Therapalz Collar

ECE 445 Design Document

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1 Introduction

1.1 Objective

'Therapalz' was a project pitched in class by Ms Fiona Kalensky. It is a a smart therapeutic companion animal which provides both comfort as well as company to patients suffering from Alzheimer's. The original animal has a realistic heartbeat, calming vibrations and makes a purr sound to replicate the behavior of a real cat. However, Ms Kalensky wanted certain external controls on the animal like an on/off button. She also wanted to improve the battery life of the animal. She also wanted a way for caregivers to adjust the settings of the animal as well as have a way to track the animal as Alzheimer's patients have a tendency to hide things. Hence, we propose to work with the existing design to design a smart collar which will have on/off and mute buttons, a tracking mechanism, light sensors which will put the animal to sleep when it is dark in the patient's room, an accelerometer which will sense the patient's activity level, a microphone sensor which will change the behavior of the animal based on the loudness/softness of the patient's voice, and finally a rudimentary app which will help the caregiver adjust the settings of the animal based on his/her need and preference.

1.2 Background

Alzheimer's is the most common form of dementia which causes problems with memory, thinking and behavior. It is a progressive disease with symptoms usually developing slowly before getting worse over time. Patients in early stages, have mild memory loss but as they get older, they begin to lose their ability to respond appropriately to their environment or even carry a conversation [1]. Alzheimer's affects about 5.5 million people older than 65 every year in the United States. Additionally, about 200,000 people under the age of 65 are affected with early-onset Alzheimer's in the United States. One in ten people age 65 and older have Alzheimer's disease and about one-third of people age 85 and older (32 percent) have Alzheimer's disease [2]. Alzheimer's is also the sixth leading cause of death in the United States [1]. Despite these startling numbers, there is currently no medical cure to Alzheimer's. This is the reason why several organizations and people have dedicated their lives to develop non medical methods to improve the quality of life of these patients to the maximum extent they possibly can.

There are several studies that have proven that pets have a positive impact on patients suffering from Alzheimer's. Pets are a great companion for patients with dementia as they help reduce anxiety, agitation, irritability, depression, and loneliness [3]. However, it is not always feasible or practical to have and look after a pet in a long-term care facility. This is why when Ms Fiona

Kalensky proposed the idea of 'Therapalz', a stuffed animal that replicates certain behavior of an actual pet, our team thought this was a perfect solution to the problem.

1.3 High level Requirements List

- **Concealability** : We would like for the buttons to be concealed in such a way such that the patient cannot accidently turn them on or off and mess with the settings of the animal. We propose to have some sort of mechanism similar to that of a locket so the buttons can only be accessed when actually intended too.
- **Sensors** : We would like to make sure that the sensors are strategically located such that they behave as intended. For example, we want the light sensors to be able to detect when the entire room is dark so it can put the animal in sleep mode to both conserve battery as well as to go mute so it doesn't disturb the patient while he or she is asleep.
- **Tracking** : We want to make sure that the animal can be tracked relatively accurately within a room even when faced with obstacles. We also want to make sure that the speaker installed on the collar makes a noise when called so it can help the caregiver locate the animal easily.

2 Design

2.1 Block Diagram

For the collar to work successfully, the power unit, the control unit and the communication system need to work harmoniously. The battery provides the collar with power. The control unit contains all the sensors along with the microcontroller which will behave as described in pre-programmed settings. The bluetooth with the help of beacons will be used to locate the animal as well as to communicate with the app and others part of the animal. Finally the app will be used to track the animal as well as adjust different settings of the animal.
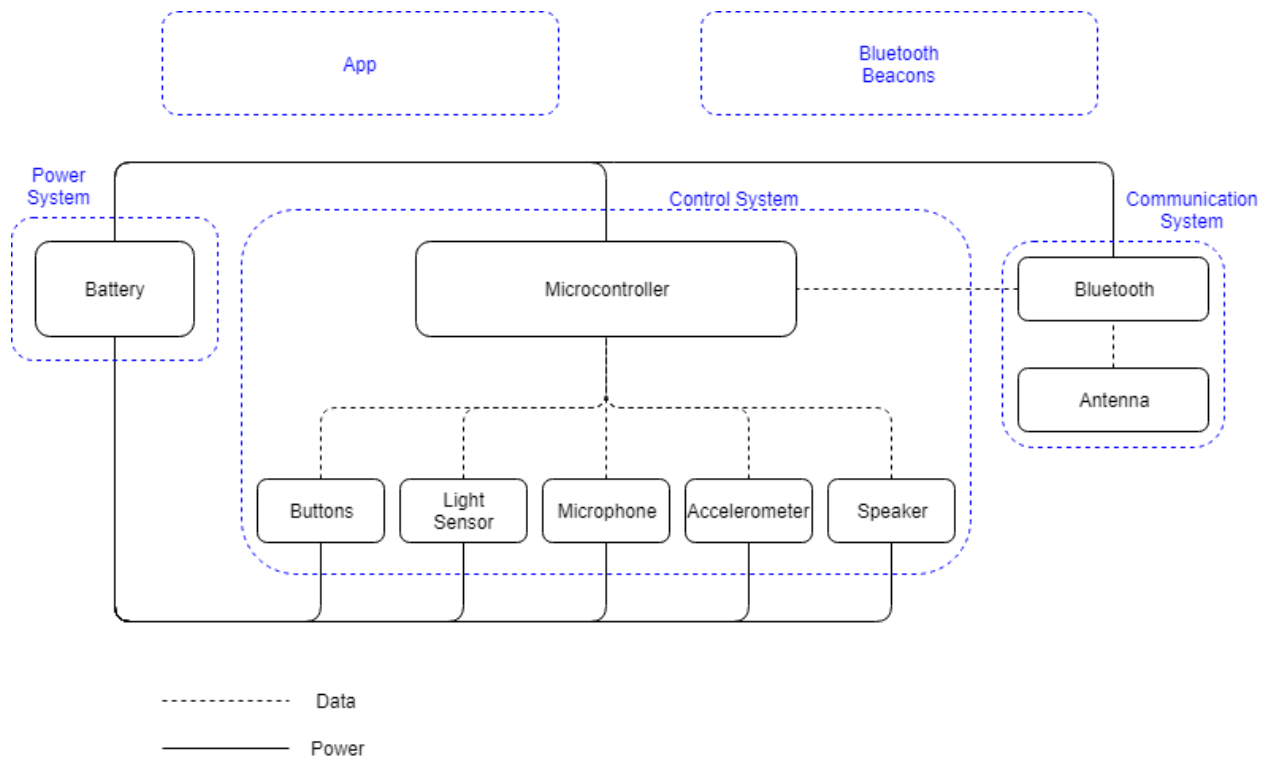
Figure 1: Block Diagram

2.2 Physical Design

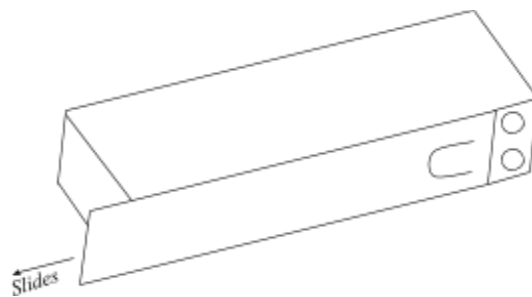This is a schematic representation of what we hope the outer casing of our device will look like.

Figure 2: Outside casing of device

2.3 Function Overview and Requirements

2.2.1 Battery:
CR2032

2.2.2 Microcontroller:
ATmega328/P

2.2.3 Bluetooth module:
Texas Instruments CC2541
Texas Instruments CC2564MODA

2.2.4 Antenna:

2.2.5 Bluetooth beacons:
RadBeacon Dot

2.2.6 Power/Mute buttons:

2.2.7 Light sensor:

2.2.8 Microphone: MEMS Mic

2.2.9 Accelerometer:

2.2.10 Speaker:

TDS SupTDS SuperSonic Small Sugar Cube Speaker

3 Cost & Schedule

3.1 Cost

3.2 Schedule

4 Ethics and Safety

We plan to conform to and follow the IEEE Code of Ethics in order to preserve the health of our product's users and their privacy, as well as to disclose potential dangers our project might pose to the users.

4.1 Potential Hazards

Alzheimer's, also known as senile dementia, is a form of dementia. A common consequence to this is that there is often an increased sensitivity towards noise that is often overlooked. Our feature of using noise to locate the pet in the case that it becomes lost is similar to that of an alarm or a pager, sources of noise that are recommended to keep at a minimum [5]. In order to try to keep the emotional health of our intended users in mind, we have incorporated the idea of using tracking via Bluetooth, so that resorting to the noise method is only applicable in extreme scenarios.

In addition to this we must take care to develop the noise we use for locating the pet to be distinct yet unobtrusive. As such it is important to understand a certain constraint on the decibel

levels of said sound. Nearing dB levels of 100, exposure for longer than 15 mins can cause possible damage to the patient's hearing [6].

Another potential hazard is as a result of having a battery in a product where the stuffed animal is in part sufficiently flammable, it is a concern to make sure the battery is never damaged in such a way that could lead to it catching on fire. Care must made to make sure the battery is not put into conditions that might result in extended overheating, which could also lead to fires.

4.2 Potential Privacy and Security Infractions

The use of accelerometer and Bluetooth data in tandem can be used to track the motion the user as they move throughout their rooms, and as such poses a significant breach of privacy. This is especially a concern considering this data will be sent through Bluetooth to the phone app. What we propose to do is to encrypt the data being sent and received with private keys for the sake of the prototype.

5 References