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Pet food dispenser design using Raspberry Pi

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ABSTRACT

A new family dynamic has included a new member as a component, the mascot. However, due to globalization, people have more and more responsibilities, making it difficult for them to be with the animal all the time, leading especially to poor nutrition of the animal as a result. This work provides a solution by using the Raspberry Pi tool to design a prototype food dispenser to improve the feeding of our pets at home. In the application, 3 stages were determined: Prototype Design, Physical Structure Design and Logical Design; making use of the Raspberry Pi. The results of this study showed that the design of the dispenser will have a beneficial social impact. These results could help to facilitate feeding in pets by establishing an automatic dispenser that would benefit family members and especially pets.

Key words : Automatic dispenser, Food dispenser, Raspberry pi.

1. INTRODUCTION

It should be noted that the family dynamic, socially speaking, has been evolving as it now consists of a new member: the pet. Each time, this animal is becoming more humanized until it is really considered one of the family members [1], as can be seen in the considerations that are given to them as the clothes they wear and even, in some cases, the birthday celebrations that are presented to them. Different studies have shown that only in Peru the relationship between individual: can is considerable, as it turns out to be 5:1 in the district of San Borja [2], 5.6:1 in Bellavista [3] and 7:1 in San Martín de Porres [4]. One explanation for this is that the benefit of pets in human health and well-being has been demonstrated [5]; however, due to globalization, people are assuming greater responsibilities and duties, making it difficult for more pet owners to have time to feed their pets [6]. It is this need to feed pets satisfactorily that prompted this study.
For the methodology of this research, the Raspberry pi microcomputer will be developed, which is rapidly gaining popularity in various applications and projects that require an adequate software capacity as well as cost-effective one [7].
Since its launch on February 29, 2012, Raspberry Pi has been characterized by a fast and powerful processor and WiFi connectivity, which can transform it into a web server in the future; on the other hand, it is also important to highlight its affordable price. Thus, this microcomputer is used as a tool for the creation of diverse technological and electronic solutions; some use it as an educational router for the Internet [8], high quality and low cost education [9], image conversion from text to voice in the desired language [10], among others.
The application aims to solve the problem by improving the feeding of our pet at home without the need for the owner to be at the house, which will be achieved through the use of technological tools such as Raspberry pi based on our methodology. So, the Prototype Design of the dispenser will be schematized; in the Physical Design Structure, the materials to be used and the structure in which it will be assembled will be defined; finally, all the programming of the actions will be done in the Logical Design.
Based on the needs of the pet and its owners, the objective is to design the prototype of the automatic food dispenser (meaning food and water) with minimum resources so that our pet is fed properly and the owner does not neglect his dog.
The present work is structured in the following way: in section II the methodology used for the food distribution system and the tools to be used will be described in more detail. Section III will demonstrate the application of the food dispenser. Section IV will show the results and discussions; finally, Section V will summarize the conclusions.

2. METHODOLOGY

Figure 1 shows the stages of the prototype design of the food dispenser that have been taken into consideration for the methodology of this study. It is also highlighted that this prototype design can be adapted according to the various specifications of the customer.

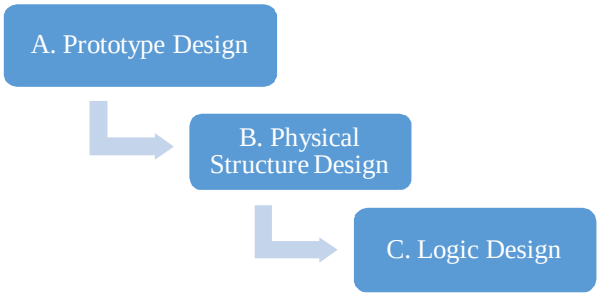

Figure 1: Design methodology diagram of the prototype dispenser

2.1 Prototype Design

This is the stage that refers to the graphic manifestation of the client's requirements for the elaboration of the physical design, without including tangible tests. In order to minimize errors, several layout versions are accepted in accordance with what the client wants.

A. 3D Slash

This tool is characterized by being one of the simplest 3D design software nowadays, the user can build his designs based on blocks or cubes giving them the shape and structure he wants. It is said that it is for people who are just getting into 3D design because it has a friendly and interactive interface, and it is also free to download and compatible with Windows, Mac Os and Linux.

2.2 Physical Structure Design

When the prototype design is finished based on the requirements of the client, the materials with which the layout is to be implemented will be chosen. Among the most used are metal, acrylic, plastic, cardboard, wood, etc. Therefore, at this stage, the main and secondary parts are identified in order to better organize the assembly, in addition to taking the measurements of the parts.

2.3 Logic Design

It should be noted that at this stage, preferably electronic materials are used in order to assemble circuits and these can show a result. At this stage, the materials that should go into the digital circuit simulator will be properly studied in order to minimize the loss of electronic elements and to function correctly.

A. Fritzing

It is a software that allows you to make electronic designs in a friendly way and facilitates the searching of elements as shown in Figure 2, we can also observe that it has a protoboard view, a schematic view and a PCB view; besides having a tab with a wide range of electronic components. It is characterized by being open source and is available for various operating systems (Windows, Linux, MacOs).

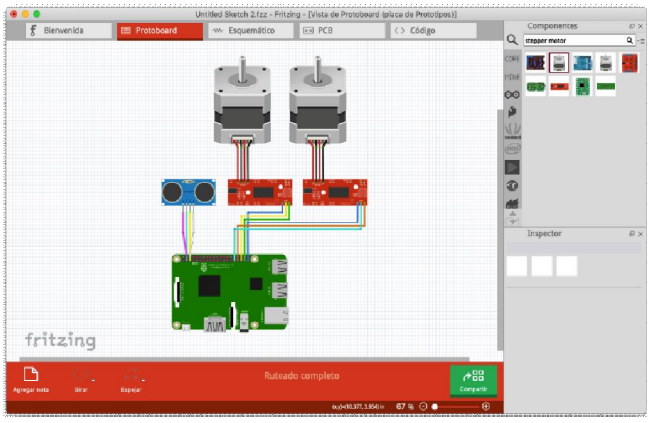

Figure 2: Fitzing simulation software interface

B. Raspberry Pi

It functions like a typical personal computer (PC), which requires an input keyboard, display unit and energy source, and as a network server, if no peripherals (keyboard and display) are required [11].

C. Movement Sensor

Sensors have been developed as electronic devices consisting of sensible cells capable of measuring specific physical parameters such as light fluctuation by means of a photoresistor, temperature through a thermistor, in order to identify flames, noises, motions, or all other fluctuations occurring throughout a given space. Therefore, sensors represent specific physical components enabling us to either detect a specific physical parameter or to measure something in the immediate environment of the sensor [12].

D. Stepper motor

It may be described like a motor without brushes that has been specifically designed to input digital signal, so it is receiving pulses coming out of the microcontroller or other electronical circuit and working correspondingly. In addition, the stepper motor can be utilised to monitor the accurate rotation and velocity by means of the open-loop control [13].

E. Driver Motor

It is characterized by being a motor controller, which makes it obtain low frequency signal and convert it into high current signal so that it can drive the motor and make movement.

F. Raspbian

This is the operating system that Raspberry Pi works with, which is free of charge since it is based on the Linux distribution called Debian. It also has exclusive packages for the optimal handling of Raspberry pi.

3. APPLICATION

3.1 Prototype Design

At this phase, the possible design of the physical structures was created. For this, the 3D slash tool was used which enabled the creation of a 3D sketch of the prototype pet food dispenser. Thus, the creation was made based on the requirements to meet the needs of the animal and its context, without performing complex actions. Figure 3 shows the draft which shows the division of 2 main parts. The first one is the water storage, and the other one is the food storage that will be provided to the animal at home.

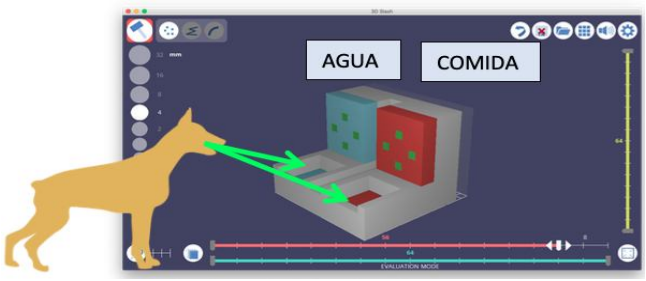

Figure 3: Relational draft: Prototype - Dog

3.2 Physical Structure Design

At this stage, construction was carried out on the basis of the prototype obtained with the help of the 3D Slash tool. The advantages and disadvantages of each material available for the work were evaluated. From this, it was decided to use the acrylic material due to its strength, flexibility when working and its economical price. In addition, there is no risk of the animals being harmed due to cuts, injuries, etc.
The fundamental pieces that will make up the dispenser are:

A. The storehouse:

Here all the food for the dogs will be kept; similarly, in the other division, the water will be held.

B. The base container:

This is the final container that is located in the lower area in order for the animal to consume its food.

C. The upper, lower and side parts:

They are in charge of protecting the logical part, the electronic elements so as to prevent them from being damaged by the animal or a third party.

3.3 Logic Design

At this stage, the design of the program that can control the sliding of food and beverages will be carried out. The Raspberry pi computer will be used due to its low cost and its data processing capacity similar to that of a pc.
Since there are several terminals, these may be configured as ports and inputs. Likewise, sensors will be used, which fulfill the function of identifying the animal when it approaches and consequently, emit a response which, in this case, would be the displacement of the food.
A driver motor will be used, which will convert the electrical current into mechanical current, and thus feed the Stepper motor so that it begins to make a rotary movement, managing to move the motor and slide the food, as well as feeding energy to the Raspberry Pi, as shown in Figure 4.

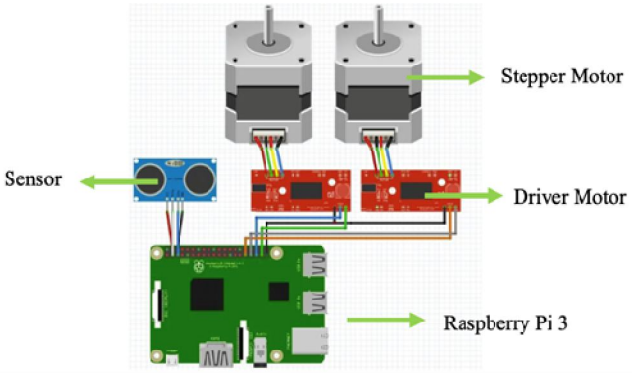

Figure 4: Protoboard view in Fritzing software of the prototype dog food dispenser

At this stage, Raspbian, which is the OS of Raspberry, will be used. The necessary packages (sensors) will be installed for the software to operate and perform programming based on the requirements.

4. RESULTS AND DISCUSSION

4.1 About the Case Study

Figure 5 [14] shows an approximation of the desired result for the present research. However, the Lancheros-Cuesta et al. study [14], differs from the present one as it did not include the recognition of the approach of the animal to the dispenser. Relevant and innovative quality for the field of study.

Figure 5: Desired Dispenser Design Approach [14]

4.2 About the Methodology

The main tool used in this paper is the Raspberry Pi, which has been selected as the processing unit for the system based on its user-friendly features and financial benefits [15]. As it is small in size, this unit offers advantages of portability and installability in every situation. It contains many facilities such as camera connector, Ethernet port, GPIO pins for connecting sensors and switches and USB ports for connecting to external devices (such as keyboard, mouse, Wifi adapter, etc.) [16].
However, currently there is a huge variety of methodologies for the design and implementation of a feed dispenser, as seen in the study by Hye et al. [17], in which a fish food dispenser was made in conjunction with the Arduino Mega tool, as shown in Figure 6. Although this tool was appropriate for the study mentioned above, it differs from the Raspberry Pi, since it does not have an Ethernet port for network connection, which could be an advantage depending on the use of the user.

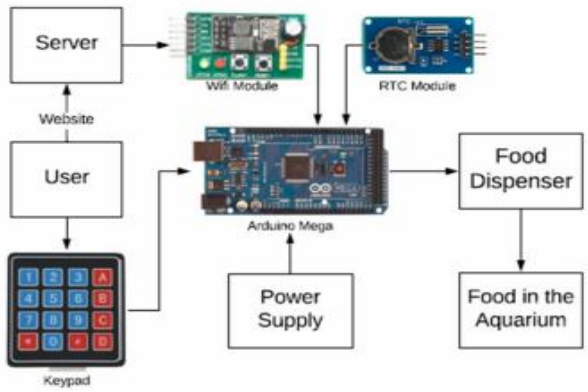

Figure 6: Arduino Mega tool in fish food dispenser [17]

5. CONCLUSION

The pet food dispenser showed positive and interesting results during the simulation. These results help the pet owner to get organized in feeding the pet and to avoid that the pet is prejudiced, especially if the owner is absent because of long working hours or unexpected journeys that may arise.

Regarding the methodology, it has been demonstrated that Raspberry Pi is a very flexible tool because it helped with the pins in the communication with the motor driver, the sensors and the motor stepper so that the food slides when the animal approaches; furthermore, its accessibility and great range are highlighted.

For future studies it is recommended to take into consideration how many kilos of food or liters of water the dispenser can hold, with the aim of having a constant refill that benefits the health of the pets. On the other hand, although the case study of this research was to focus on a food dispenser, it is reiterated that Raspberry Pi has proven to be a flexible tool; therefore, it is considered capable of contributing to social problems such as problems in education, economy, etc.

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