	The system was based on the sensing layer, network layer, and application layer, three-layer Internet of things architecture. CC2530 worked as the coordinator of the lower computer and completed the data acquisition of the LAN network through the ZigBee wireless transmission protocol. The STM32 microcontroller was used as the core controller of the lower computer to control the interface circuit of each execution component. The ESP8266 Wi-Fi communication module was mounted on the STM32 to form an embedded gateway, which completed the data transmission between the lower computer and the upper computer and the mobile intelligent terminal.
Huong [13]	Design and Implementati on of a Pet Care System	Not stated	To build a pet feeding machine, a food dispenser, a servo, and a configured Raspberry Pi were connected. The pet's food could be released from the food dispenser as a result of Raspberry Pi triggering the servo to rotate the spinner. A progressive web application for remotely manipulating the pet feeding machine was developed using ReactJS. As important as

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			that, a web server for receiving control signals from the web app was built and deployed in Raspberry Pi using NodeJS. Core features, such as immediate feed and scheduling feed were implemented in this system
Anggraini et al [12]	Mobile based monitoring system for an automatic cat feeder using Raspberry Pi.	Keeping a cat at home takes time and effort.	The webcam can take pictures (photographs or videos) processed with the fswebcam and the avconv functions on the Raspberry Pi. The stepper motor can rotate the feed valve by utilising a General- Purpose Input Output (GPIO) pin and a program which is inserted into the Raspberry Pi. Next, the Raspberry Pi will be connected to the Internet and a server network so that the system control can be done remotely by using a web browser or web view on a mobile. The overall function of the system in the form of feeding the cat either directly or scheduled, as well as monitoring of photographs or videos around the feed.

2.3. Hardware and Software for Pet Feeding System

From literature review, there are hardware and software that are being used by the researcher to build the system. Generally, the system consists of three subsystems. The performing unit, camera and food dispenser are connected to a microcontroller. Then, the microcontroller connects to the internet and a server to enable remotely control using a mobile application. Most of the researchers use raspberry pi as microcontroller for this system. Linux operating system and Raspberry Pi board as development platform [1], to build a pet feeding machine, a food dispenser, a servo, and a configured Raspberry Pi were connected [14] and the webcam can take pictures (photographs or videos) processed with the fswebcam and the avconv functions on the Raspberry Pi.

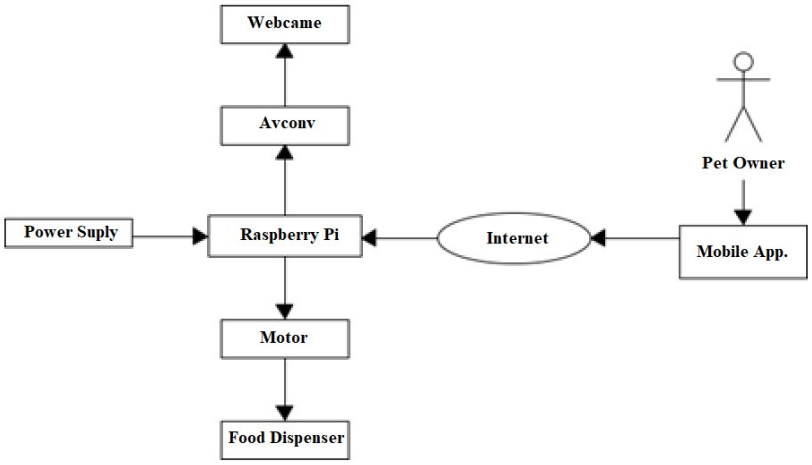

Figure 1. Block Diagram for the System

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The motor can rotate the feed valve by utilizing a General-Purpose Input Output (GPIO) pin and a program which is inserted into the Raspberry Pi. The Raspberry Pi camera module can take full HD 1080p photo and video and can be controlled programmatically. USB camera also can be used by installing the fswebcam package. Two 5V pins and two 3V3 pins are present on the board, as well as several ground pins, which are unconfigurable. The remaining pins are all general purpose 3V3 pins, meaning outputs are set to 3V3 and inputs are 3V3-tolerant.

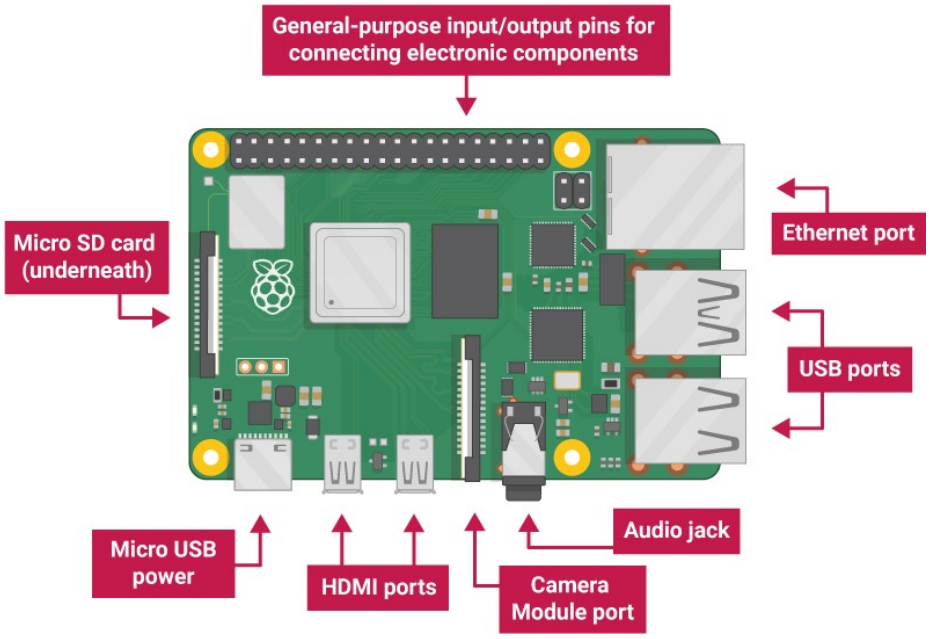

Figure 2. Raspberry Pi Board

3. Methodology

Rapid application development (RAD) model is going to be used. RAD is an agile study management that are popular in software development [15]. The advantages of using RAD for this study is to get a fast result. Researcher can work in a fast-paced environment during the study development. RAD focus more on the prototype development then planning stage [16]. Reducing planning time can help researcher to measure the progress and involve in any issues and changes needed for the study. RAD can consist of four main phases. The phases are requirement planning, user design, rapid construction, and cutover. RAD suitable for small team to allow fast communication with quick meeting for fast information transfer.

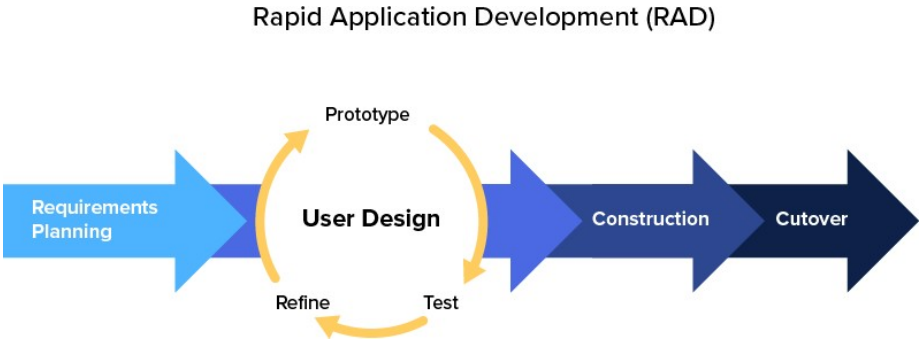

Figure 5. Rapid Prototyping Model

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- Phase 1: Requirement Planning
  This phase is important for the objective number one that is to analyze the need of the system by pet keeper to help them to take care pets at home. The researcher meets with the pet owner as the clients, for an interview. This phase is a critical step for the study to be success and minimize the mistake. A few interview and communication with the clients help the researcher to determine the goals and expectations for the study.
- Phase 2: User Design
  During this phase, the researcher begins the development and achieve study objective number two that is to build a Pet Care System using the trendiest technologies from both the Internet of Things and the mobile application development. Researcher and pet owners will work closely to create and improve on the working prototypes until the final product is ready. The prototype represents all the system processes, inputs, and outputs. Testing is carried out for the prototype and ensure that all the processes is correct and meet the client's expectations. After testing, the prototype will be refine incorporating with the client's feedback.
- Phase 3: Construction
  This is the phase where the prototypes and beta systems from the design phase is convert into the working system. Majority changes and problems faces were solved by the researcher in the phase before, so now the developers can construct the final working model faster.
- Phase 4: Cutover
  The final phase, the finished product is launch. This phase resembles the final task in of Software Development Cycle (SDLC) implementation phase, including data conversion, testing, changeover to the new system and user training. As a result, objective number three manage to achieve by researcher.

4. Result and Finding

4.1. Prototype

The food dispenser is a customize dispenser that will hold all electronics components. The size of the food dispenser prototype is (H230 x W50 x L80mm). The body are made up of aluminum and the food container are from plastic. It is strong material and suitable for the study.

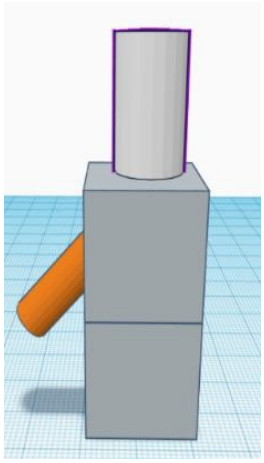

Figure 6. Food Dispenser in 3D Design

4.2. Testing for Pet Feeding System

During the testing phase, the researcher tests all the function of the system to make sure it works correctly. The test result as follow in Table 2.

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Table 2. Testing for the Pet Feeding System

Test	Procedure	Expected Outcome	Result
1	Push button	Food released afterpressing the button	Succeed
2	Login button in web application	The login button is clickable and showing correct output	Succeed
3	LCD	Show message thatprogram to be display	Succeed
4	Feed button in web application	Release food whenpressed	Succeed
5	Scheduling the food	Can set date and timefor food scheduling	Succeed
6	Webcam	Capture pictures	Succeed

The overall analysis data for the Pet Feeding System have shown positive feedback from the potential user.

5. Conclusions

The study finding shows Pet Feeding System is needed among the pet owner to act as assistant for them taking their beloved pet. With the system people will not worry to leave their pet alone. Utilizing Internet of Things (IoT) into pet management give benefits to humans and animals. For the future work for Pet Feeding System, researcher hope this system can be apply in the Zoo, Pet Shop, Wildlife Department, etc. Automation food feeding and monitoring can make animals care easier. New features can be implemented to improve the system. For commercialization part, Pet Feeding System has potential buyer based on the feedback result. This commercialization potential chances can increase when the system can be sold at affordable cost. User can easily install and use the system like plug and play concept.

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