Senior Design 1 Initial Project Document

Robo-dog: Emotional Support Robot

Department of Electrical Engineering and Computer Science

Group 29

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Section 2

This project seeks to provide users with an alternative to live animal emotional support companionship. There is an increasing number of people, old and young, suffering from loneliness and anxiety at home, with not many alternatives to traditional cats or dogs. Emotional support animals require time and money to take care of. This can become overwhelming or untenable for many people. Furthermore, some people in need of these animals have allergies or a family member with allergies that do not allow obtaining an emotional support animal. Therefore, an autonomous robot that mimics the basic behavior of an emotional support animal, tied with the functionality of a virtual assistant such as Amazon's Alexa ™, could provide a sense of companionship without the need for continuous expenses.

The goal of the project is for it to be:

- light-weight (easy for the average adult to pick up and carry),
- portable
- not prohibitively expensive
- easy to use
- autonomous
- interactive
- reliable
- long use time

The overall goal of the project is to have a portable, easy to use autonomous robot that can be interacted with to perform both the functions of a virtual assistant, and the functions of a dog. The expected size of the robot is around the size of a small dog, like a Chihuahua. The majority of the robot costs will be in creating or purchasing the overall product. Maintenance should be cheap as it will be rechargeable and should last a decent amount of time. One of the goals is to make the robot easy to use. The commands should not be so complicated that the user must remember specific random sentences. Rather, the actions of the robot should be tied with the definition of the phrases commanded by the user.

The objectives of the project are to integrate a virtual assistant into the robot and have the robot perform certain actions that make it mimic an emotional support dog. These include following the user, standing still on command and "sitting" (by folding the legs). Moreover, because the dog is electronic, we are capable of making it even more useful than a regular emotional support dog. The robot dog should be able to display information or data onto a screen located where the eyes would normally be. Furthermore, the dog will also be linked to a smart assistant and will be able to use all functions that are included with this capability. These include searching queries on the internet, controlling smart devices at home, and setting reminders. The other objective of the project is to make the robot act like a dog. Some planned functions include wiggling its tail,

following the user, and sitting on command. The function of the project is to have a useful and understandable robot which gives the user a positive experience. As a reminder, the robot dog should give a general sense of companionship. For reference of the basic physical frame of the robot, see common children's toys such as:"Remote Control Robot Dog Toy" by Top Race (https://www.amazon.com/Remote-Control-Dancing-Imitates-Animals/dp/B08G6PT5DC/). Like the plan of our own robot design, this robot uses wheels for its legs for easier mobility. The overall shape of the robot is also a good reference on how to make the shape of our robot dog. This reference is only an insight on how we plan to design our robot physically.

Section 3

Requirement	**Description**
Movement capability	• Motors need to be able to move joints fluidly and support the robot structure. • Wheels need to have enough torque to move the entire robot at a pace where it can follow the user.
8-hour battery life	• Minimum battery life for all day usage on average. Can be tested by extrapolating from an hour of use.
Virtual Assistant integration	• Connects with a virtual assistance API to perform default tasks. • Capable of performing new commands. • Connects to the internet via WiFi. • Has the bluetooth capability integrated in the virtual assistant.
Voice recognition	• Recognizes specific voice input commands to perform specific tasks. • Capable of receiving a command after being called by name.
Audio response	• Speakers should emit "doglike sounds" to announce presence, audibly show whether it has understood certain commands, and interact with other requirements as needed • Speaker sounds should be crisp enough that everything can be heard well • Volume level adjustable.

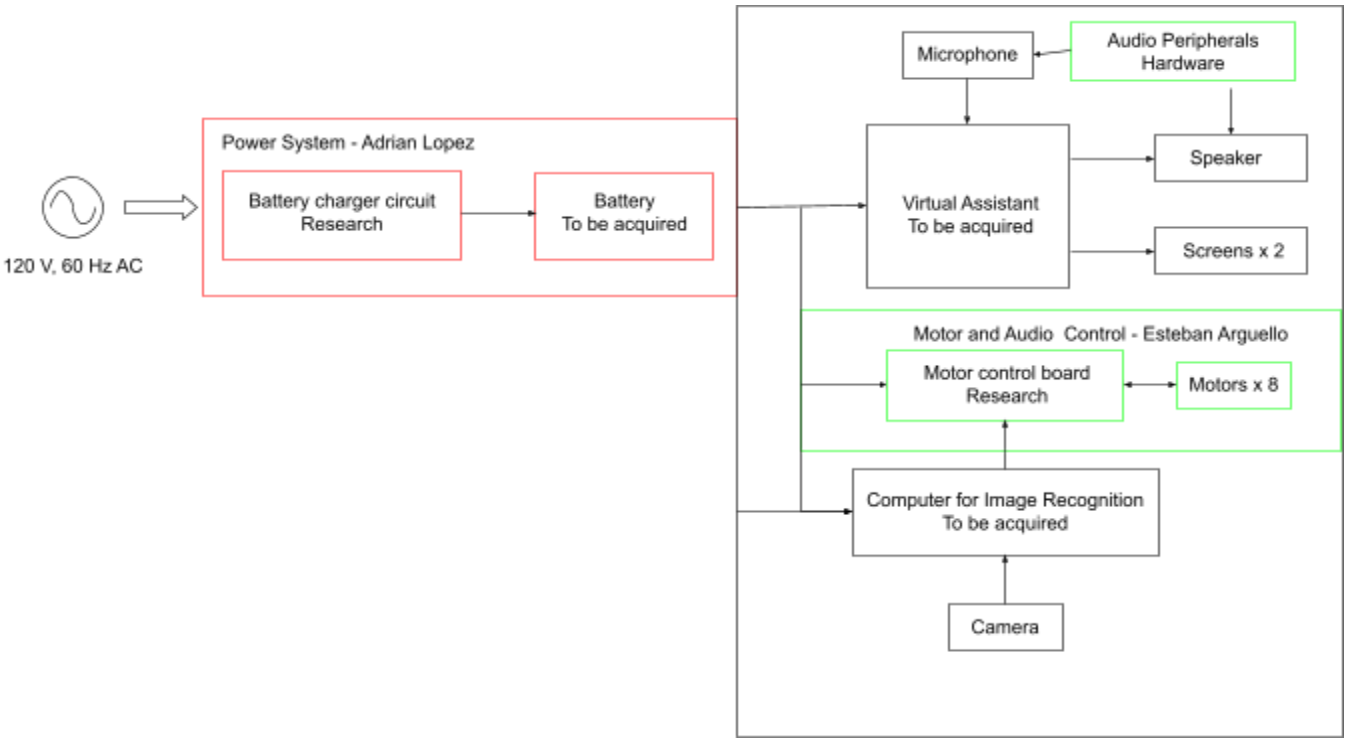
Detection of when it is petted	• Using touch sensors in specific areas, the device should detect and produce sounds and specific movement to represent doglike behavior. • Should be sensitive enough so that the touch is not rough, but not so sensitive that it reacts on anything softer.
Display capability	• Displays the time and/or date. • Displays search results.
Wake up function	• Goes into standby if it is not used for a certain period of time. Can be reactivated by touch or voice command.
Reset button	• Button that fully resets the robot in case there is malfunction. • Not too easy to press, but fairly easy to access.

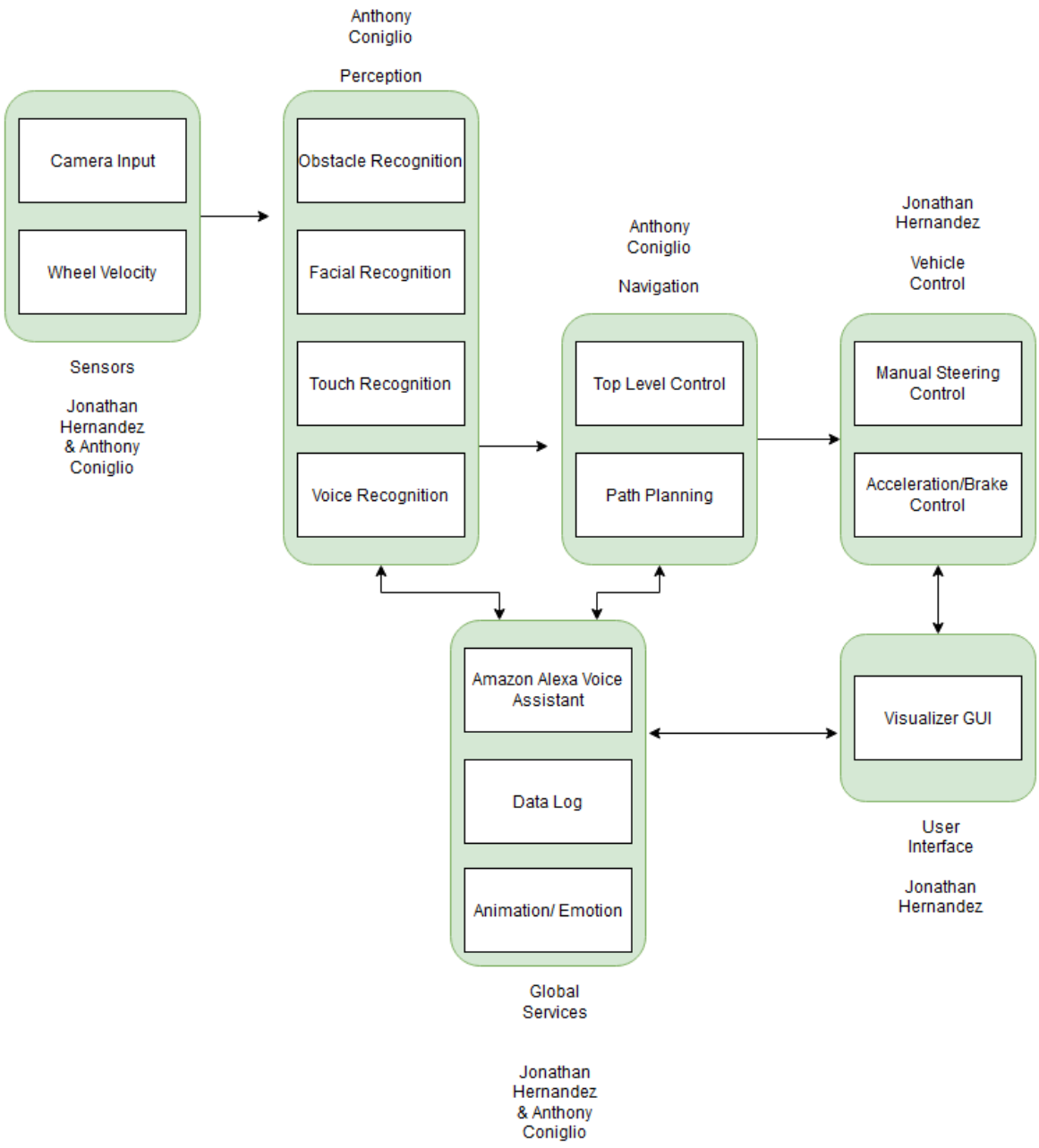
Constraints	**Description**
Audio sounds must be separate	Audio sounds must be played one at a time to avoid confusion and interference.
Device cannot overheat	The device will be on continuously and in a relatively closed casing.
Robot needs to be light-weight	The robot needs to be comfortably lifted by an average adult.

Standards	**Description**
USB	For communicating between the robot and a computer when plugged in, and potentially (pending further research) for charging the battery.
RS-485	For controlling the various motors throughout the robot. (A different standard may be selected pending further research)

Part name	Description	Possible numbers
Motors	Motors will be used for the wheel legs, neck, tail, and joints.	8
Camera	The camera will be integrated near the eyes for use of AI vision.	2
Screen	Screen will replace eye sockets and used to display information	1 rectangular
Microphone	Used to receive audio input for commands	1
Speakers	Located where the ears would be. Gives output audio.	1 or 2
Wheels	Used instead of legs for easier mobility.	4
Controller	Goes inside and controls peripherals.	2
Battery	Inside powering all electronics.	1
Charging supply	Connected to battery.	
Virtual assistant	“Brain” of the robot; most likely located where the brain normally goes.	1
Plastic Casing	3D printed body	
Touch sensor	In the back for “petting detection”	1

Section 4


120 V, 60 Hz AC
Power System - Adrian Lopez
Battery charger circuit
Research
Battery
To be acquired
Microphone
Audio Peripherals
Hardware
Virtual Assistant
To be acquired
Speaker
Screens x 2
Motor and Audio Control - Esteban Arguello
Motor control board
Research
Motors x 8
Computer for Image Recognition
To be acquired
Camera



Section 5

Part name	Description	Possible numbers	Cost
18v DC Motor Drill RS-550 D-Shaft 1/8in / 3.175mm Shaft - Fan Cooled High Torque 20K RPM Power Tool Replacement Upgrade 18 Volt (12v - 24v DC) DIY Electric Projects Robots	Motors will be used for the wheel legs, neck, tail, and joints.	8	8 x $15.45 = $123.60

Remote Controlled Car			
0.3 MegaPixels USB Camera for Raspberry Pi and NVIDIA Jetson Nano	The camera will be integrated near the eyes for use of AI vision.	2	2 x $8.50 = $17.00
Adafruit Animated Eyes Bonnet for Raspberry Pi Pack	Screen will replace eye sockets and used to display information	1 rectangle	$49.95
Electret Microphone by Sparkfun Electronics	Used to receive audio input for commands	1	$0.95
Gravity Digital Speaker Module	Located where the ears would be. Gives output audio.	1 or 2	2 x $6.00 - $12.00
360 Robot Vacuum Universal Wheel S6	Used instead of legs for easier mobility.	4	4 x $13.45 = 53.80
Arduino Uno R3 Microcontroller Board.	Goes inside and controls peripherals.	1	$44.90
LAMPVPATH (Pack of 2) 4 AA Battery Holder, 4 AA Battery Holder with Leads, 4 AA Battery Holder with Wires	Inside powering all electronics.	1	$5.98
3.7V LiPo Battery Charger	Connected to battery.	1	$12.00
Echo Dot (3rd Gen) - Smart speaker with Alexa - Charcoal	“Brain” of the robot; most likely located where the brain normally goes.	1	$39.99
Plastic Casing (3d printed)	3D printed body		Cost of raw materials
Gravity Gesture/Touch Sensor	In the back for “petting detection”	1	$9.90
Total Amount			**$370.07**

Section 6

The initial project milestone for the first semester is primarily putting together all the necessary paperwork that is needed when building a project. In order for us to pitch the project idea to someone who is interested, we need to not only have a working project, but the paperwork to back it up. Additionally, these documents help guide us as engineers to have working knowledge of all the hardware and software components in use for the project. To create this paperwork, we

will need to do extensive research on the technology available, parts that could potentially be used, and other projects similar to this one. This research will help create the project that we desire while also keeping cost, efficiency and reliability in mind. By the end of the first semester, we should have a clear idea on how we will build the prototype which is the milestone of the second semester.

The initial project milestone for the second semester is to use all the components listed in the report and the research gathered in the first semester to start building a project and have a working prototype to demonstrate to people. To fully accomplish this milestone , we want the project to be actively responsive to the user and autonomous in its avoidance of objects and recognition of people. The robot should act like a dog while also using its capability as a smart device to be a virtual assistant. Thus making a smart robodog.