ENGINNERING DESIGN
FINAL PROJECT REPORT FORMAT

Joey the Companion Robot
Group #4
Luis Ramos & Vinitha Tadepalli
Dr. Hary Kalva
CE & CS
December 6th, 2019

Inspired by Dr. Farber's work with the elderly, her solution to the loneliness epidemic was our project design. Made from NVIDIA's Jetson Nano and a Google Voice Box, this companion robot is affordable and the solution to those left isolated by their friends and loved ones. Joey aims at solving this issue in the elderly and hopefully anyone that needs comfort and connection to the outside world. Our robot dog is a solution backed with technology and empathy, a pioneer in empathetic robotics. By allowing people to communicate with it while analyzing their emotions using vision Joey, the robot will allow humans to see robots as companions. This will allow the elderly demographic a chance to feel less isolated and that they are always care about.

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Contents

1. Introduction

1.1. Problem Description

A. The loneliness epidemic found within the elderly community.
B. Lack of affordable technology available to assist the community
C. Social Isolation causes a decrease in motor function.

1.2. Significance of the Problem

A. This is an important problem to address because loneliness is harmful to the health of a senior citizen. After much research and understanding one can see that there is a loneliness epidemic especially in the elderly demographic population. Due to feelings of social isolation there are people that are suffering. Targeted to make people feel comfort and connect to their interests and network.
B. The elderly community and those in society in need of company benefit from this solution.
C. Existing solutions like most other smart assistants like Joey are too expensive

1.3. Overview of the Solution

A. Conversational robot with the look of a Yorkie dog able to move about. Our solution to the problem was a conversational robot that could have an outer shell resembling a dog. This robot would have audio output filled with positivity as well as any needed requests such as time and weather. The robot would also help people keep in touch with family members by accessing and reading their social media out loud. The robot is also mobile and therefore is able to move to wherever the person is located. This can be helpful with elderly people who might not be able to move.

1.4. Goals and objectives

The goal is to develop a conversational companion robot able to move around. The specific objectives are:

1. Implement emotion detection (Luis)
2. Implement motion (Luis)
3. Implement object detection (Luis)
4. Design Joey the robot dog (Luis, Vinitha and Dr. Farber)
5. Design voice capabilities (Vinitha)
6. Implement Social Media connectivity (Vinitha)

2. Related Research

1. Sony Aibo
2. Gizmo the Robotic Puppy
3. Nao Robot
4. Anki Cozmo and Vector

Our project is not the first of its kind. A quick Internet search for “robotic dog companion for the elderly” will produce a multitude of results. For example, Ageless Innovation, LLC, has already released a line of Joy For All Companion Pets© that are tailored to “bring comfort, companionship, and fun to elder loved ones.” Healthcare Products, LLC created a website, The Alzheimer’s Store™, that allows people to purchase companion robot pets that provide comfort to those suffering from Alzheimer’s and dementia. In fact, it is now well known that robot pets are available to keep the elderly company.

In addition to the general information mentioned above, specific patents are available online that describe designs similar to our project. We have reviewed some of these patents to get a better understanding of how we should design our project. We reviewed six patents, comparing each to our project with respect to similarities, differences, strengths, and weaknesses. The following presents our reviews:

1st Patent

Team Member Responsible: Keren Jean-Fort

Patent Number: US9796078B2

Title: “Companion robot for personal interaction”

Inventor(s): Colin Angle, Clara Vu, Matthew Cross, and Tony L. Campbell

Assignee: iRobot Corporation

Date Filed: 2013-10-02

Date Granted: 2017-10-24

Number of Claims: 20

Summary of Patent:

Though there are robots already existing to interact with humans, these usually come with significant design flaws with respect to human use. At best, the robots are general-purpose companions that are not tailored to the specific individual’s home (e.g. the robots are so small that they can be trip hazards to those with balance issues) or preferences. At worst, the robots are so large and heavy that they can only be used in institutions (e.g. hospitals) and may make the user uncomfortable.

The 1st patent of this report describes a number of robot systems for human-friendly communication and home use. Human- and home-friendly features of the proposed systems include: a size that is appropriate for indoor home use (roughly human size); quiet parking in an area of the house where the robot is not likely to be an inconvenience (e.g. charging dock, nearby bedroom); a constantly-running program routine to search for, call the name of, and follow the user until the user communicates otherwise; a personalized health management subsystem, which involves storing the user's health information, scheduling medication dosage and consumption, communicating to the user relevant health-related schedule times, and even dispensing medication; a text- and audio-based communication subsystem that allows the robot to hear and respond to user questions (using its database or the Internet) – even with gestures such as a head nod; a household management subsystem that scans the home to inform the user if the house should be cleaned, checks the household inventory (by scanning RFID tags or barcodes) to determine if the user should go shopping, assists the user while shopping (also by scanning RFID tags or barcodes), and communicates with scheduled visitors (contractors, service providers, caregivers, etc.); and a home entertainment control subsystem.

Discussion:

The patent is relevant to our project because our project idea is a robotic companion as well. This patent is similar to our project in some important ways: the patent idea, like our project, is meant to be user-friendly; the patented system, like our project, will manage the user's daily medication routines; the patent idea, like our project, will search the Internet in response to the user; the patent idea, like our project, will search for and follow the user; and the patent idea, like our project, will have an object and person detection system involving image analysis and voice recognition. The most important difference between the patent and our project is that our project will have a puppy-like body; the patent system's body is humanoid. Other relevant differences involve the patent's additional body heat (IR) sensor for person recognition (our project, as it currently stands, will only use facial and voice recognition) and the patent's medication dispenser (our project, as it currently stands, will not have one). Should the need arise, we may consider incorporating an IR sensor into our project design to improve object and person detection. The medication dispenser will most likely not be a part of our design due to the relatively small size of our proposed robot.

2nd Patent

Team Member Responsible: Keren Jean-Fort

Patent Number: US8909370B2

Title: "Interactive systems employing robotic companions"

Inventor(s): Walter Dan Stiehl, Cynthia Breazeal, Jun Ki Lee, Allan Z. Maymin, Heather Knight, Robert L. Toscano, and Iris M. Cheung

Assignee: Massachusetts Institute of Technology

Date Filed: 2008-05-08

Date Granted: 2014-12-09

Number of Claims: 20

Summary of Patent:

Socially interactive robotic companions can be and are being used to assist people with difficulties communicating verbally, such as autistic patients. The robotic companions can also provide social interaction for those who are socially isolated; examples include online students who are isolated from their teachers and other students, and the elderly who are isolated from their children. Unfortunately, the mechanical and physical design of most robotic companions are not natural enough to convince users to continually and socially interact with the robot. The design limitations involve texture, appearance, and motion.

The 2nd patent of this report describes a Teddy bear-like robotic companion that can interact with the user socially and respond to the environment naturally. It features a Teddy bear texture and appearance; a collection of pressure, proximity, and temperature sensors to receive inputs from the environment and react realistically; and a system of motors arranged to provide quiet, realistic motion.

Discussion:

The patent is relevant to our project because our project idea is a robotic companion as well. The patent is similar to our project idea in some ways: both the patent idea and our project idea will have a recognizable body, both ideas will use sensors to respond to the environment, both ideas will be mobile, and both ideas will socially interact with the user in a user-friendly manner. Relevant differences involve the patent's additional realistic, touch-sensitive texture (our project, as it currently stands, will not have it) and the patent's realistic motion (our project, as it currently stands, will not have it). Should the client desire arise, we will incorporate realistic, touch-sensitive texture and a quiet, realistic movement system into our project design to enhance user comfort.

3rd Patent

Team Member Responsible: Luis Ramos

Patent Number: ZR20170022717A

Title: "Pet robot that elderly people get around just in time to eat"

Inventor(s): 최성

Assignee: 최성

Date Filed: 2015-08-21

Date Granted: 2017-03-02

Number of Claims: 1

Summary of Patent:

Robot pet acts like a dog making sounds after a successful attempt at delivering medicine. This is accomplished through color sensors and smart organization by days of the pills to pick out the elderly's medicine using its cranes. It has a main base system called the doghouse where it goes back to after serving the user, connecting to it by the use of bluetooth and distance sensors.

Discussion:

This design is relevant to ours' in such a way that it incorporates very similar roles found in my team's elderly assisting robot puppy. Similarities include the concept—a robot built to function as a companion dog—the way it provides positive feedback to the user, its use of distance sensors similar to our idea of object detection to avoid obstacles and how it recognizes the medicine it must give its user similar to our idea of recognition of the user's face and/or emotion. Our main difference is in the home base, we have not yet thought of such a concept. This would actually improve our design since it provides a means to automatically charge the robot after it performs its tasks.

4th Patent

Team Member Responsible: Luis Ramos

Patent Number: KR20190053147A

Title: "A Robot Dog for a Person Having a Impaired Eyesight"

Inventor(s): 조현홍

Assignee: (주)아이로보테크

Date Filed: 2019-04-25

Date Granted: 2019-05-17

Number of Claims: 1

Summary of Patent:

A literal robot dog assisting the disabled through the use of a robotic sensing hand. It guides the visually impaired by measuring the landscape for obstacles while communicating with an external unit which provides information on where to go next.

Discussion:

This project is relevant to my team's design in such a way that it incorporates a similar shell concept to our robot dog as seen in the provided images, looking almost identical to what my team is going for. Similarities include the robot's ability to constantly be measuring the terrain for obstacles much like our idea for integrating the same in our elderly assisting robot puppy. This robot's communication with an external server to provide mapping information to its user is also similar to our design for having our companion robot puppy constantly fetching data from social media while building and updating the user's profiles. The major difference is in the robotic sensing handle which communicates with a device that the user wears. This is not seen in our concept since we decided it would complicated things. However, making it central to the robots performance like how it's used here would be a way my team can incorporate a similar idea to our robot puppy; maybe in the form of an app for the user's smartphone, for instance, as an extension for the smart assistant.

5th patent

1. **Team Member Responsible:** Vinitha Tadepalli

2. **Patent Number:** CN103679203B

Title: Robot system and method for detecting human face and recognizing emotion

Inventor(s): 蔡则苏王丙祥王玲

Assignee: 江苏久祥汽车电器集团有限公司

Date Filed: 2013-12-18

Date Granted: 2015-06-17

Number of Claims: 3

3.**Summary of Patent:** This patent is for a software that can understand emotions that are expressed. This is a software that was built to be used on robots. These robots as stated in the patent can be used to act as home surveillance or care for elderly. This software is supposed to read a face based on geometric shapes on the face using precise calculations. Then it should be able to go through the library it contains to find the facial expression and match it with a better understanding of that person. There will be a database that will store the collection of expressions. Furthermore, additional information taken in by the robot through a camera that is found unnecessary will not be used. This means this robot will have an understanding of what expressions and information are necessary but what are not. This robot will also have a thorough understanding of how the emotion is being extracted and where the emotion is being extracted from.

4. **Discussion:** This patent is relevant to my teams project as we are trying to make a robot that can detect emotional expression. We however plan to not just use the face but also the posture of the person to detect how the person is feeling. We also plan to use this robot for a singular reason which is to help the elderly. We of course would not have the same patent as this patent. The software we use would also be different compared to the software used for this robot in the patent. A major difference would be that our robot would use more than just the face to recognize the feelings of a person. We hope our robot can also detect fluctuations in voice to recognize emotion. Although the accuracy and measurement described when sorting emotions within this patent could be similar to how we want our robot to be. However our robot will use more than facial recognition and shape to detect emotion.

6th patent

Team Member Responsible: Vinitha Tadepalli

2. **Patent Number:** KR101880775B1

   Title: Humanoid robot equipped with a natural dialogue interface, method for controlling the robot and corresponding program

   Inventor(s): 브루노 매소니에제롬 몽소

   Assignee: 소프트뱅크 로보틱스 유럽

   Date Filed: 2011-07-11

   Date Granted: 2018-08-17

   Number of Claims: 22

3. **Summary:** This robot patent involves a very humanoid robot that can communicate with humans and use voice detection abilities. This robot is broken into various communication channels once being the robot receiving voice transmission and the other being the robot sending in voice transmission. This robot also takes in input about the upper part of the body and any touch. The robot can also signal to the human using voice as well as gestures. The human can do the same back to the robot. The idea behind this robot is almost close to natural human communication. This robot uses a MCU unit as well as sensors to achieve communication with humans. The robot also looks like a human. The robot will have arms and legs just like a human.

4. **Discussion:** This robot has some similarities with the project that my group and I are working on. We are also heavily focusing on the robot being able to communicate with the elderly. However a major difference is that our robot is not humanoid in shape. Another difference between this patent and the robot we plan to build is that the robot we plan to build also uses emotional detection to further understand the human. The robot we plan to build also can recognize body language which is similar to the robot in this patent however the robot we plan to build will be much more precise and only try to pick up on certain emotions. The robot we plan to build also uses this information to understand the needs of the humans which is really important for the elderly.

2. System Design

2.1. Project Requirements

A majority of the requirements were gathered by talking to Harolyn Farber about her interactions with the elderly patients she serves. Requirements were also gathered by researching companion robots and understanding loneliness and the impacts of it on the elderly. Once all the research was considered and the most important functions of the companion robot were prioritized, decisions were made as to which requirements would be officially worked towards within the project. The chosen requirements from Engineering Design 1 were changed due to the change in structure of our team and having one less member within our team for Engineering Design 2.

Below are the requirements that were proposed:

Functional Requirements:

• F.1. The system shall move and detect the presence of approaching obstacles
• F.2. The system shall alert the user to take prescribed medicine
• F.3. The system shall detect and periodically alert of new family and interests news feed
• F.4. The system shall periodically output motivational quotes to the user
• F.5. The system shall accept user phrases and voice in order access family and interests updates
• F.6. The system shall be mobile and on wheels
• F.7. The system shall be able to project sound at ~75dB
• F.8. The system shall understand user input and respond to input after processing
• F.9. The system shall be customizable based on user and their daily routines

Usability Requirements:

• U.1. The system shall be able to store user data safely available to to that specific user
• U.2. The system shall operate without recharging for 6 hours
• U.3. The system shall be compact
• U.4. The system shall be able to detect its user
• U.5. The system shall be able to process auditory input on any decibel scale
• U.6. The system shall respond to remote user commands using the user interface
• U.7. The system shall fetch and output general assistant-like info from Google

Safety Requirements:

• S.1. The system body-shell packaging shall be water proof
• S.2. The system shall be securely attached within the shell housing appearing to be a robot puppy
• S.3. The system shall be able to secure user data
• S.4. The system shall not overheat
• S.5. The system shall maintain a safe distance so as to not impede the path of any individual

2.2. Project Requirements Not Met

Certain Requirements from our initial list of requirements were not met due to technical difficulties, permission/safety concerns, billing as well as a decrease in members within our project.

Some of these requirements we had planned to assign to the third member of our team but after being reduced to only having two members we had to reprioritize requirements considering our resources.

F.2. The system shall alert the user to take prescribed medicine
- This was not implemented because in order to implement calendar access which was the way this could have been implemented certain permissions would need to be taken from the user and there would have to be changes made to their billing account.

F.7. The system shall be able to project sound at ~75dB
- We are not entirely sure if this requirement was met because we never measured the decibel output although the output volume was worked upon heavily to provide a more desirable voice output.

U.2. The system shall operate without recharging for 6 hours
- This was requirement we were going to work with our third member to complete because of his electrical engineering background. This requirement was not met due to his departure from our team. We did attempt to use a portable charging unit however this would deplete battery very quickly.

U.3. The system shall be compact
- This was a requirement that was not prioritized as much as some of the functional and safety requirements. This was also tough due to the size of the equipment available for our use.

U.5. The system shall be able to process auditory input on any decibel scale
- The decibel level of the auditory input that was functionable was not something that was measured. I believe this requirement may not have been met due to the state of the equipment that was used within the voice communications component of this project.

S.2. The system body-shell packaging shall be water proof
- This was a requirement that was not met due to the fact that we did not have water proof equipment to use for the system and we also did not have enough resources by the end of the project to work on this requirement.

S.3. The system shall be securely attached within the shell housing appearing to be a robot puppy
- This was something that was initially assigned to the third member of our team who was no longer a part of the team during the actual building of this product and therefore this was a tough requirement to meet with limited time, people and financial resources.

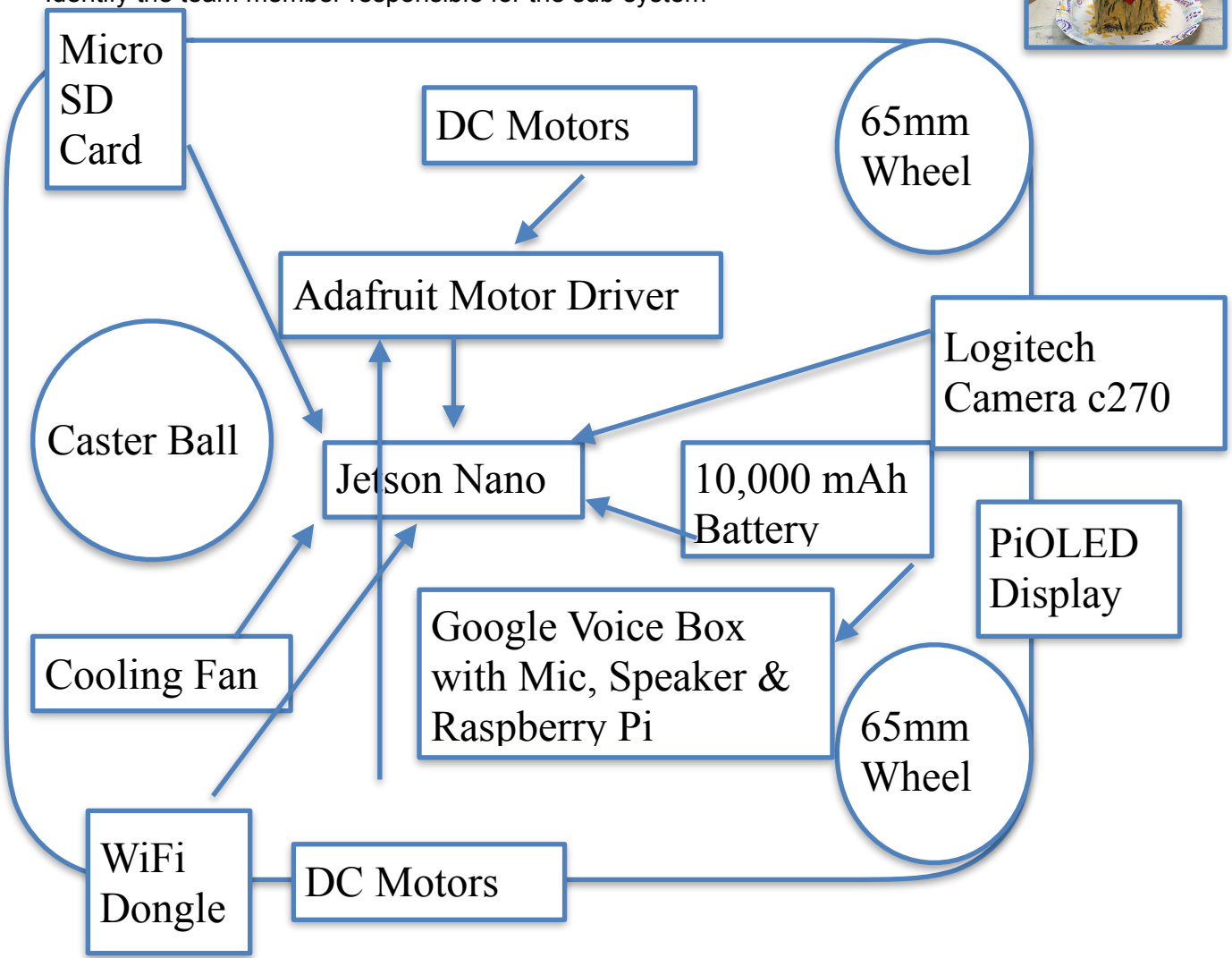
2.3. Project Requirements Added

From the list in Section 2.1, identify the requirements that you did not have in your proposal but added to the implementation. Describe why the particular requirement was added and implemented.

- The voice component of the robot shall be able to start on boot.
  - This requirement was added after taking into consideration and observing how long the set up took in order execute a script from the command line for the communication to start happening. This was done by changing the script that ran on boot and enabling the script with relevant code to be incorporated to the process that ran on boot.
- The robot shall have wifi enabled.
  - This requirement was added after considering the API and internet connection needed for the robot function. This was implemented with using a wifi dongle for the Jetson nano and the Raspberry Pi had a built-in wifi module.
- The robot must have an understanding of emotion.
  - This was added after considering the social nature of the robot and emotion classification was implemented by using the Jetson Nano.

2.4. System Diagram

Show a functional block diagram and provide a detailed description of sub system
Describe how your design meets each of the requirements.
Describe the mechanical and electrical design
Block diagram(s) identifying the system and sub-systems.
Description of the block diagram.
Interaction between sub-systems
Identify the team member responsible for the sub-system



Subsystem #1:

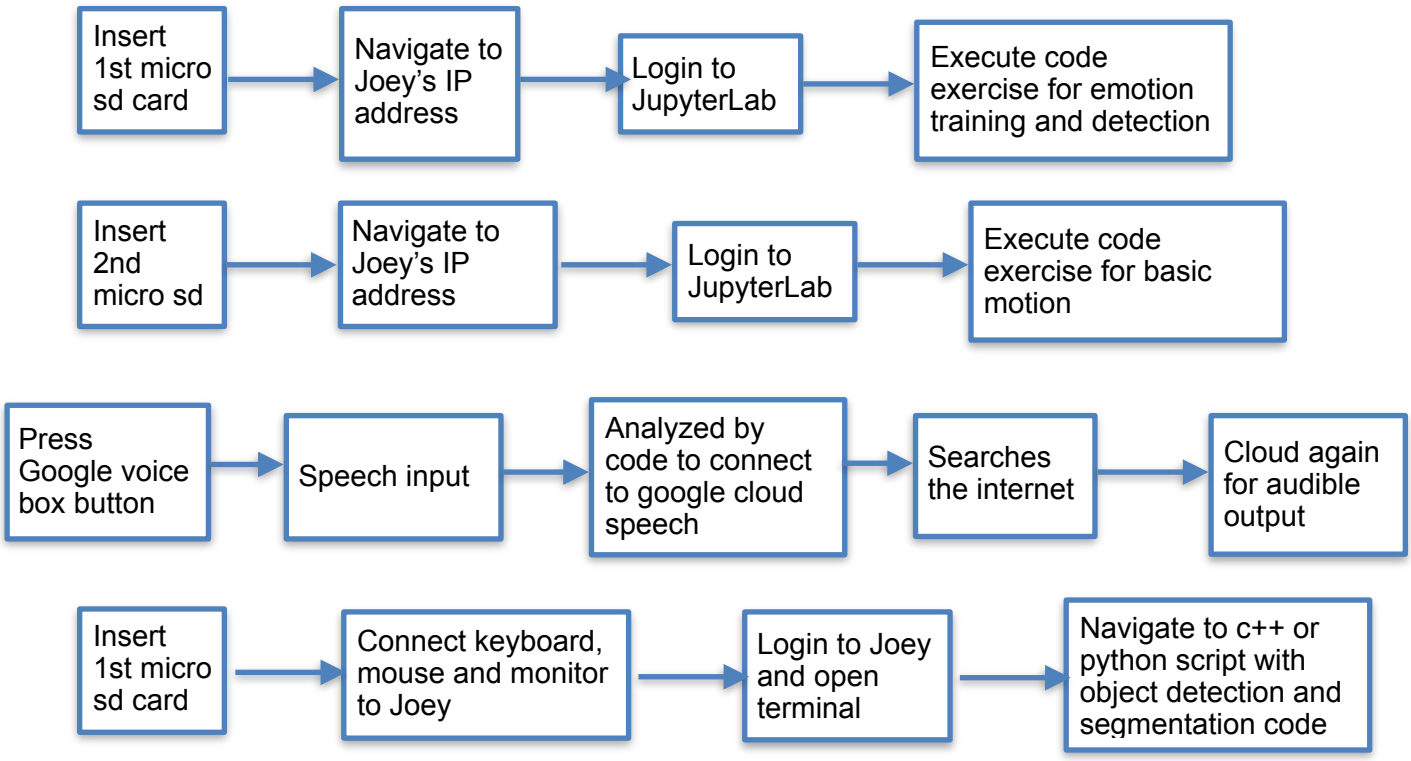
This first subsystem consists of the coding and all the web-based software handled by Vinitha and Luis. By web-based it is meant that the robot must be at a constant over-the-air fetching of the most current data regarding the user's preferred family activities and interests such inspiring quotes, news, etc. The brains and central processing unit for this system is the Jetson Nano and Google Voice Box, chosen after the Arduino since it is able to implement more things than the latter. With these powerful devices at our disposal the system must be able to detect and understand voices and phrases on any decibel scale before securely processing this input with some help from Ai. The team decided on the Google Cloud Speech for these basic voice remote command recognition, programmed for it to be customizable based on the system's user. A secure database is built around this library providing the user with their personalized interface, a profile storing information only available to that specific user. Programming languages used to implement all this involve Python & C++. Aside from the basic smart assistant-like tasks by our robot dog system, the Jetson Nano has a camera that is able to be used alongside implementation of object detection code. With this our system acts like an iRobot 'Roomba' smart vacuum device, moving about while being able to detect obstacles while analyzing emotion.

Subsystem #2:

This second and last subsystem consists of all that is tangible—the hardware per se—within our puppy robot system. Everything from the cooling fan to the speaker and microphone, the 3 wheels, camera and battery for it all; which are by the way each connected to the Jetson Nano, Google Voice Box and its database (the second subsystem). Research into finding the best and most affordable of these parts is done by the team as a whole as well as finding the parts to 3D print in the FAU lab, picking the power supply, wheels, etc. An all-motion 360 degree caster ball on the middle of the robot provide it with travel toward wherever it needs to go, with the other two wheels connected to DC motors which simultaneously connects to Adafruit's motor driver and Jetson Nano for commands, etc. A cooling fan that monitors the internal temperature of the robot detecting if it gets too hot has it turning on until this overheating drops to a certain value. This way the fan is not running continuously and draining the around 10,000mAh battery supply utilized to supply power to every smart device in the system. Of these smart devices, the Google Voice Box and camera are of the most complex

devices within our system. This is due to the fact that the camera has to be in constant detection of objects when the robot is moving while scanning its surroundings so as to not impede with anyone's path. Not just this but it must also measure its user's emotion using visual and auditory input. The latter is carried out by the google cloud speech, the intermediate piece for these smart assistants and their users, along with the speaker. This product is mainly aimed for use by the elderly as proposed by Dr. Farber, an Audiologist from Boca Raton with over 30 years of experience in her field. She has been the central part for this project design, aiding us with her vision of a cure to loneliness for her patients.

2.5. State Diagram



3. System Implementation

3.1. Hardware

Joey Body (Dr. Farber)

- Description:
  - The Joey Yorkie body was made of paper mache by the Audiologist's sister. This came after difficulties trying to find the design and create the chassis so that it fits our system.
- Testing and Calibration:
  - One design was found but the team had difficulties editing it through FreeCAD. Once the paper mache was made, it fit perfectly on the voice box. Nevertheless, it kept falling of the Jetbot once it moved, so a shelf was created for support.
- Integration:
  - Eventually, Joey's body was set for display during the showcase. It became the center of attention to grab audiences and judges into our booth to present our final design project.

Jetson Nano (Luis)

- Description:
  - Provided by NVIDIA, this powerful computer lets us run neural networks for applications like object detection, segmentation etc. With an SD card and the image system image with it, SDK's are able to have it so it can be trained and deploy AI software.
- Testing and Calibration:
  - Troubleshooting was mainly performed through Ubuntu and JupyterLab. The first operated as its OS and through terminal made it possible to install c++ and Python scripts used for Object detection and segmentation. The latter provided notebooks with editable exercises written in python for basic motion and emotion detection training.
- Integration:
  - During presentations, this was prepared to showcase edited scripts for object detection, segmentation, emotion detection training and basic motion.

Jetbot (Luis)

- Description:
  - This became Joey's main body made up of several components. A micro SD card for its system image, motors and its driver, 2 wheels and a caster ball, a 10,000mAh battery pack, piOLED display, raspberry pi camera, wifi dongle, 3D printed chasis and camera mount along with adhesives and screws.
- Testing and Calibration:
  - Having been predicted to be completed within a day, this portion of Joey was severely underestimated when it came to building it. For starters, the 3D printed parts had to be cleaned with pliers, system images had to be installed separately for emotion and object detection away from the basic motion portion, motors were replaced for stronger ones with wires already soldered onto them since they broke at first and the motor driver was replaced from an unsupported one by the system.

- Integration:

        - Emotion detection after training and basic motion controlled through software were showcased perfectly. These became the forefront for Joey's motion and vision capabilities.

Google Voice Box (Vinitha):
The voice subsystem used parts from the Google Voice Kit and available parts:

- Speaker
- Voice Hat
- Mic Board
- Raspberry Pi
- SD Card
- Cardboard Box

Component description:

- Speaker:
    - Description:
        - This is a speaker that comes within the voice kit and can be used to project an audio output to users. This connects to the Voice Hat component in order to derive power.
    - Testing and Calibration:
        - To test the speaker a certain script was ran on the Raspberry Pi with audio output.
    - Integration:
        - This was integrated into the voice component by wiring up the right connections to the Voice Hat which was incorporated altogether into the Voice Component.
- Voice Hat
    - Description:
        - The Voice Hat is the AIY voice hat designed by Google for smoother integration with their voice and language libraries. It uses 9 GPIO pins in order to function.
    - Testing and Calibration:
        - The Voice Hat was tested once everything was integrated into the Voice component. Certain tests scripts made availably by the manufacturer were run on the device to check for functionality.
    - Integration:
        - The Voice Hat is the main integrating piece within the larger Voice Component. It was important to integrate this correctly with the Mic Board, Speaker, and Raspberry Pi in order for the device to work. This was done by following wiring diagrams and documentation.

- Mic Board
    - Description:
        - The Mic Board used within this project was also manufactured by Google. This board contains a microphone with a left microphone and right microphone meaning one can speak into either side of the voice box and the input will still be processed.
    - Testing and Calibration:
        - The testing and calibration for this component was done after following the wiring diagrams and schematics.
    - Integration:
        - This part was integrated into the Voice Hat in order to receive audio input.

- Raspberry Pi
    - Description:
        - The Raspberry Pi is a microcontroller that runs its own operating system based of Raspbian. This was used in order to code all the software needed for the hardware parts to function.
    - Testing and Calibration:
        - This component was tested once implemented by running various updating and upgrading scripts to check that the right python installations were stored on the device as well as the right programs.
    - Integration:
        - This was the device that all the other devices were later integrated into. This was the core controlling unit for the voice box and everything was integrated to fit the Raspberry Pi by using schematics.

3.2. Software

Voice Component:

- All of the software development for the voice component was done using python libraries and command line language. The software from the google aiy voice kit demos was modified as well as new code was written such as the tweepy api interface to data mine twitter.There was also a pygames module which was imported and used in order to play music from mp3 through the speakers. This software was all contained within the Raspberry Pi and was written to influence the Voice Hat.

Emotion Detection and Basic Motion:

- All software was performed through JupyterLab after navigating to Joey through its IP address, configured from Ubuntu. Python code from exercises provided for emotion training and basic motion were edited so as to provide the user with accurate facial expression detection and software created buttons for forward, back, left and right motion; respectively.

Object Detection:

- Though terminal on Ubuntu, Jetpack apk was installed which contained scripts to train and navigate to the code for over 1000 images to recognize. Once launched, objects were color coded and accuracy predicted with percentages at the top of their squares.

3.3. User Interface

Voice Component:

- The user interface is done through voice recognition and button press. Once plugged in after 3-5 minutes the product is ready for ‘voice recognition’ based commands. The user will push the button and their voice command/comment will receive a response. The code can also be modified to where there is active listening happening.

Emotion Detection and Basic Motion:

- JupyterLab is user intuitive to the point were NVIDIA even provides a course on it for which you get a certificate of completion for. It breaks down sections into folders much like the file explorer on windows and finder on Mac. These contain all types of files where the python scripts were the focus containing code for emotion and motion training.

Object Detection:

- Terminal is used through Ubuntu to navigate to the system folder containing the scripts edited for segmentation and object detection. This opens up a window with the camera showing the output.

3.4. Data Communications

Voice Component:

The communications within the Voice component happened through Wifi and data was stored on google cloud. Data was retrieved using the internet and by using specific APIs.

Emotion Detection, Object Detection & Basic motion:

JupyterLab was accessed through Jetbot's IP address thanks to the wifi dongle on the Jetson Nano. Interfaces and exercises came over the internet primarily from GitHub and NVIDIA's developer blogs.

4. Testing and Performance Evaluation

Voice Component:

The voice functionality was tested various times using test cases such as users not being able to speak loud enough. The voice components could hear a decently lower volume of a voice command and volume on the output could also be decreased. Although we could not measure this decrease or increase level in decibels, the output volume can be decreased.

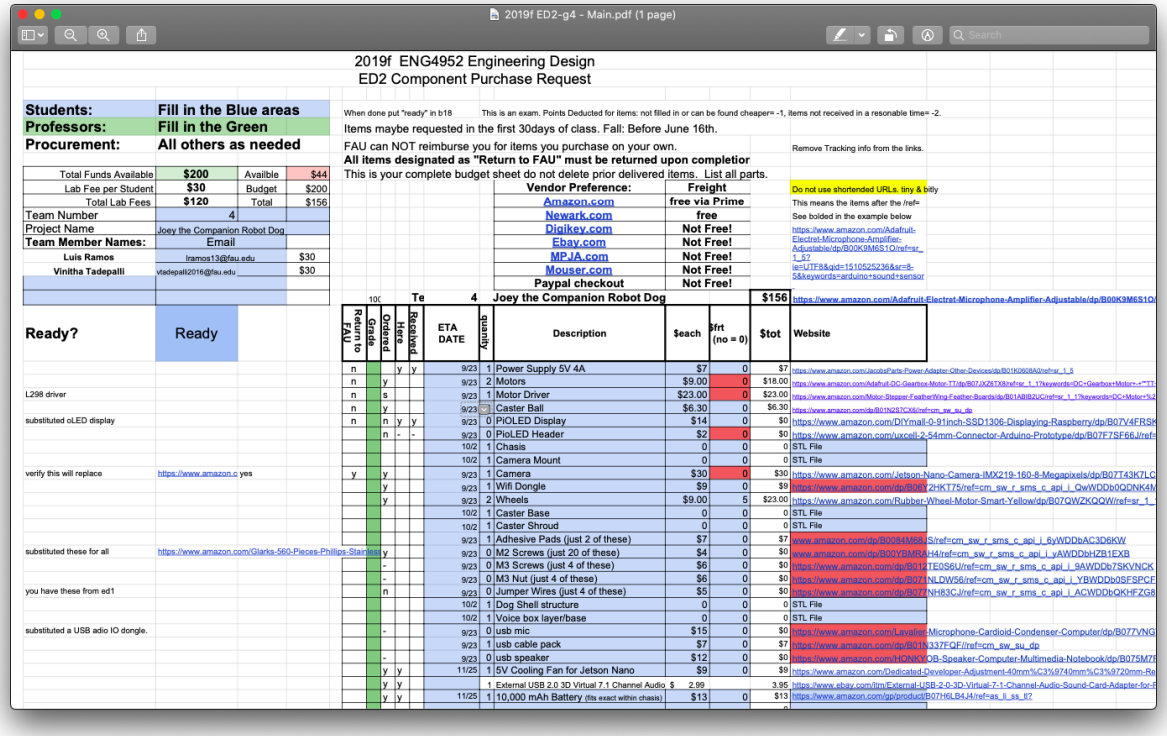
Emotion Detection, Object Detection & Basic motion:

Training had to be done prior to providing accurate emotion showcasing where JupyterLab was prepared with an exercise-like module for expressions and evaluation. It was the same for motion, where a python notebook script was edited so as to have software-like buttons for 360 motion of the robot. Object detection was downloaded from NVIDIA's GitHub page and edited to train for even more images to detect for accuracy.

4.1. Performance Assessment

A. I believe overall the system with the two main components as well as the smaller components performed well because a majority of the initial requirements were met. Only 7 out of the 22 initial given requirements were not met. This shows more than 50% of the requirements were met. We also fixed any noise level issues such as the audio output being to loud. We also worked on changing the motor hat in order to help the wheels turn and changing the power being given to the motors in order to move the robot.

5. **Budget**



2019f ED2-g4 - Main.pdf (1 page)

2019f ENG4952 Engineering Design
ED2 Component Purchase Request

Students:	**Fill in the Blue areas**
Professors:	**Fill in the Green**
Procurement:	**All others as needed**

When done put "ready" in b18 — This is an exam. Points Deducted for items: not filled in or can be found cheaper= -1, items not received in a resonable time= -2.

Items maybe requested in the first 30days of class. Fall: Before June 16th.

FAU can NOT reimburse you for items you purchase on your own. Remove Tracking info from the links.

All items designated as "Return to FAU" must be returned upon completior

This is your complete budget sheet do not delete prior delivered items. List all parts.

Total Funds Available	$200	Availble	$44
Lab Fee per Student	$30	Budget	$200
Total Lab Fees	$120	Total	$156
Team Number	4		
Project Name	Joey the Companion Robot Dog		
Team Member Names:	Email		
Luis Ramos	lramos13@fau.edu		$30
Vinitha Tadepalli	vtadepalli2016@fau.edu		$30

Vendor Preference:	Freight
Amazon.com	free via Prime
Newark.com	free
Digikey.com	Not Free!
Ebay.com	Not Free!
MPJA.com	Not Free!
Mouser.com	Not Free!
Paypal checkout	Not Free!

Do not use shortended URLs. tiny & bitly

This means the items after the /ref=

See bolded in the example below

https://www.amazon.com/Adafruit-Electret-Microphone-Amplifier-Adjustable/dp/B00K9M6S1O/ref=sr_1_5?ie=UTF8&qid=1510525236&sr=8-5&keywords=arduino+sound+sensor

Ready? Ready

10(Te 4 **Joey the Companion Robot Dog** **$156** https://www.amazon.com/Adafruit-Electret-Microphone-Amplifier-Adjustable/dp/B00K9M6S1O

Return to FAU	Grade	Ordered	Here	Received	ETA DATE	quantity	Description	$each	$frt (no = 0)	$tot	Website
n			y	y	9/23	1	Power Supply 5V 4A	$7	0	$7	https://www.amazon.com/JacobsParts-Power-Adapter-Other-Devices/dp/B01K0908A0/ref=sr_1_5
n		y			9/23	2	Motors	$9.00	0	$18.00	https://www.amazon.com/Adafruit-DC-Gearbox-Motor-TT/dp/B07JXZ6TX8/ref=sr_1_1?keywords=DC+Gearbox+Motor+-+TT
n		s			9/23	1	Motor Driver	$23.00	0	$23.00	https://www.amazon.com/Motor-Stepper-FeatherWing-Feather-Boards/dp/B01ABIB2UC/ref=sr_1_1?keywords=DC+Motor+%2
n		y			9/23		Caster Ball	$6.30	0	$6.30	https://www.amazon.com/dp/B01N2S7CX6/ref=cm_sw_su_dp
n		n	y	y	9/23	0	PIOLED Display	$14	0	$0	https://www.amazon.com/DIYmall-0-91inch-SSD1306-Displaying-Raspberry/dp/B07V4FRSK
		n	-	-	9/23	0	PioLED Header	$2	0	$0	https://www.amazon.com/uxcell-2-54mm-Connector-Arduino-Prototype/dp/B07F7SF66J/ref=
					10/2	1	Chasis	0	0	0	STL File
					10/2	1	Camera Mount	0	0	0	STL File
y		y			9/23	1	Camera	$30	0	$30	https://www.amazon.com/Jetson-Nano-Camera-IMX219-160-8-Megapixels/dp/B07T43K7LC
		y			9/23	1	Wifi Dongle	$9	0	$9	https://www.amazon.com/dp/B06Y2HKT75/ref=cm_sw_r_sms_c_api_i_QwWDDb0QDNK4M
		y			9/23	2	Wheels	$9.00	5	$23.00	https://www.amazon.com/Rubber-Wheel-Motor-Smart-Yellow/dp/B07QWZKQQW/ref=sr_1_
					10/2	1	Caster Base	0	0	0	STL File
					10/2	1	Caster Shroud	0	0	0	STL File
					9/23	1	Adhesive Pads (just 2 of these)	$7	0	$7	www.amazon.com/dp/B0084M68JS/ref=cm_sw_r_sms_c_api_i_6yWDDbAC3D6KW
		y			9/23	0	M2 Screws (just 20 of these)	$4	0	$0	www.amazon.com/dp/B007DMR4H4/ref=cm_sw_r_sms_c_api_i_yAWDDbHZB1EXB
			-		9/23	0	M3 Screws (just 4 of these)	$6	0	$0	https://www.amazon.com/dp/B012TED56U/ref=cm_sw_r_sms_c_api_i_9AWDDb7SKVNCK
			-		9/23	0	M3 Nut (just 4 of these)	$6	0	$0	https://www.amazon.com/dp/B071NLDW56/ref=cm_sw_r_sms_c_api_i_YBWDDb0SFSPCF
		n			9/23	0	Jumper Wires (just 4 of these)	$5	0	$0	https://www.amazon.com/dp/B077NH83CJ/ref=cm_sw_r_sms_c_api_i_ACWDDbQKHFZG8
					10/2	1	Dog Shell structure	0	0	0	STL File
					10/2	1	Voice box layer/base	0	0	0	STL File
			-		9/23	0	usb mic	$15	0	$0	https://www.amazon.com/Lavalier-Microphone-Cardioid-Condenser-Computer/dp/B077VNG
					9/23	1	usb cable pack	$7	0	$7	https://www.amazon.com/dp/B01N337FQF/ref=cm_sw_su_dp
			-		9/23	0	usb speaker	$12	0	$0	https://www.amazon.com/HONKYOB-Speaker-Computer-Multimedia-Notebook/dp/B075M7F
		y	y		11/25	1	5V Cooling Fan for Jetson Nano	$9	0	$9	https://www.amazon.com/Dedicated-Developer-Adjustment-40mm%C3%9740mm%C3%9720mm-Re
		y	y			1	External USB 2.0 3D Virtual 7.1 Channel Audio	$ 2.99		3.95	https://www.ebay.com/itm/External-USB-2-0-3D-Virtual-7-1-Channel-Audio-Sound-Card-Adapter-for-F
		y	y		11/25	1	10,000 mAh Battery (fits exact within chasis)	$13	0	$13	https://www.amazon.com/gp/product/B07H6LB4J4/ref=as_li_ss_tl?

verify this will replace — https://www.amazon.c — yes

substituted these for all — https://www.amazon.com/Glarks-560-Pieces-Phillips-Stainless

you have these from ed1

substituted a USB adio IO dongle.

6. **Project Management and Workload Distribution**

I believe the work distribution was 50-50. This can be seen in how we have to main components within the project and these were worked on to the fullest extent possible. We both put effort into integrating the two parts together into a final design with a moving robot that had a way to communicate. The team initially consisted of three people but after we were left with just two people we ended up dividing the work 50-50 where equal work was given to each person. We discussed and agreed on deadlines and also discussed these with Harolyn Farber and Dr.Kalva.

Name	Effort
Luis Ramos	50%
Vinitha Tadepalli	50%
Total	100%

7. **References**

https://docs.google.com/spreadsheets/d/1m2syTbefMMIxWSy5qG2Tb-h0KasAb8Sq4zkA6Blkck4/edit#gid=1559275717

https://www.gulfali.com/products/mg010-voice-control-free-mode-sing-dance-smart-dogrobot-1?variant=22619183612022&utm_medium=cpc&utm_source=google&utm_campaign=Google%20Shopping&gclid=CjwKCAjw-ITqBRB7EiwAZ1c5U55KvJatwjbHZhyaxBHCyJb6e5iW0N-3pGazstbv0tFAA9xQ0NRtVBoClpAQAvD_BwE

https://www.pewresearch.org/fact-tank/2019/07/03/on-average-older-adults-spend-over-halftheir-waking-hours-alone/

https://www.gov.mb.ca/seniors/publications/docs/senior_centre_report.pdf

https://joyforall.com/

https://www.alzstore.com/perfect-petzzz-cavalier-king-charles-p/0606.htm?gclid=EAIaIQobChMI3dmH9qfR4wIVFo3ICh2jFgYBEAQYAyABEgKwqvD_BwE

https://youtu.be/BVhmGc1eW58

https://youtu.be/cFvGAL9tesM

https://youtu.be/u0aPNuuOLKA

https://patents.google.com/patent/US9796078B2/en

https://patents.google.com/patent/US8909370B2/en

https://aiyprojects.readthedocs.io/en/latest/voice.html#id1