

Nala: Smart Companion Robot for Seniors

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ABSTRACT

A companion bot named “Nala,” capable of appointment reminders, memory games, and LED matrix visual response was built. The exterior of the bot’s body is shaped like a friendly cat, which is meant to reduce anxiety of the user, and encourage the user to be engaged mentally, even during extended periods of physical isolation. Using Raspberry Pi embedded hardware, and the Amazon Alexa API, the bot is able to interact through voice commands from the user. The robot’s body has been designed with Fusion 360 and is made to sit on a table near the user.

SENIOR CARE COMPANION ROBOTS

Senior care companion robots have been on the market since the 1990s, with the Japanese baby seal robot Paro being a notable “first” in the field. As more older people are living alone, and as robotic technology becomes further integrated into our lives, it is estimated that in the next ten years robotic assistance for senior citizens will be more commonplace.



Figure 1. Paro, the baby seal robot with senior citizen.

MEET NALA

Nala is an easy-to-use companion robot, that is lightweight, portable, and requires no special knowledge to use. Nala plugs into wall voltage, and after the power button has been pushed, will “come to life” once the user has spoken the “wake word,” which is an activation word for the Alexa API software. By interacting with Nala, an older person, who may have less contact with others, can be engaged. It is suggested that an older person who regularly interacts with a pleasant companion robot may feel less anxiety and stress, without the use of medication.

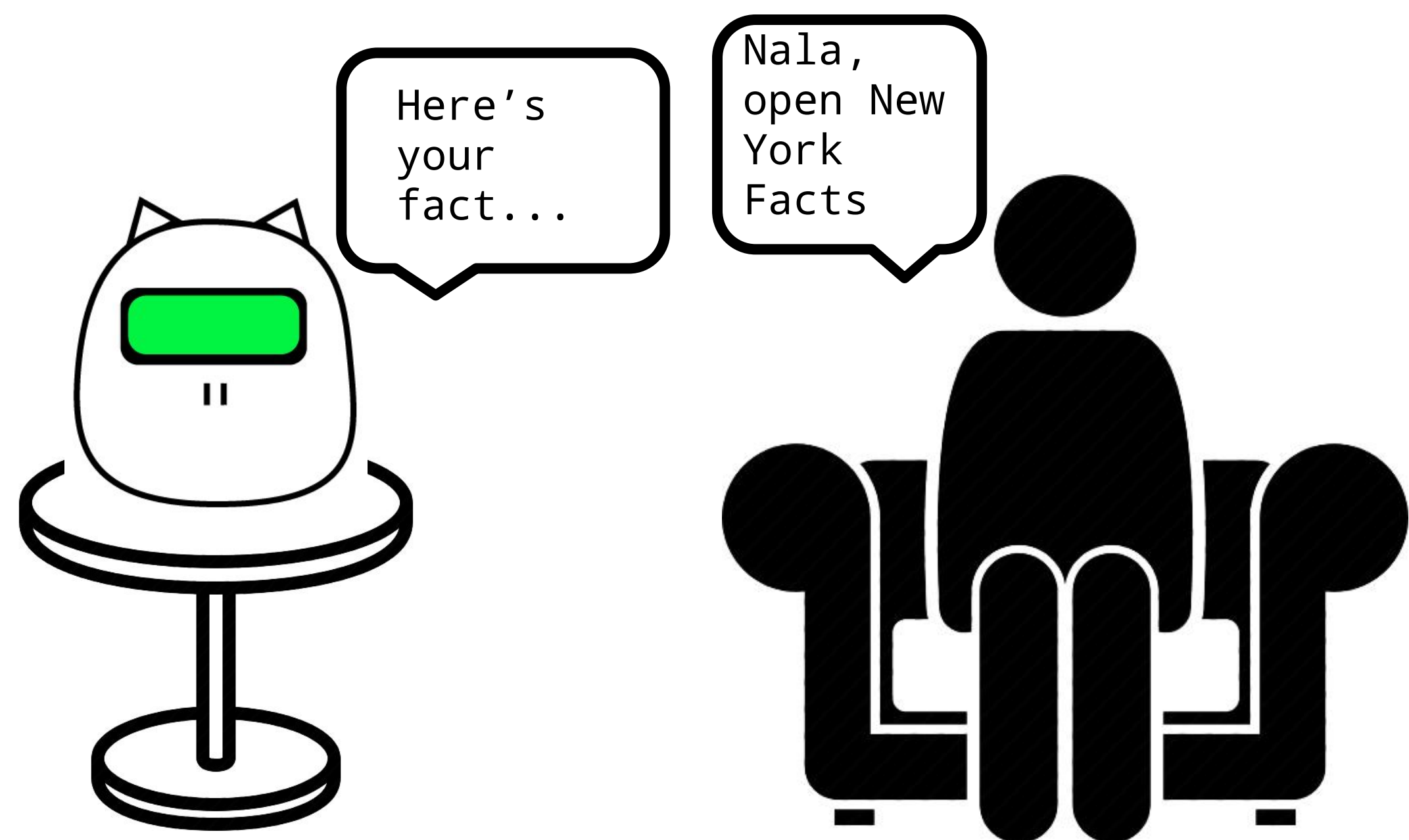


Figure 2: Visual description of Nala use.

MAKING NALA “SMART”: ALEXA VOICE SERVICE

Amazon provides access to its machine learning algorithms, which are freely available as application programming interfaces (APIs). We used these APIs in Nala’s routines to allow Nala to learn to respond in a more natural way. In this way, the more time a user spends with Nala, the more Nala can respond in an engaging way with the user, and provide therapeutic benefits.



Figure 3: Block diagram describing Alexa’s use with Nala

ONBOARD COMPUTATIONS: RASPBERRY PI

The Raspberry Pi handles the onboard computations for the Alexa Voice Service and runs different modules such as the speaker and the LED Matrix. When the Pi starts up, it runs a set of boot scripts to automatically initiate various processes.

First, the Alexa Voice Service starts and activates Amazon Web Services (AWS), where the machine learning algorithms occur. Then, a consecutive code runs that sends electrical signals to the LED Matrix via the Pi’s GPIO pins. The Pi controls the LEDs to display images or texts on the LED Matrix. Simultaneously, other processes run such as the speaker letting the user know that the bot is ready. All the software and hardware modules are automated in the bot; therefore, the user does not need technical skills to interact with Nala.

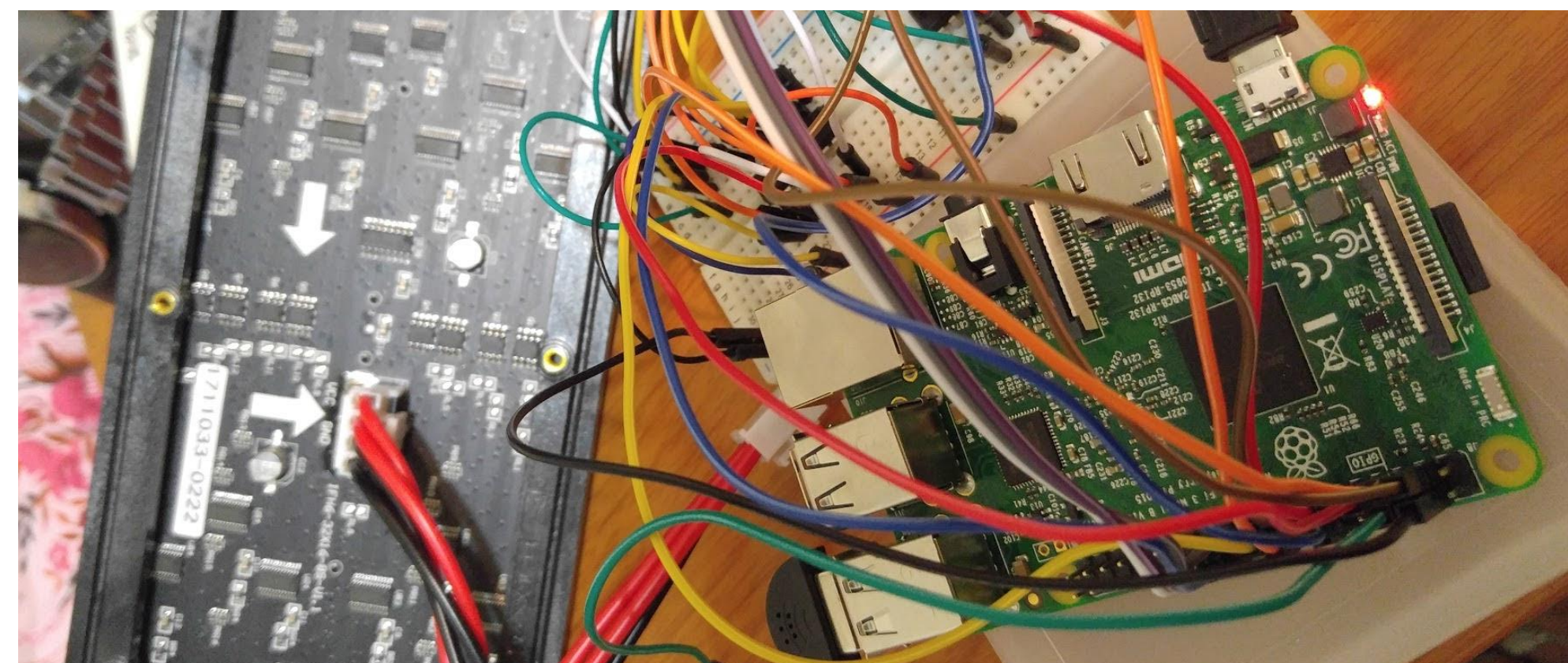
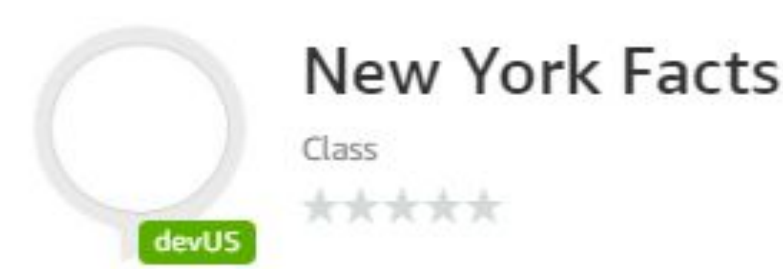


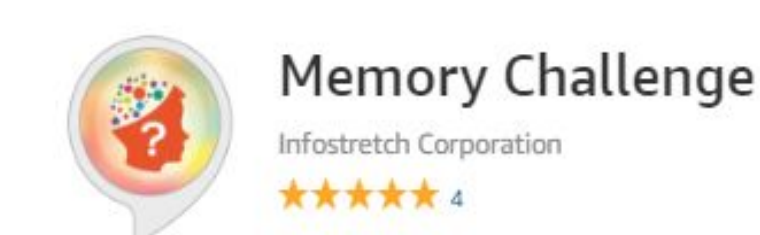
Figure 4: Raspberry Pi with microphone under test connected to LED matrix.

NALA’S CUSTOM SKILLS CAPABILITIES

Amazon has a library of over 25,000 “skills,” and we have created custom skills for Nala’s user. To activate a skill, the user must say “Nala, Open <Skill Name>.” One of our custom skills tells the user facts about New York.



This skill has stored 25 interesting facts about New York and will randomly select one of these facts to talk about.



Our memory challenge skill tests the user’s memory by giving her five random words which to memorize. Nala then asks the user questions whose answers lie among the words that were given by Nala in the beginning of the game.

ELECTRICAL SYSTEM

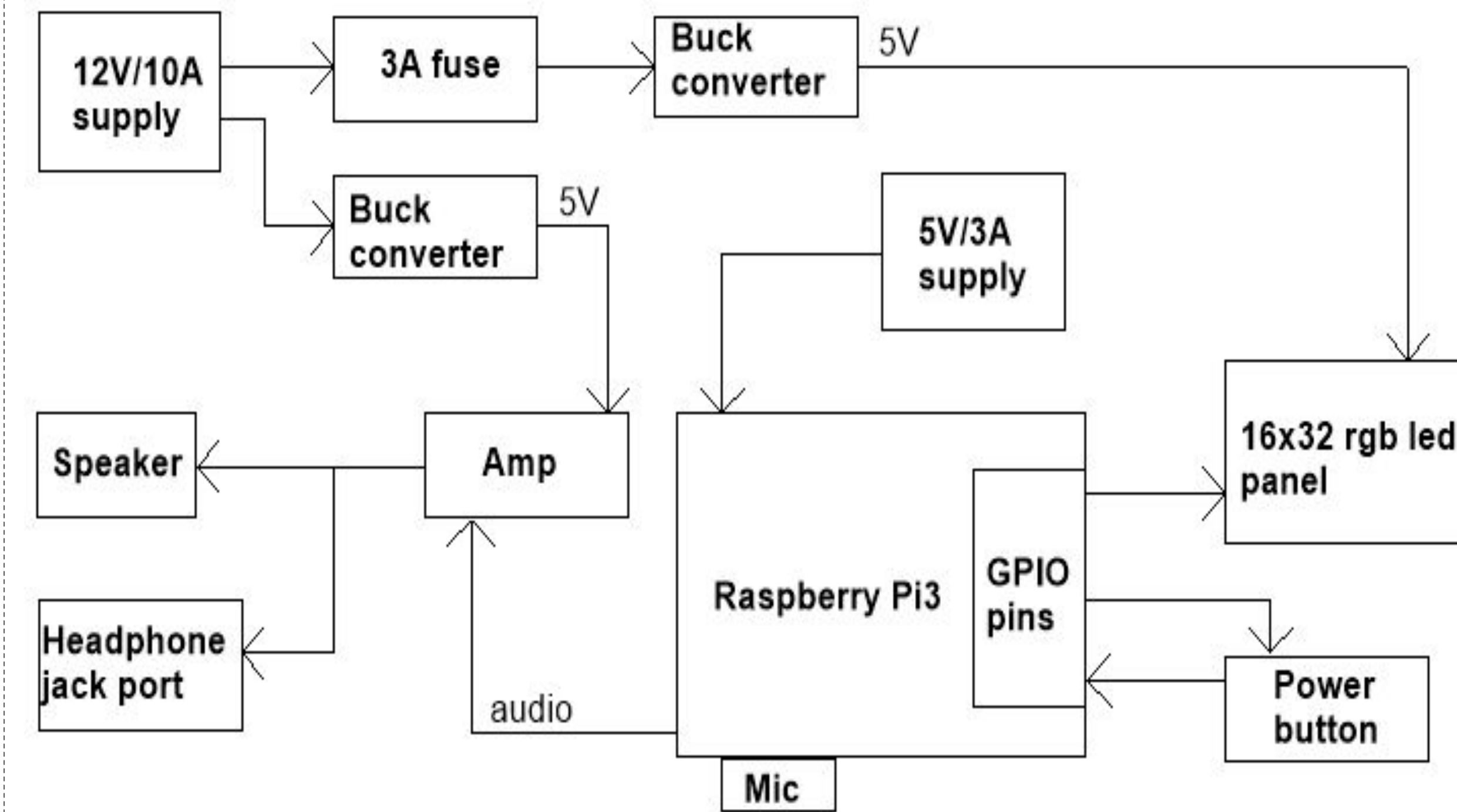


Figure 5: Block diagram of Nala’s electrical system.

3D DESIGN

We wanted the external features of Nala to be cute, fun, and inviting to the user. We looked at images of cartoon cats that made people feel at ease, and we also considered popular images of cats that people were familiar with, like the Asian “good luck” cat.



Figure 6. Evolution of Nala 3D design inspiration: Amazon cat toy, Asian good luck cat, Inspector Black Cat, character from IBC show.

We designed Nala in Fusion 360. Nala consists of three main pieces: a base, a bottom, and a head, which are connected with M3 screw hardware. Nala has recognizable catlike ears, an LED display connected with a frame that resembles a virtual reality headset, and slots on the front of her body to allow sound to enter her microphone. Internally, supports were created for the electronics hardware and screw holders.

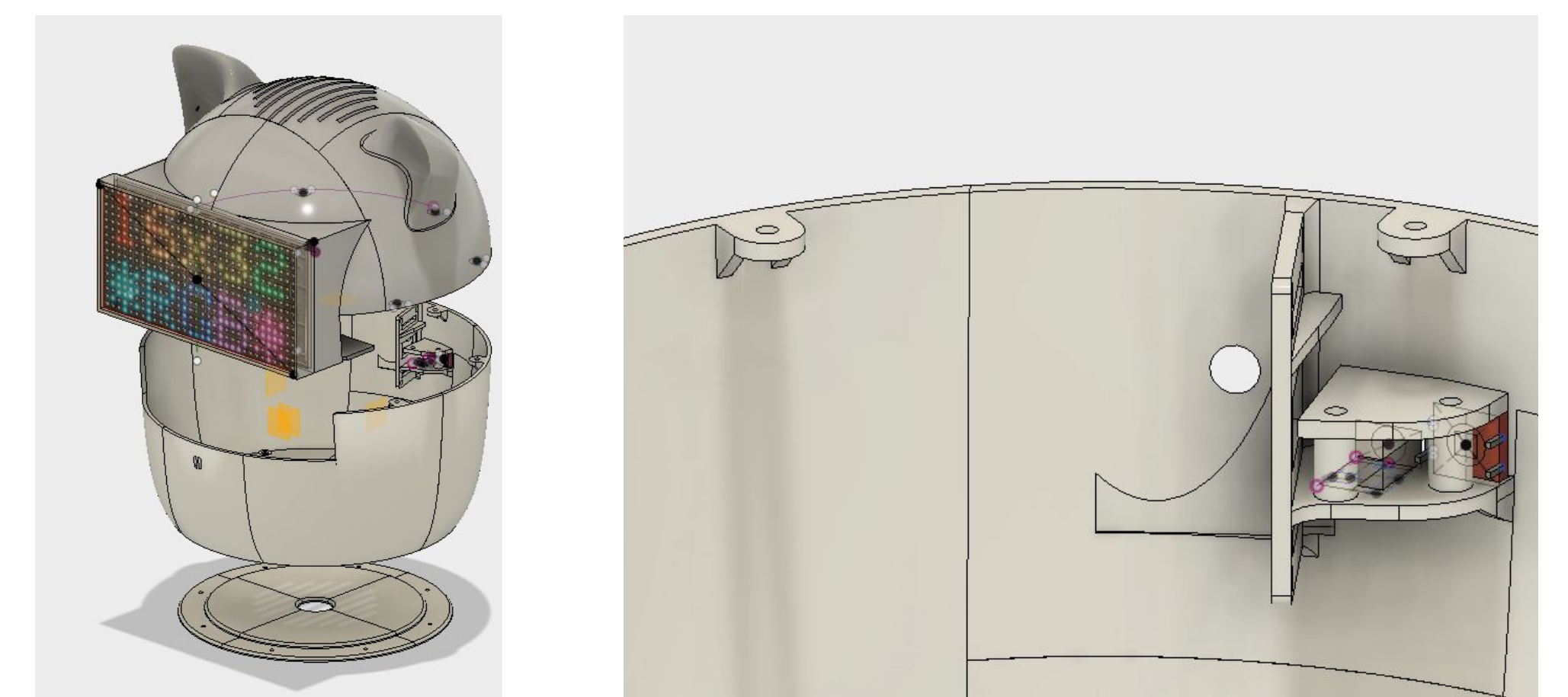


Figure 7. Three main physical components of Nala (left); ribbed hardware holders and electronics mount (right).

CONCLUSION

The goals of the project were achieved. We created a cute, user-friendly, therapeutic, and interactive companion robot for the elderly. In a future phase of the project, the following improvements could be made:

- Incorporating a pulse band with Nala to monitor the user’s vital signals, and sending necessary alerts in case of emergencies.
- Allowing Nala to control smart home devices such as lights, security systems, air conditioning units, and thermostats.
- Adding motors/drivers to enable physical motion.
- Modifying the current body shape to meet user needs.