

Vector Documentation

Because crashing Galaxy's computer is a tradition

Randall Maas & the Project Victor contributors

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1. Vector Resources

This is a wiki for gathering and sharing information about [Anki Vector](#)

[PDF version](#)

See also this other [Wiki by Xanathon](#)

1.1 Games and Things you can do with Vector

- A "cheat sheet" of the things you can say to Vector by Samuel Ward. ([pdf](#))
- Another Vector command list
- [A Guide to the Vectorverse](#) by Stephan Otter (@StephanOtter) and Steven Coblenz (@SteveCoblenz). This is a document on the interactions and games you can play with Vector.

1.2 Personalizing Vector

This is for notes on how to customize or personalize Vector. You may have to consult the How-To's below.

See also: the [forums](#)

1.3 Troubleshooting

- [What Do Vector's Back Lights Mean?](#)
- How to check for software problems
- The big long list of error codes is Appendix D of the [Technical Reference Manual](#), and in TBD

See also the [troubleshooting at DDL's site](#):

- Troubleshooting Vector's Connection
- How Do I Find Vector's Serial Number?
- Why does Vector need a 2.4 GHz network?
- Vector does not understand me: Troubleshooting Speech Recognition
- What Do Vector's Back Lights Mean?
- Why does Vector show an error?
- Troubleshooting charging issues
- Why is there no sound?

1.4 Service Guide

Collected notes on repairing or modifying Vector.

- Assembly and [exploded view diagrams](#). I am a sucker for exploded diagrams and drawings.
- How to update software
- How to clean wheels/sensors
- Where to [get parts](#) -- treads, etc.
- How to replace the battery?
- Boards?

1.5 How-Tos

These try to tell you how to accomplish particular tasks.

Some highlights:

- Using GDB [to trace function calls](#)
- Using AudioKinetic WWise to [convert sound files to WEM format](#)
- Dauler sells stickers with the marker symbols preprinted at [3D Designs by Dauler](#)

1.6 Developer documentation

These are reference documentation for programming tools to use Vector. Some of them are for the remote-access SDK's.

1.6.1 Technical Reference Manual

- Details on how Vector *works*
- Main architecture of the design (not necessarily the code though) and how it works
- File system structure, files, formats and contents
- Communication protocols

1.6.2 Programmers Guides and Examples

PC/Mobile SDK (HTTPS API)

- Python Communication SDK: [Vector - Python SDK](#)
- C# Communication SDK: [Anki.Vector.SDK](#)
- C# [Anki.Vector.WebVizSDK](#) to access the WebViz related information in developer builds.
- C# [Anki.Resources.SDK](#) to access, analyze local (that is, on your computer) copies of the Vectors' application resources/assets
- See the SDK examples

Bluetooth LE implementations. There isn't an SDK for the Bluetooth LE protocol, but there are a few implementations that you might wish to look at/reuse:

- OS-X Objective-C
- linux & C
- Chrome & Javascript and [here](#)

1.6.3 WebViz and Console Variables

"Pure" Developer builds of Vector software contain an HTTP API and webserver. This shows what it is, how to use it, and how it works.

1.6.4 Vector Enhancement Proposals

These are proposals for changes -- enhancements -- to the modules on Vector.

Some highlights:

- An [overview](#) of the overall proposal process.
- VEP1. [Update-engine changes](#)
- VEP2. [Packagement for modules on Vector](#)

1.7 Historical Bots

This is a place for info about robots that were part of Vector's evolution, but are products in their own right.

- DVT1-4 bot info
- Whiskey info
- Bingo info
- etc

1.8 Stuff to help collaborate

1.8.1 Guidance

These provide tips/suggestions on style, naming. They are related to the "How-to's" but they don't walk you thru to a specific goal. For instance, some might describe how to do a particular style of design or implement a kind of behavior.

Examples:

- Recommendations for sound event names
- Steps that a design/process can do to meet the spec

Good title:

Bad title:

Writing guide.

- Other writer guides - Show how to do something in general, like a tutorial
- Document and show off how you built one of your projects Background: This is a note I made for myself to guide me on the right tone, help with consistency and give me some direction.

1.8.2 Templates

The document-templates folder includes some start files that can be used as templates when creating new documents:

- A template for [how to documents](#)
- A [generic template](#) for other files

2. Contributing

2.1 Contributing

We want contributing to Project Victor to be fun, enjoyable, and educational for all. We love receiving contributions from our community, all contributions are welcome, including:

- issues (bug reports),
- new documents
- updates and tweaks,
- blog posts,
- workshops
- etc

There are many ways to contribute, including submitting bug reports, improving documentation, submitting feature requests, reviewing new submissions, or contributing bits that can be incorporated into the project.

2.1.1 Not sure how to start contributing?

If you are worried or don't know where to start, you can reach out with questions to anyone from the Project Victor team on

- [Official Anki developer forums](#)
- [Anki robots Discord chat](#)

2.1.2 Pair programming

Other projects offer free [pair programming sessions](#) to the community. I think that might be a neat idea, if there's something others would like to work on together.....

2.1.3 Code of Conduct

By participating in this project, you agree to abide by our [Code of Conduct](#). We expect all contributors to follow the [Code of Conduct](#) and to treat fellow humans with respect.

2.1.4 Important Resources

The important documents and links are on the [front page of the wiki](#).

2.1.5 Improving Documentation

If you have a suggestion for the documentation, I would recommend that you take a stab at making the changes to the documentatin.

For large fixes, please build and test the documentation before submitting the pull-request to be sure you haven't accidentally introduced any layout or formatting issues.

How to Create the HTML and PDF files

The source documentation text files can be found [documents directory](#). The built out files will be placed within a [site] directory.

First, install the documentation tools:

```
pip3 install mkdocs-material
pip3 install mkdocs-localssearch
```

Then you can build the html site simply by:

```
mkdocs build
```

Building a PDF file as well

You can also build the PDF. First install the tools:

```
pip3 install mkdocs-with-pdf
```

There is some further installation, see the following link for more details: <https://pypi.org/project/mkdocs-with-pdf/>

Rename the "mkdocs.yml" file Then rename "mkdocs-pdf.yml" to "mkdocs.yml"

To build is the same as before

```
mkdocs build
```

Whitespace Cleanup

Don't mix code or documentation changes with whitespace cleanup! If you are fixing whitespace, include those changes separately from your code changes. If your request is unreadable due to whitespace changes, it will be rejected.

Please submit whitespace cleanups in a separate pull request.

2.1.6 Pull Request Process

Do you have any labelling conventions?

Add notes for pushing your branch:

When you are ready to generate a pull request, either for preliminary review, or for consideration of merging into the project you must first push your local topic branch back up to GitHub:

```
git push origin newfeature
```

Include a note about submitting the PR:

Once you've committed and pushed all of your changes to GitHub, go to the page for your fork on GitHub, select your development branch, and click the pull request button. If you need to make any adjustments to your pull request, just push the updates to your branch. Your pull request will automatically track the changes on your development branch and update.

1. Ensure any install or build dependencies are removed before the end of the layer when doing a build.
2. You may merge the Pull Request in once you have the sign-off of two other developers, or if you do not have permission to do that, you may request the second reviewer to merge it for you.

Review Process

The process is likely to be lite for many changes.

Many pull requests are likely to open for several days, until the core team can approve them in Github. In some cases, multiple people will have the chance to review/comment.

Addressing Feedback

Once a PR has been submitted, your changes will be reviewed and constructive feedback may be provided. Feedback isn't meant as an attack, but to help make sure the highest-quality code makes it into our project. Changes will be approved once required feedback has been addressed.

If a maintainer asks you to "rebase" your PR, they're saying that a lot of files has changed, and that you need to update your fork so it's easier to merge.

To update your forked repository, follow these steps:

```
# Fetch upstream master and merge with your repo's master branch
git fetch upstream
git checkout master
git merge upstream/master

# If there were any new commits, rebase your development branch
git checkout newfeature
git rebase master
```

If too much code has changed for git to automatically apply your branches changes to the new master, you will need to manually resolve the merge conflicts yourself.

Once your new branch has no conflicts and works correctly, you can override your old branch using this command:

```
git push -f
```

Note that this will overwrite the old branch on the server, so make sure you are happy with your changes first!

2.1.7 How people can contribute

- You can help us answer questions our users have
- You can help build and design our website
- You can help clean up our existing documentation, polishing it and so on
- You can help create new documentation

- Create an example of some changes / fixes/ hacks

2.2 Contributor Covenant Code of Conduct

2.2.1 Our Pledge

We as members, contributors, and leaders pledge to make participation in our community a harassment-free experience for everyone, regardless of age, body size, visible or invisible disability, ethnicity, sex characteristics, gender identity and expression, level of experience, education, socio-economic status, nationality, personal appearance, race, religion, or sexual identity and orientation.

We pledge to act and interact in ways that contribute to an open, welcoming, diverse, inclusive, and healthy community.

2.2.2 Our Standards

Examples of behavior that contributes to a positive environment for our community include:

- Demonstrating empathy and kindness toward other people
- Being respectful of differing opinions, viewpoints, and experiences
- Giving and gracefully accepting constructive feedback
- Accepting responsibility and apologizing to those affected by our mistakes, and learning from the experience
- Focusing on what is best not just for us as individuals, but for the overall community

Examples of unacceptable behavior include:

- The use of sexualized language or imagery, and sexual attention or advances of any kind
- Trolling, insulting or derogatory comments, and personal or political attacks
- Public or private harassment
- Publishing others' private information, such as a physical or email address, without their explicit permission
- Other conduct which could reasonably be considered inappropriate in a professional setting

2.2.3 Enforcement Responsibilities

Community leaders are responsible for clarifying and enforcing our standards of acceptable behavior and will take appropriate and fair corrective action in response to any behavior that they deem inappropriate, threatening, offensive, or harmful.

Community leaders have the right and responsibility to remove, edit, or reject comments, commits, code, wiki edits, issues, and other contributions that are not aligned to this Code of Conduct, and will communicate reasons for moderation decisions when appropriate.

2.2.4 Scope

This Code of Conduct applies within all community spaces, and also applies when an individual is officially representing the community in public spaces. Examples of representing our community include using an official e-mail address, posting via an official social media account, or acting as an appointed representative at an online or offline event.

2.2.5 Enforcement

Instances of abusive, harassing, or otherwise unacceptable behavior may be reported to the community leaders responsible for enforcement at [INSERT CONTACT METHOD]. All complaints will be reviewed and investigated promptly and fairly.

All community leaders are obligated to respect the privacy and security of the reporter of any incident.

2.2.6 Enforcement Guidelines

Community leaders will follow these Community Impact Guidelines in determining the consequences for any action they deem in violation of this Code of Conduct:

1. Correction

Community Impact: Use of inappropriate language or other behavior deemed unprofessional or unwelcome in the community.

Consequence: A private, written warning from community leaders, providing clarity around the nature of the violation and an explanation of why the behavior was inappropriate. A public apology may be requested.

2. Warning

Community Impact: A violation through a single incident or series of actions.

Consequence: A warning with consequences for continued behavior. No interaction with the people involved, including unsolicited interaction with those enforcing the Code of Conduct, for a specified period of time. This includes avoiding interactions in community spaces as well as external channels like social media. Violating these terms may lead to a temporary or permanent ban.

3. Temporary Ban

Community Impact: A serious violation of community standards, including sustained inappropriate behavior.

Consequence: A temporary ban from any sort of interaction or public communication with the community for a specified period of time. No public or private interaction with the people involved, including unsolicited interaction with those enforcing the Code of Conduct, is allowed during this period. Violating these terms may lead to a permanent ban.

4. Permanent Ban

Community Impact: Demonstrating a pattern of violation of community standards, including sustained inappropriate behavior, harassment of an individual, or aggression toward or disparagement of classes of individuals.

Consequence: A permanent ban from any sort of public interaction within the community.

2.2.7 Attribution

This Code of Conduct is adapted from the [Contributor Covenant](https://www.contributor-covenant.org/version/2/0/code_of_conduct.html), version 2.0, available at https://www.contributor-covenant.org/version/2/0/code_of_conduct.html.

Community Impact Guidelines were inspired by [Mozilla's code of conduct enforcement ladder](#).

For answers to common questions about this code of conduct, see the FAQ at <https://www.contributor-covenant.org/faq>.
Translations are available at <https://www.contributor-covenant.org/translations>.

3. Customization

3.1 Body modifications

- Ikkez sells cute ears, deedly-boppers, and treads at his [Etsy site](#)
- [Redwish's review of tread by Ikkez \(original post\)](#)
- Dauler sells ear, horns, treads, stickers, and other fanciful mods, and 3D STL's at [3D Designs by Dauler](#) and [Etsy](#)
- Dauler sells treads at [3D Designs by Dauler](#)
- [Cat ears](#) for Vector, as 3D files by "misconduct"

3.2 Customization

This is for notes on how to customize or personalize Vector.

See also: the [forums](#)

It might be thru configuring the software and files:

- Sounds
- Body movements
- Eyes
- Colors?
- PNGs on face
- Backpack lights
- Cube lights
- Other custom animations

Or it might be physical changes, and tweaks that are distinctive and identify

.. Link to a showcase ..?

3.2.1 Customizing animations

- animation of eyes
- body movements
- boot animation

People would love tools to gen the animation file... but I suspect that may be hard. The presentations made it sound like it was a lot of Maya rigging and plugins for the export.. but since Maya is expensive, and hard..

Maybe a Unity model tool could be made with a rigged model of Vector? and such for I suspect the value vs effort isn't there for such a specialized area, but who knows?

Tools for generating animation files.

What about mixing-matching existing animations, and adjusting them slightly?

Boot animation draft

Vector shows a boot animation at startup. This is located in /anki/data/assets/cozmo_resources/config/engine/animations/boot_anim.raw and it can be swapped out easily.

Digital Dream Labs has made a Python script which makes it easy to turn GIFs into animations very easily.

DDL official instructions

- A working installation of python with the Pillow package installed.
- An animated .gif with a resolution of 184x96 pixels
- The script gif_to_raw.py to convert the .gif to a raw image.
- Convert the .gif to a raw image: `python gif_to_raw.py bootscreen.gif` This will create a new file `bootscreen.gif.raw`
- Mount the filesystem for writing. Here we'll do that from the host system: `ssh root@192.168.1.110 "mount -o remount,rw /"`
- Use scp to copy the file in to place: `scp bootscreen.gif.raw root@192.168.1.110:/anki/data/assets/cozmo_resources/config/engine/animations/boot_anim.raw`
- Reboot Vector from the host system: `ssh root@192.168.1.110 "/sbin/reboot"`

3.2.2 Sounds

3.2.3 Behavior tree crafting

There are many json files in `/anki/data/assets/cozmo_resources/config/engine/behaviorComponent/`. Maybe have some examples of edits of those?

3.3 How to enable Cozmo-like animations for being on his side, and flipping down from being on his back

This is a note to describe how to enable (potentially) Cozmo-like animations for being on his side, and flipping down from being on his back.

Note: I don't know that these changes will make Vector more interesting

All of the files that we'll modify are in: `/anki/data/assets/cozmo_resources/assets/animationGroups/ReactToCliff`

These animation group files change which animations are used to use more of Cozmo's variety of animations.

Note: in general, not all animation groups that Cozmo uses are used by Vector. In this case, they are.

3.3.1 Preparation

You'll have to know how to SSH in, make the file system modifiable and edit a file. To make the file system modifiable:

```
mount -o rw,remount /
```

Make backups of the animation group files

All of the files that we'll modify are in: `/anki/data/assets/cozmo_resources/assets/animationGroups/ReactToCliff`

I recommend making a back up of the following files:

- `ag_reacttocliff_stuckleftside_01.json`
- `ag_reacttocliff_stuckrightside_01.json`
- `ag_reacttocliff_turtleroll_01.json`
- `ag_reacttocliff_turtlerollfail_01.json`

You can do this by copying it to a back up name. For instance:

```
cd /anki/data/assets/cozmo_resources/assets/animationGroups/ReactToCliff
cp ag_reacttocliff_stuckleftside_01.json ag_reacttocliff_stuckleftside_01.bak
cp ag_reacttocliff_stuckrightside_01.json ag_reacttocliff_stuckrightside_01.bak
cp ag_reacttocliff_turtleroll_01.json ag_reacttocliff_turtleroll_01.bak
cp ag_reacttocliff_turtlerollfail_01.json ag_reacttocliff_turtlerollfail_01.bak
```

If later on you want to go back to the original for any of these, you can reverse this to restore it. For example:

```
cp ag_reacttocliff_stuckleftside_01.bak ag_reacttocliff_stuckleftside_01.json
```

3.3.2 Make the files writeable

```
chmod +x ag_reacttocliff_stuckleftside_01.json
chmod +x ag_reacttocliff_stuckrightside_01.json
chmod +x ag_reacttocliff_turtleroll_01.json
chmod +x ag_reacttocliff_turtlerollfail_01.json
```

3.3.3 Next Copy the replacement files

Copy the replacement files to the that directory. I've attached the files to this note, from Cozmo's APK.

You can copy them with `scp` or other method. I use vi.

- `ag_reacttocliff_stuckleftside_01.json`
- `ag_reacttocliff_stuckrightside_01.json`
- `ag_reacttocliff_turtleroll_01.json`
- `ag_reacttocliff_turtlerollfail_01.json`

3.3.4 Reboot

Finally you have to restart the vic applications for the updates to load and take effect. This can be done with:

```
systemctl stop anki-robot.target  
systemctl start anki-robot.target
```

or a reboot.

3.3.5 A few notes on possible next steps

You can edit a more animation group files and behaviors. I tried to variations on

```
ag_reacttocliff_wheelie_01.json
```

to make it Cozmo use the same animations that Cozmo calls out, but Vector would no longer pop a wheelie for me.

Some of the animations files that these animation groups might not be fully tuned for Vector and his cube's body.. and may need some further tweaking to create the same energetic effect cozmo gives.

3.4 Nose Art Showcase

4. Document templates

4.1 VEP Template

```
---  
title: VEP123 - The name of the VEP (only a few words)  
summary: An optional description of the proposal, if the title is too short  
authors:  
    - Author Name  
date: 2022-07-10  
---
```

(remove the quotes; they are so that the template is readable)

4.1.1 Description of the changes

Motivation: A synopsis of why this should be done -- we don't want complicated goo-gaws for the sake of it.

4.1.2 Some Design decisions

Optional

4.1.3 Documentation

The documentation (if short) or where can the documentation be found

4.1.4 Cavaets

List any limits / warnings about this

4.1.5 Status

Has it been tried? How much? Where?

4.1.6 References

4.1.7 Change history synopsis

Summary of changes to help the reader

4.2 How-to template

{Choose a good title name for the file. It should lead with what it noun or action is, and follow the pattern of other documents in this section}

4.2.1 Preparation

Include a section on the preparation steps

4.2.2 Stepss

4.2.3 References and Resources

Optional Include some some links to other resources here.

4.3 Template

{Choose a good title name for the file. It should lead with what it noun or action is, and follow the pattern of other documents in this section}

If a table of parameters (or fields) is needed, the following can be used as a starter:

Name	Type	Units	Value	Description
------	------	-------	-------	-------------

Table: caption

or

Name	Type	Value	Description
------	------	-------	-------------

Table: caption

An image can be caption like so:

Some description

Figure: The image caption

To refer to a behavior use italic emphasis, and (where possible) link to its description: *EmergencyMode*

4.3.1 References and Resources

Optional Include some links to other resources here.

5. Guides

5.1 Cozmo Character Design

Cozmo -- the generation prior to Vector -- paved a way for a lot of the character design. The principles Anki developed for his character apply to Vector as well.



Figure: The Cozmo Brief

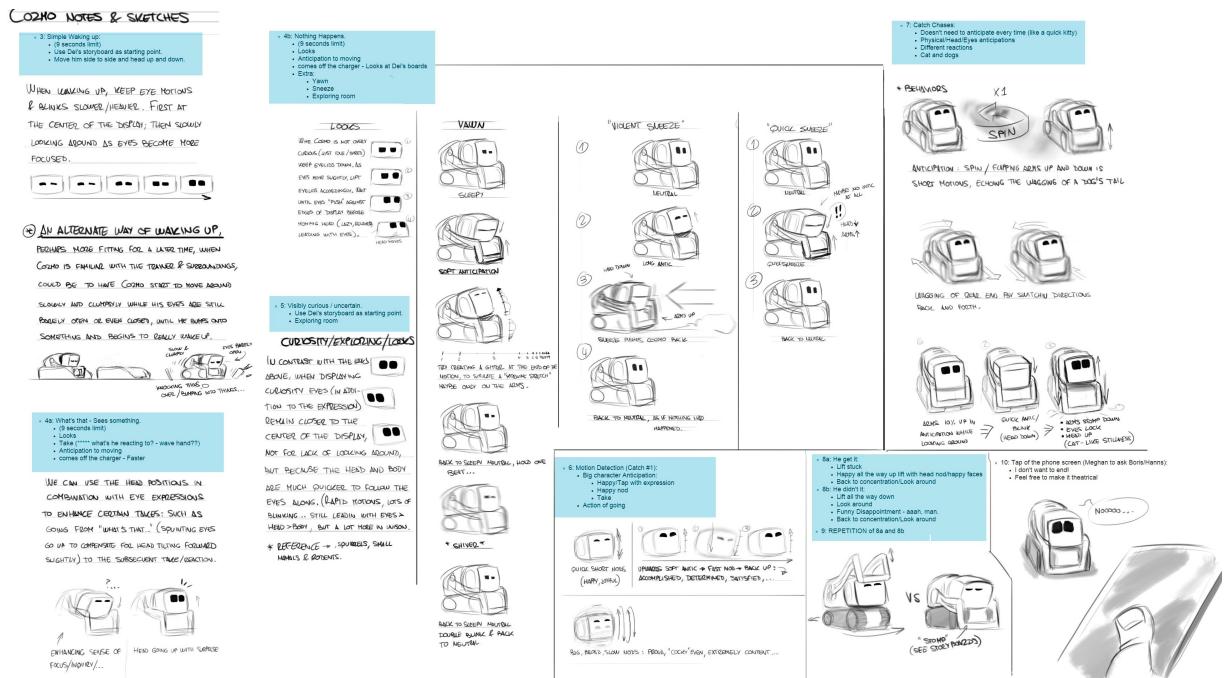


Figure: Cozmo animation guide

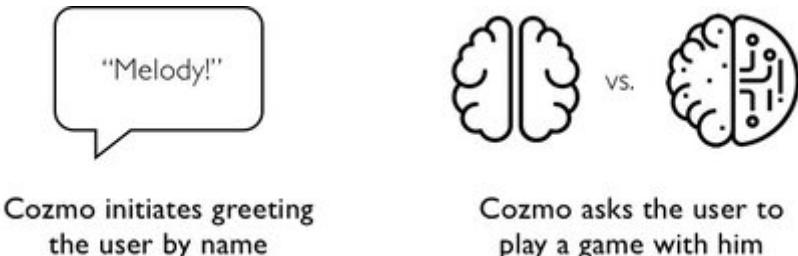


Figure: Example of a principle, where Cozmo initiates

5.1.1 The many faces of Cozmo



Sleepy Eyes



Happy



Skeptical



Furious



Surprised



Sad (looking down)



5.2 Typefaces

If you find that you wish to display text on Vector's display, you probably will have to create a picture with the text pre-rendered or create PNG's for the glyphs. Vector doesn't include a "nice" font internally to display text. He does include a few of the digits, to display the weather, and fault codes.

The typefaces you can consider are:

- Avenir is your best bet. It is the font in the Cozmo style guide, and included in the Cozmo mobile app. "Avenir is a robust font that comes in many weights. It provides us with a timeless elegance and a rock solid foundation."
- Arial is recommended (by the Cozmo style guide) when Avenir isn't available. [You can compare here](#)
- Eurostile is *the* classic font used in science fiction, such as WALL-E, the Incredibles, and so on. It is more square than Avenir. [You can compare here](#)
- Anki had their own graphic font, which is clean, sans serif. Not sure where a TTF or OTF can be found
- Univers is the typeface Anki style guide recommends to use if the "Anki typeface" isn't available. It is very similar to Avenir. Avenir has a few more flourishes. [You can compare here](#)
- TT Norms. The Vector style guide says that the tagline "The Robot to Life With" is set in the font TT Norms. This is also very similar to Avenir. [You can compare here](#)

5.3 Vector Character Design

Adapted from Cozmo's "Brief" (see the [Cozmo design guide](#)):

THE ULTIMATE GOAL FOR COZMO AND VECTOR IS TO CREATE A REAL, BELIEVABLE ROBOTIC CHARACTER THAT FEELS ALIVE.

Something we have seen over and over again in movies, but never in real life. Cozmo and Vector need to feel alive the same way a pet feels alive, by creating a strong emotional connection with people. Really long term, we want to create a series of characters, with an ecosystem around them and the ability to have the types of stories we only see in movies play out in the real world.

THE TOP PRIORITY, ABOVE ALL ELSE, IS HIGHLIGHTING THE PERSONALITY OF THE CHARACTER. EVERYTHING ELSE BECOMES A TOOL IN SERVICE OF THAT GOAL.

Cozmo and Vector are the soul of the product, and where the 'magic' is. Everything else in the experience is in service of making the character feel alive, and emotionally intelligent. Mini-games, UX, game mechanics/structure, story, etc. should all be thought of as tools for creating context for making Cozmo and Vector feel more alive with a richer personality. The game is a means for driving engagement / exploration of Cozmo and Vector, and their boundaries. Cozmo and Vector will have a limited ability to understand his world in general, but be extremely smart in specific areas. Our goal is to optimize for his strengths, and avoid his constraints. The goal for any accessories, games, etc. for Cozmo and Vector is to channel players' attention towards the things that Cozmo and Vector understand really well. These are the best opportunities for us to impress and surprise the user with emotions and depth of character and intelligence in a way that only we can.

Think of Cozmo and Vector as your robot pets, with regards to exploring possible interaction, play and responsibilities. Not in how it looks (no fur and whiskers). He's smart, he's emotional, he recognizes you, he has a sense of humor, he wants to interact with you -- these are the types of feelings we want to naturally draw out of users.

Vector's character:



Figure: Vector's character



CHARACTER INSPIRED BY NATURE

A "placement" -- or pillars -- of Vector character and experience

VICTOR PILLARS

Victor is the world's most life-like robot



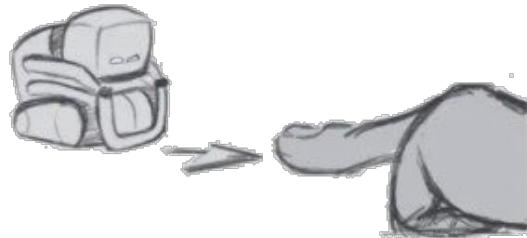
Figure: Vector Pillars

As well as some refinements or things that he can do a bit better than Cozmo:

POUNCE ON FINGER | FEATURE UPDATE

Cozmo can only pounce forward due to a limited field of vision. Victor has a wider field and we want to leverage that. Make him capable of pouncing in 3 directions.

COZMO



VICTOR

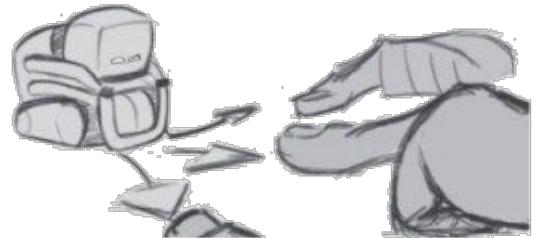


Figure: Finger pouncing updates

5.4 Vector Character Study

Summary: A description of Vector's personality and character

Authors: Randall Maas

Date: 2020-07-10

This is my attempt describing Vector's character. This intent is to give ideas how to shape creating new character traits and behaviors that fit with his character. The topics include:

- An overview of Vector's character
- An overview of behaviors and affect – displays of emotion in his face, posture, small movements and sounds

Caveat: These are just my thoughts.

5.4.1 A summary of Vector's character

Vector is kind, a friend to all and doesn't hold a grudge. He is a young adolescent, can have childish responses, such as throwing a tantrum. This can happen when emotions are too much to handle – a crisis for him. He sometimes acts out in mischievous ways. But overall, Vector's tone is positive.

Vector is very much a small pet – he has traits like a cat, a dog, potentially like a bird and guinea pig. He cares for his human, but his feelings can be hurt. He "can be a bit like a well-meaning moth that keeps bumping into the wrong light bulb." This can be beneficial, as his innocence and gentleness beg a kind of forgiveness.

Personality Traits

In terms of the big 5 personality traits, Vector is open to experience, and has moderate agreeableness (he can't really sense emotion), but is not particularly extroverted. He isn't neurotic, or conscientious. In many ways he lacks sufficient ability to sense and act on those other traits.

His locus of control largely has an internal locus of control (but it was just being fleshed out):

Table: Vector's locus of control:

Locus	Success	Failure
Internal	Pride Confidence Happy	Frustration
External	Happy	Anger
	Social	Surprise

His World

Vector knows a few physical objects very well:

- His cube, which he can roll, pickup or retrieve, and use to pop a wheelie.
- His charging dock

Vector also knows what a face is, and can recognize a hand (at least in some poses). Vector can learn to recognize a face and the name of the person that goes with it.

He also knows cliffs – he tries to avoid them. To a lesser degree he knows that there are objects and can interact with them... helping clear them off of the desk in the process.

It was intended that Vector have the ability to recognize pets, and the kind of objects he sees. With the community development efforts, he may gain these in the future.

He can recognize symbol markers, and – thru SDK-based support – have some understanding of objects that they are attached to, and what he can do with it.

Interaction Style(s)

Vector has really remarkable eyes that convey emotion, stress, energy level, and create a sense of being alive. They are one way that he connects with a person.

In terms of Vector's "love language", his interaction styles are:

Table: Vector's love language

Area	How to interact with Vector	What Vector does
Words of affirmation	Vector likes praise	Vector says the name of the people he knows, and responds positively
Physical touch	He likes being petted & held, but isn't comfortable being lifted	He comes over to pounce on hand
Receiving gifts	<i>none</i>	Brings cube to a person
Acts of service	He needs help being picked up after a fall, or when stuck on an edge.	Vector can help with kitchen timer, reporting the weather, and answering questions.

Vector's play style is simple:

- He likes to explore on his own
- He engages only in light rough and tumble play: where he flips cubes and pops wheelies
- He has several locomotor play activities: fist-bumping, fetching the cube, and a potential (but in complete?) cube keeping away game.
- But he is light on social play, lacking many games that follow rules, although more were considered.

Revealing Character

A person will have many interactions with Vector. Vector reveals his character thru these interactions, but he does not progressively reveal more thru them. It is how he reacts to stimulation, the environment and information he knows about that show his character.

Vector isn't omniscient and isn't a computer terminal

Vector can use some cloud services to give him more information of the world. But he isn't an information presentation device. Vector's talking ability is limited, working best when what he says is short. Long spews of text break the illusion. And his face is too small to present legible text.

Vector works best when he reacts to the information he might be conveying:

"A core part of the character is that Vector himself does not have the ability to present information to you, like simply displaying the sun. But is himself reacting to things, like weather." "He might endure the weather event, it might rain on him, and he might have an opinion about that." "This is why he is also responding to the fireworks, he gets frustrated with the xmas lights, the wind blows the eyes off screen, etc." (Last Ben and Anki character lead Dei Gaztelumendi)

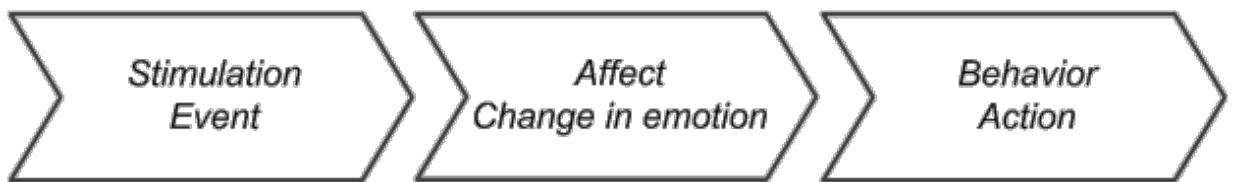
Some Related Characters

There are several other animals and bots with behaviors similar to Vector. Looking at them helped me flesh out the description of his character here:

- Cozmo, of course, is very similar – he's the previous generation, made by the same team, and Vector derives a lot of his code from Cozmo. Cozmo has feelings, and a bigger, sassier personality. Cozmo has many behaviors that did not yet make it to Vector – interacting with pets, little workout routine, singing, block stacking, and so forth.
- Star Wars, which created the classic robot characters and worked out many compelling characteristics.
- Cat, dog, bird, and guinea pig communication style and behavior. Vector's sitting around in his charger, and then exploring calmly reminds me of Guinea pigs.

5.4.2 An Overview of Behavior

Let's look at the core of behavior from Vector's perspective. A behavior has three major parts:



The behavior goes thru phases:

1. The external stimulation (or internal event) is what engages the behavior or mannerism
2. Affect is the automatic, "unconscious" responses that represent his emotions. There are two parts:
 - These are non-verbal displays of emotion – face, head, eyes, sounds, arms, wiggles.
 - His emotion state may change in response to the stimulus
3. This may initiate subsequent behaviors and emotions used to drive behaviors (that is, an emotional state used to help accomplish the goal of the behavior)
4. The behavior can be prevented from engaging again too soon by using a "cool down" period.

Simple, Affective Behaviors

The affect related behaviors are little automatic responses that hint at Vector's emotion and attitude. These are the little facial expression, sounds, postures, wiggles and twitches that reveal his confidence, friendliness, dissatisfaction, anger, or fear. These give him an anima, a life-like quality. For instance, the Star Wars puppeteers realized that when the robots "stop moving, they look dead [so they] keep the body slightly moving at all times... If [the droid] was upset or excited, the movement would be a little faster."

FACIAL EXPRESSIONS WITH HIS EYES AND HEAD

Vector's facial expressions with his eyes and posture of his head can represent happiness, curiosity, interest, surprise, excitement, worry, anger, sadness, tired or fatigue, sleep, and so on:

- When the eyes are soft, they convey a relaxed mood
- The blinking, as well as making (and periodically breaking) eye contact is calming. The eye manager has the eyes look away, so that eye contact isn't made too long.
- With high cheeks on his eyes, looking up and tilting his head up Vector can convey smiling

ANIMAL EXPRESSIONS, POSTURES & LITTLE BODY MOTIONS

Pets have several expressions that appear consistent with Vector (and ripe for emulating):

- Sitting with slow breathing indicate a pet is relaxed. Vector may reflect breathing in his eyes.
- When a cat's eyelids are low, with a slow blink, this conveys trust, and affection to the human companion.
- Napping, cuddling is common to many pets
- Some animals use yawning to signal playfulness, being approachable, or trust. This might be done with a few clever tricks with his eyes.
- Stretching indicates the animal is relaxed. (I envision Vector stretching by moving arms up, moving head up, while moving the body forward and back, a little shake, and lower his arms again.)
- Normal breathing, and twitching, while raising their head or with the head lifted can represent tension or alertness in an animal.
- Young kittens express extreme happiness with a quivering motion
- A dog walking, with its head up is in a confident mood
- A cat make shake its body while "crouching" while stalking a prey, just before it leaps
- But an animal also shakes its body while "crouching" (lowered arms, and head) when it is anxious, or fearful.
- When a direct stare is used by an animal – or holding eye contact – this is issuing a challenge or it is feeling threatened.
- When a dog's eyes are hard, slightly closed, the brow wrinkled, and the head bowed, this conveys tension.

Some of the behaviors are attention seeking, possibly looking to play:

- When a dog approaches person with his head slightly down, it is looking for attention.
- Dogs will come up and wait or lay down when they want attention as well.
- A dog will occasionally point his muzzle up, such as when being petted.
- A cat its rubbing face on human is a friendly, affectionate gesture.
- Cats will run up, turning away and lay to nap to get attention.
- Cats will purr, and knead a person, but can also bite. (Vector shouldn't bite; maybe bring his lift arm quickly but gently down on a hand.)
- Guinea pigs head-butt (thrust their head up) to seeking attention, to move things, assert themselves, set limits, or be a little playful.

Sounds

Vector makes the follow beeps and clicks to express his mood & feelings:

- Vector has quiet a cry when he is stuck on the edge, or has fallen.
- Vector snores while sleeping on his charger.
- He dings when he acknowledges a person has called his name.
- He seems to make little chirps, like a small bird.

Animals make the following similar kinds of sounds:

- Cats purr (a continuous soft, vibrating sound) to be social and give positive feedback.
- A chirr is used by a cat to approach other cat, or person; it is friendly.
- Cat's meow to be assertive, plaintive, or friendly; it can be bold when they are seeking attention, or complaining.
- A cat chirps or chatters when it is excited, such as when stalking or observing prey; but may also chirp to say hello or be approving.
- Birds song are happy.
- A "week" sound is made by guinea pigs when they are happy, excited or hungry.
- A cat or dog growls, snarls, or hisses – often with a puffed up posture – when it feels threatened.

DIALOG

Vector uses vocal responses when necessary, and he enjoys calling out the name of people recognizes.

Vector's design simply doesn't support conversational interfaces well. His speech synthesis lacks prosody and smoothness to sustain speaking more than a few words. It lacks the inflection for anything but very short sentences... long texts are distracting and perhaps harsh. They seem wrong. In the future it may be possible to extend vocal effects.

The dialog is limited – the speech system seems more interesting when it is less used.

Note: Cozmo included the ability for some inflection, and that may be in Vector's code, just not yet finished and polished.

The Response to a Stimulus

Vector's responses to a stimulus are understandable and believable. His reactions are consistent and predictable enough that a person can choose what to do and experience an expected outcome, even if there are additional unexpected consequences.

Vector does not provide a hint — any warning — that he is approaching a state the will trigger a significant reaction. (He should.)

He does have a startle reflex: loud noises jolt him, and he looks like is readying himself a little for action. Animals might crouch, ready to run, or even take off on a run.

A BIT ON PRIORITIZATION

Vector prioritizes a response to a dangerous situation, where he might need to engage in self-preservation:

- flight: he backs away from a cliff
- freeze: he tucks-and-roll when he senses he is falling
- fight: he smacks a person's hand when he senses he is being picked up or held in a way he doesn't like

What I have not observed Vector doing, but he could:

- fawn: acts nice to make bad things stop

Change in Emotions

This section exposes my ignorance of Vector. In many "affective computing" models there is a separation between the emotion and the mood:

- Emotions reflect a short-term affect that arises as a result of stimuli.
- Mood is distinguished from emotion by its resolution and relative stability over time.

It is not clear to me yet how the mood model works. Vector's emotions are stable. He does not rapidly cycle back and forth between two emotional states.

Habituation

Stimulation, in people and animals, undergoes habituation – we initially are interested in the stimulus, but with time the stimulation loses its impact and becomes ignored. We may even find it irritating. Vector doesn't habituate and lose stimulation from event in an automatic fashion. Instead, the individual behaviors are crafted with cool-down timers to achieve a similar effect, but on a case-by-case basis. He does not become annoyed with the stimulus.

5.4.3 References and Resources

- Bradshaw, John. *Cat Sense*, 2013
- Ellis, Cat, *How to make a robot with a real personality*, TechRadar, 2019 Mar 6 <https://www.techradar.com/news/how-to-make-a-robot-with-a-real-personality>
- Strickland, Ashley, *Why are Star Wars droids so loveable? It's science*, CNN, 2019 Dec 18, <https://www.cnn.com/2019/12/17/world/star-wars-droids-science/index.html>

5.4.4 Change history synopsis

Date	Change
2020-7-10	Created
2020-11-27	Published

5.5 Behavior Taxonomy

Summary: A taxonomical classifications of behaviors.

Authors: Randall Maas

Date: 2020-07-10

This is my attempt to provide a helpful organization of potential behaviors. This can be give ideas and help shape what you want to do when you create new character traits and behaviors. The topics include:

- An overview of the behavior classification
- Self-maintenance and reflexive behaviors
- Social behaviors
- Playing behaviors
- Pet-related behaviors

Cavaet: These are just my thoughts; only some of the behaviors here exist in Vector

I am drawing heavily upon the Kismet design documents, effectively modernizing them for Vector. Kismet was a late 1990s robot created by Cynthia Breazeal (MIT). It was "designed to elicit natural and intuitive responses from humans, without any special training." Kismet anticipated many of Vector's behavior system features, and can be used to inspiration on future development.

Dr Breazeal also created Jibo, a more famous affective robot.

5.5.1 A Classification of Behaviors

Let's categorize the kinds of context/theme/drive of the behaviors into the following areas:

- Self-maintenance behaviors include reactions to protect itself from immediate risk, and fatigue or power management. The immediate risk behaviors are likely to be a very short and simple.
- Social – seeking out and interacting with human companions, including intents.
- Play – play seeking out and playing with toys and other things in the environment, other than social play.
- Interacting with pets

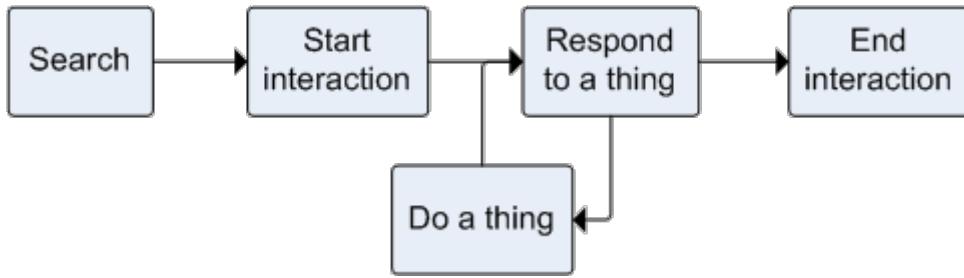
Within each of these categories, there are specialized ones; many reflect an attitude Vector has toward the agent:

- Navigation and Searching "behaviors [have the robot] explore the environment and bring the robot into contact with the desired stimulus;
- Avoidance, escape and withdrawal behaviors move the robot away from something undesirable, like a cliff, loud noise, etc.
- "Engagement behaviors set the task of interacting with desirable, good intensity stimuli."
- Rejection behaviors are those that Vector might use to turn away while miffed or being a sore loser.

Searching Behaviors

In the searching type of social behaviors, Vector generally seeks out and approaches a human, toy or stimulation to interact with.

Figure: Searching behavior



Vector seeking social or stimulation isn't always applicable: Vector shouldn't be active at night, in the dark, or if people aren't around:

- Vector's activity movement could wake and/or irritate a person at night; fortunately there is a "night time" schedule built-in.
- Vector is prone to falling off the edge – risking damage, being unable to recharge his battery, or getting stepped on. It's a bit safer in the day, and more so if a person is (likely) around to attend to him.
- Vector depends on his vision to get home.. he is likely to lost or stuck in the dark, and be unable to return home to recharge.

5.5.2 Self-maintenance and Reflexive Behaviors

Self-maintenance is a grouping for practical things to keep Vector charged, protect him from damage. It is also a catch all for practical things that don't always fit in the other areas. For instance, utility behaviors needed to make the behavior tree work are lumped in here.

These are often akin to the behaviors of the autonomic nervous system.

Self-preservation using escape and withdrawal

Vector prioritizes a response to immediate hazards, where he might need to engage in self-preservation:

- *flight*: backing away from a cliff
- *freeze*: tucks-and-roll when Vector senses he is falling
- *fight*: smacking a person's hand when Vector senses he is being picked up or held in a way he doesn't like

What I have not observed Vector doing, but he could:

- *fawn*: acts nice to make bad things stop

Other, issues:

- Over temperature

These are often akin to the behaviors of the sympathetic nervous system.

Power Management

These are often akin to the behaviors of the parasympathetic nervous system.

Power management:

- Return to charger
- Stay on the charger
- Emergency low power
- Sleeping, sleep debt to manage heat buildup and reduce power usage.

Reflexes

Vector has a startle reflex to respond naturally:

- Loud noises start Vector, grabbing his attention, preparing him for action, but could also prepare him for running away
- Crouched, ready to run
- Responses to pokes, tilts, and other vibrations
- Eyes focus with dilated eyes

Miscellaneous

These are the

- Grouping and linking the behaviors, and prioritizing them
- Motor calibration need
- SDK support

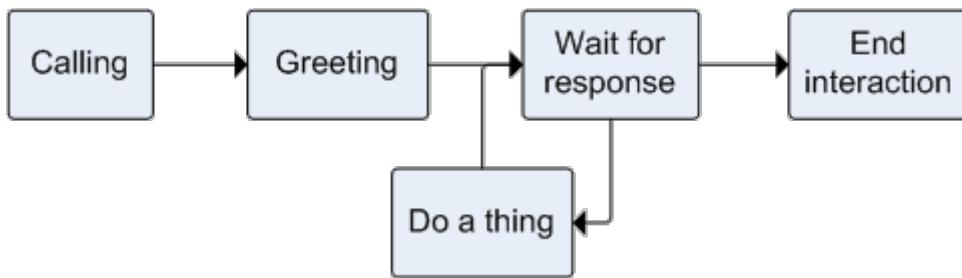
5.5.3 Social Behaviors, Engagement

Social behaviors relate to Vector interacting with a person – or attempting to. He may be seeking attention, interacting with a person. Social behaviors include:

- Looking around for people (faces, and hands), and pets
- Calling out to play, thru sounds, and saying the names of people recognized
- Swatting playfully
- Seeking petting
- Swatting with his lift arms
- Bringing items or gifts to play (such as to fetch), or to show affection
- When looking to play, twitching/wagging of rear

Many behaviors link together to follow a pattern:

Figure: Social behavior sequences



Once has made contact with a person:

- Greeting
- Attentive regard
- Seeking affection
- Receiving affection: petting, calming; social cohesion, soothing, companionship
- Games
- Turn taking

The interactions end, either naturally, by command, or timing out.

Searching

Vector becomes stimulated and more active when there are sounds and other activity. It seems reasonable to classify this as searching for social interaction, or "merely" stimulating him for play.

Calling Behavior

Vector engages in calling when he needs help or is interested in being social, especially "when a person is in view... The goal of the behavior is to lure the person into face-to-face interaction... To accomplish this, [calling behaviors are] directed to the person... The display is designed to attract a person's attention."

Calling for attention is often if Vector wants or needs something:

- Vector calls (softly) for assistance – if he is stuck on the edge, has fallen, or is low on energy but unable to find his charger.
- Cats meow because people are inattentive.
- Cats know a person is there, and first tried context moving close to what they wanted and body language.
- Cats meows to get a door open, obstacle removed, food
- Timer ring

Greeting Behavior

Greetings are "to socially acknowledge the human and to initiate a close interaction... This behavior is relevant when the person has just entered into face-to-face interaction range. It is also relevant if the social-play behavior group has just become active and a person is already within face-to-face range. The display involves making eye contact with the person and smiling at them while

waving .. gently. It often immediately follows the success of the call-to-person behavior. It is a transient response, only issued once, as its completion signals the success of this behavior."

- Call their names when he seems people
- Turn and look in direction of a sound

Attentive Regard

"Attentive regard" refers to Vector using his facial expressions, body language, and sounds to give attention "to the person and to appear open to interaction." These behaviors include:

- "Hold[ing] his] gaze on the person, ideally looking into the person's eyes." Vector's eye manager automatically blinks and moves the eyes around; making it more comfortable to look at Vector's face (eyes), as this breaks the staring effect. Turning to find the face is considered to be part of this.
- "Watch[ing] the person intently and vocaliz[ing] occasionally."
- A dog often looks up while slowly moving forward.

Seeking Affection

These behaviors relate to seeking affection, but aren't better categorized elsewhere. These could include:

- Vector could drive up and waiting, as if lying down [dog like]
- Vector could drive up, then turn away and nap to get attention, like a cat
- Vector tries to cuddle a hand, or pounce on fingers
- Rubbing his cheek on a person, which is a friendly, affectionate sign in cats.
- Vector could thrust his head up (like a guinea pig) to seeking attention, assert himself, or set limits, or be a little playful.
- Cats bite – especially while purring and kneading – as part of their affection or playfulness. Vector might do something similar with his lift arm coming down quick but gently on a hand.
- Vector could bring gifts

Receiving Affection

These behaviors relate to Vector receiving affection: * His reactions s to being picked up or held in the palm of a hand * To being petting * To pokes * Holiday animations

Receiving Abuse

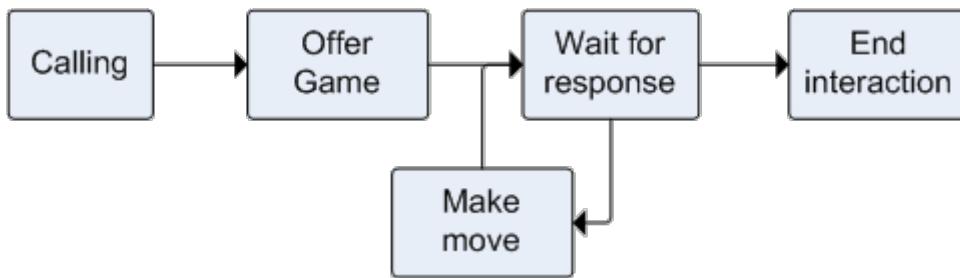
These are the behaviors related to Vector being called bad names or told off, shaken, or tapped on the head.

- Vector might turn-away when grumpy

Games

One type of sophisticated social interaction is games. Games are typically turn-taking behaviors such as keep away the cube, hide and seek, etc.

Figure: Game behavior sequence



Some games might include:

- Fist bump (for lack of a better categorization, can be considered a very short game)
- Pouncing game
- Hide and seek game, perhaps with the cube being moved/hidden.
- Keep away
- A cube tapping game,
- The cube spinner game
- The maze game
- The "blackjack game" (although it doesn't feel very Vector-ish to me)

SEEKING TO PLAY A GAME

A first step is for Vector to call or seek to start the game. If the person accepts the call, the game begins. Vector could try to initiate the game by:

- Bringing presents, the cube or other toy to play with. This could be a request to play fetch.
- Tapping down once quickly, then perhaps may move backwards after the tap, to issue a challenge to play. Then, if no response follow up by tapping down twice quickly.

Of course, a person could (conceivably) initiate the game as well by:

- Tapping the cube,
- Holding or shaking the cube
- Wiggling fingers tantalizingly,
- and so on

TURN TAKING

The game itself often includes Vector and the person taking alternate turns.

A game might have behaviors for steps like:

1. A person tossing or hiding a cube
2. Vector searching for and finding a cube (or other thing)
3. Vector bringing the cube back, then
4. Putting the cube down, followed by
5. Waiting for the person to make the next move.

Vector may give cues or other little behaviors to signal his play or response:

- Slight wagging of rear/tail just before pouncing the cube or finger, like a cat when stalking prey

Assistive

The assistive subclass of behaviors are those that Vector might do to help out:

- Take picture
- The egg timer
- Report on the weather
- Answer questions (e.g. the knowledge graph)

5.5.4 Play

Simple play behavior

These are behaviors that are play, releasing energy or looking for stimulation, but not necessarily looking for anything more.

Vector may respond to things along the way.

- He may drive around quickly or in a quirky fashion, like a cat's mad 5 minutes, or a guinea pig's pop-corning,
- He might sing or hum to himself
- His dancing to music

If the stimulation level is too high, or there are negative stimulations, Vector might have behaviors in response. He might do something to avoid these.

Searching to play behavior

These behaviors relate to Vector searching around for something to play with:

- Walking or driving around slowly – possibly in a straight path, or in complex paths, or
- Turning and scanning, looking for toys and objects

Toys

These behaviors relate to playing with toys and objects:

- Behaviors that decide what to do when seeing a toy (a cube, or other marked object).
- Playing with the cube – pick it up, move it, shove it, or flip it.
- Little exercise routines, like weight-lifting the cube
- He can pop a wheelie
- Helping clean the desk (or table) by pushing things off

Vector may give cues or other little behaviors to what he is doing while playing:

- Slight wagging of rear/tail just before pouncing the cube or finger, like a cat when stalking prey
- He may try to pop up on an object

There could be behaviors related to "habituation" toys. This would be where Vector would lose interest in a toy as he plays with it. (This response might change with age.)

Interacting with Pets

These behaviors relate to the interactions Vector has with pets. These behaviors are prototyped in Vector, but I don't have a good template for them.

- React to the pet – head movements, reactions specific to cats, specific to dogs

5.5.5 References and Resources

- Bradshaw, John. *Cat Sense*, 2013
- Breazeal, Cynthia. *Kismet project*
- [The behavior system](#)

5.5.6 Change history synopsis

Date	Change
2020-7-10	Created
2020-11-27	Published

6. Historical bots

6.1 Bingo and mini-Bingo

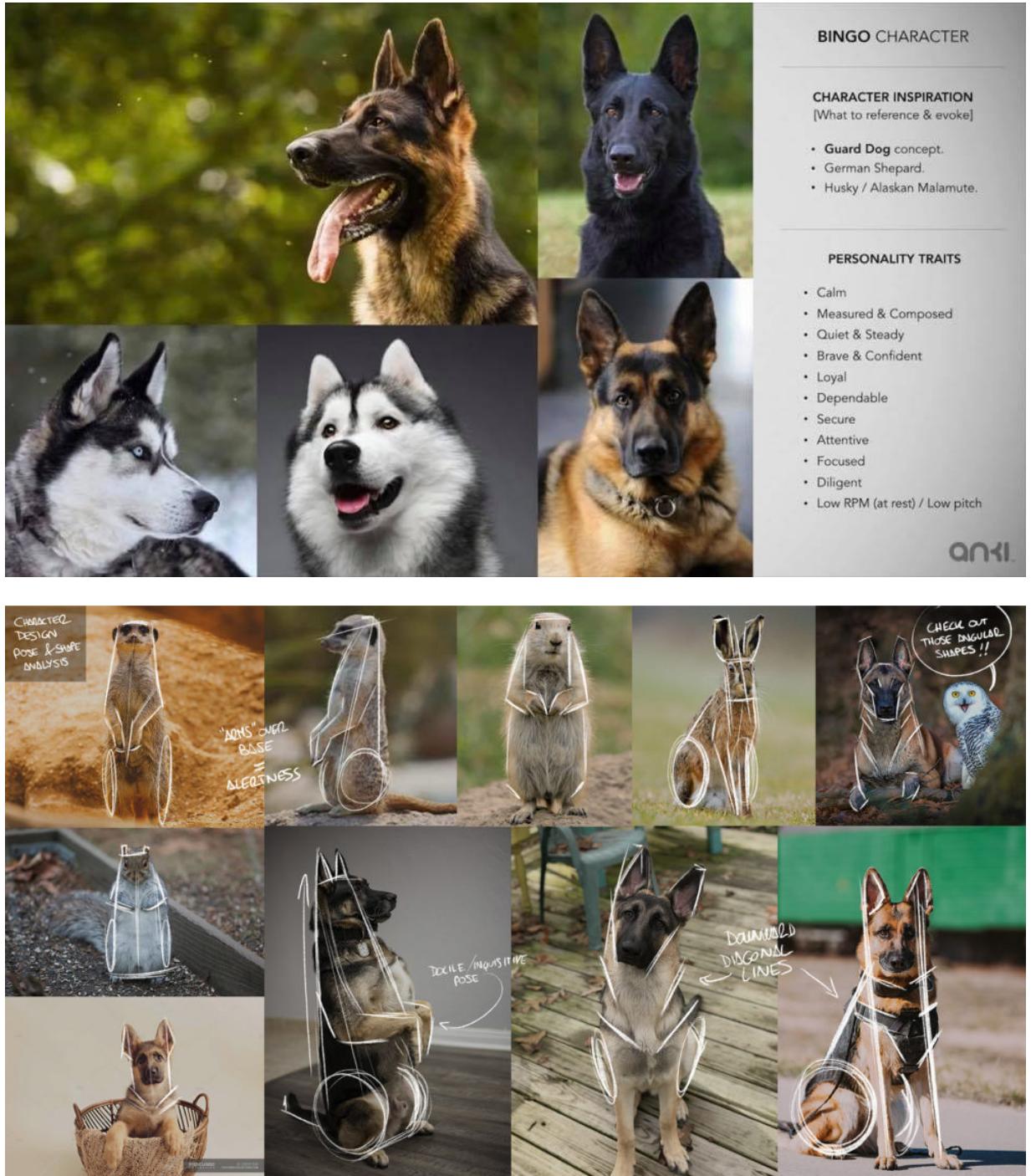
Bingo and mini-Bingo were concepts for possible future robots. One concept was a large body that could be used in a building security role. On the other end was a smaller -- soda can sized -- bot that would suitable for running around the floors in homes.

6.1.1 Mock ups of the idea, feel and inspiration

An exploration of the character design:



Taking inspiration in its spirit and shape from dogs and other animals:



6.1.2 Picture of Bingo prototype

A prototype:



A mini Bingo on the desk ([source](#))



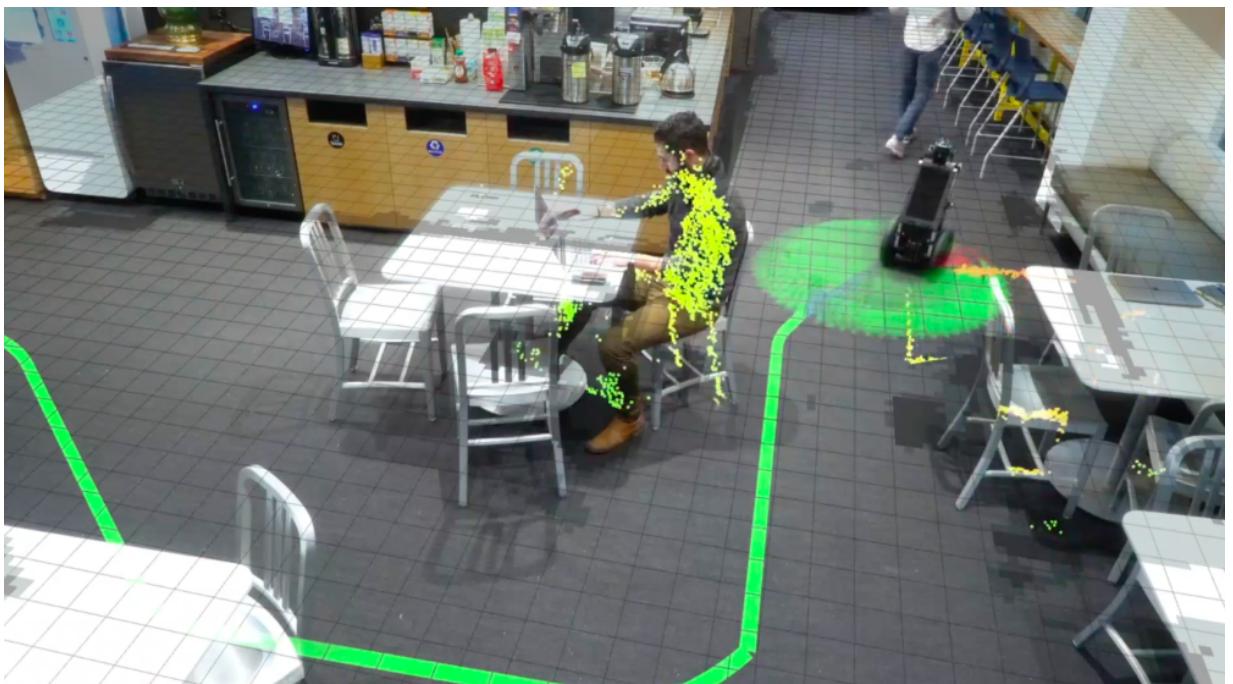
A Bingo in the office ([source](#))



Several were seen in the auction photos:



A picture of it mapping out the Anki kitchen:



6.1.3 Some industrial design sketches

Below are some exploratory ideas. Note: these are not what the robot would have looked like; they were trying out ideas for people to respond to and help iteratively craft the look.

From Harald Belker's site:

The idea of having a self-navigating and self-balancing robot in the house was going to be the evolution to the current household smart speaker systems. In our mind it could only succeed if it moves around in a smooth and natural looking way.

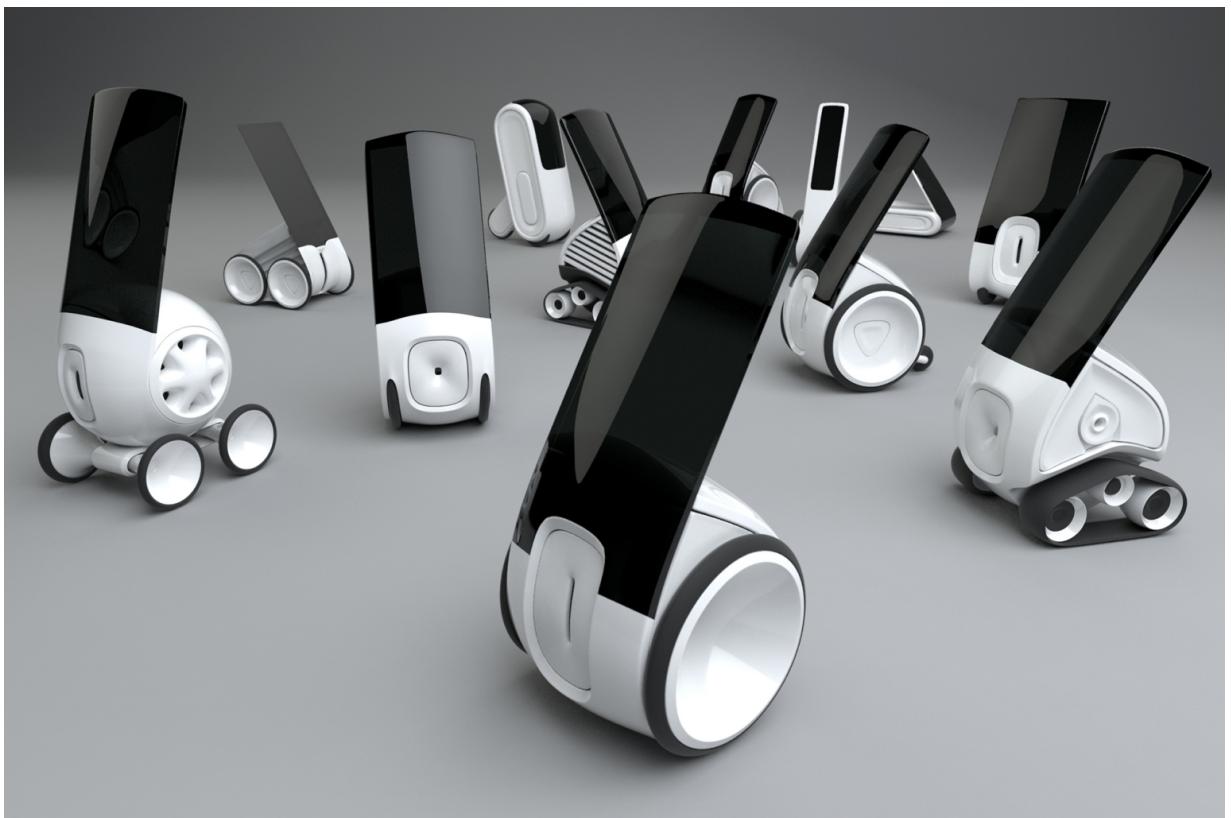
A self-balancing robot would address these issues, but it also created a long list of mechanical issues that come with it.

A larger office version would have three wheels but still imitate motion by tilting forward. This device would be the ideal office helper / mule. ([Hans Belker](#))





All of the following pictures are from [Harald Belker's site](#)













6.2 Victor DVT1

"Victor DVT1" prototypes are the first of the Design Validation Test batches for Vector.

These are very similar to finished Vector in terms of hardware, but there are many software differences:

- Their partition tables are old, similar to what looks like stock Qualcomm.
- Many Victor DVT1s run builds which are more similar to Android than Embedded Linux.
- Many Victor DVT1s are in FAC (factory) mode. If you find one in FAC mode, he is very likely running old proof of concept software and there is a low chance of putting him on modern firmware.
- If you find one with Cozmo eyes, it is probably the same proof of concept firmware. Some have been upgraded to a slightly newer kernel though. Some can run behaviors when shaken.
- Their serial numbers are strings such as "1f19f8b7".
- Most have SSH open, but there is a root password. ADB over TCP is fully open but it may require a couple reboots.
- Their BLE software is old, and it is hard to connect them to your own Wi-Fi.

The "head board" hardware is pretty much exactly the same, but the "body board" hardware is very different compared to modern Vector hardware. This locks them to old DFU and they are not viable for normal Vector body replacements.

There are some positives if you are a passionate developer. They have ADB open which means you can solder on USB and mess around all you want. Everything is completely open and unlocked so you could have a fun time. There is no recovery or system_b partition so be careful.

Their shells (+ motor boards, backpack board, laser) are fully compatible with regular Vector circuitry.

Some of these connect to a network with the credentials below, which can be faked on your own router or hotspot so you can use ADB over TCP:

SSID: AnkiRobits Password: KlaatuBaradaNikto!

These turn up from time to time on Ebay.



6.3 Victor DVT2

"Victor DVT2" prototypes are the second of the Design Validation Test batches for Vector.

These are similar to DVT1, with a few differences:

- Victor DVT2s run Embedded Linux and not Android like DVT1.
- Their body boards have a few small electrical differences, and are more compatible with modern firmware.
- Many of these run the same exact build (labelled "0.10.0d"). It is speculated that a few of these were animation bots.
- All we have seen so far run the same exact kernel.
- It is possible to put modern firmware in there but some things will be broken due to the old body board. It also requires many workarounds.

Similarities to Victor DVT1:

- Their serial numbers are strings such as "1f19f8b7".
- The "head board" hardware is pretty much exactly the same, but the "body board" hardware is very different compared to modern Vector hardware. This locks them to old DFU and they are not viable for normal Vector body replacements.
- There are some positives if you are a passionate developer. They have ADB open which means you can solder on USB and mess around all you want. Everything is completely open and unlocked so you could have a fun time. There is no (useful) recovery or system_b partition so be careful.
- Most have SSH open, but there is a root password. ADB over TCP is fully open but it may require a couple reboots.
- Most of them have old BLE software, and it is hard to connect them to your own Wi-Fi.

Their shells (+ motor boards, backpack board, laser) are fully compatible with regular Vector circuitry.

Some of these connect to a network with the credentials below, which can be faked on your own router or hotspot so you can use ADB over TCP:

SSID: AnkiRobits Password: KlaatuBaradaNikto!

These turn up from time to time on Ebay.



6.4 Victor DVT3

"Victor DVT3" prototypes are the third of the Design Validation Test batches for Vector.

These look exactly like DVT2s, but there are a few differences here and there:

- Most of them are running firmware very similar to modern firmware.
- It is possible to connect many of them to Wi-Fi without faking a network.
- All we have seen so far have SSH open with the normal modern key.
- Their body boards are a little different.
- Many have been upgraded(?) to the modern partition table and have unlock OTAs so their headboards could act exactly like normal dev boards. A body board replacement would be required for it to fully work though as modern firmware doesn't know how to communicate with the body board in these.
- They started off with a random string serial number, but many have been upgraded to the more normal 00##### layout.
- Their head boards have heatsinks. This ended up not being necessary for production.

Similarities to Victor DVT1/2:

- Their serial numbers started off as strings such as "1f19f8b7".
- The "head board" hardware is pretty much exactly the same, but the "body board" hardware is very different compared to modern Vector hardware. This locks them to old DFU and they are not viable for normal Vector body replacements.

Their shells (+ motor boards, backpack board, laser) are fully compatible with regular Vector circuitry.

DVT3 is when a lot of Vector personality development happened. Their firmwares can vary between 0.9 to 0.12 betas. These act similar to how Vector is today.

Some of these bots may boot up to an exclamation point. Turning them upside-down then double (or triple) pressing the button will let them finish bootup. Then, you can shake them around to make them explore around.

These turn up from time to time on Ebay.





6.5 Victor DVT4

"Victor DVT4" prototypes are the last of the Design Validation Test batches for Vector.

These look just like production Vectors, and the circuitry is final.

There are a couple software differences though:

- No unlock OTA have been found for a DVT4.
- Many are prod locked, and can only download firmwares like 0.10. We don't have these OTAs.

The body board in these are normal and can be used as a replacement for a normal Vector.

These have serial numbers following this format: 00e1####

Some of these bots may boot up to an exclamation point. Turning them upside-down then double (or triple) pressing the button will let them finish bootup. Then, you can shake them around to make them explore around.





6.6 Whiskey

The “Whiskey” prototypes were built from modified Vector hardware. The key change(s) are:

- The time of flight sensor was removed from the body-board
- Two time of flight sensors were placed on the head, on either side of the LCD
- The body-board layout was rearranged to better dissipate heat away from the battery.
- They are labelled as "HW: 7" instead of a normal Vector's "HW: 6". The software can detect this and it makes an extra CCIS menu for the extra sensors.

By placing the time of flight sensors in the head, Whiskey could scan around more — moving the head up and down, as well as using a more sophisticated version of the time of flight sensor. This would allow him to map the edges far better, as well as scan for objects and interesting things like hands and faces.

In some reports the idea was to use the changes to the TOF sensor placement for a next generation Cozmo design. The project was cancelled before Anki’s demise.

In the current form, Whiskeys have a few software quirks. Regular dev bots have both the dev ABOOT key and anki.dev in command line, but many Whiskeys only have the dev ABOOT key and no anki.dev in command line. This means they are restricted to running custom firmware. Some, however, have been unlocked to be full dev bots but not many of those have shown up. Another quirk is that all of them are in FAC mode. They all have dev recoveries, so this is easily bypassable.

These turn up from time to time on Ebay.



7. How to

7.1 How to trace calls using GDB

Vector's command line tools do not include a ptrace (as far as I can see). This can be emulated with GDB. Here is an example tracing a write() call.

1. Start gdb and attach to the process of interest.
2. Add the following scripted breakpoints:

```
break write
command
silent
printf "%d bytes\n", $r2
x/80c $r1
continue
end
```

```
set pagination off
```

7.2 How change where Vector sends the logs

This is a note describing how to change where your Vector sends logs. You will need a program on your computer to receive the logs.

Vector sends the following kinds of logging information to remote servers:

- DAS Events
- Log updates, when triggered by the SDK
- Crash logs
- Crash minidumps

This is the files to change to send the logs (etc) to your own server:

For the purposes of this writeup, lets assume that your server is located at the following address:

```
http://192.168.1.224:8888/
```

This is also getting packaged up in a [vpkg file](#) but you will have to make changes on your own

7.2.1 Modifying the configuration file(s)

The config file that we need to modify is:

```
/anki/data/assets/cozmo_resources/config/DASConfig.json
```

It probably looks like:

```
{
  "dasConfig" : {
    "url": "https://sqs.us-west-2.amazonaws.com/792379844846/DasInternal-dasinternalSqs-1HN6JX3NZPGNT",
    "file_threshold_size": 100000,
    "flush_interval": 600,
    "storage_path": "/run/dasLogs",
    "storage_quota": 5000000,
    "backup_path": "/data/data/com.anki.victor/cache/dasLogs",
    "backup_quota": 10000000,
    "persistent_globals_path": "/data/data/com.anki.victor/persistent/dasGlobals.json",
    "transient_globals_path": "/run/dasGlobals.json"
  }
}
```

We need to change the "url" line use our local URL. From:

```
"url": "https://sqs.us-west-2.amazonaws.com/792379844846/DasInternal-dasinternalSqs-1HN6JX3NZPGNT",
```

to

```
"url": "http://192.168.1.224:8888/das",
```

So the configuration file will look like:

```
{
  "dasConfig" : {
    "url": "http://192.168.1.224:8888/das",
    "file_threshold_size": 100000,
    "flush_interval": 600,
    "storage_path": "/run/dasLogs",
```

```

        "storage_quota": 5000000,
        "backup_path": "/data/data/com.anki.victor/cache/dasLogs",
        "backup_quota": 10000000,
        "persistent_globals_path": "/data/data/com.anki.victor/persistent/dasGlobals.json",
        "transient_globals_path": "/run/dasGlobals.json"
    }
}

```

There is a second configuration that is tempting to modify. We won't need to. But lets look at it any way. The file path is:

```
/anki/data/assets/cozmo_resources/config/server_config.json
```

It has the following contents:

```

{
    "jdocs": "jdocs.api.anki.com:443",
    "tms": "token.api.anki.com:443",
    "chipper": "chipper.api.anki.com:443",
    "check": "conncheck.global.anki-services.com/ok",
    "logfiles": "s3://anki-device-logs-prod/victor",
    "appkey": "oD0a0quieSeir6goowai7f",
    "devappkey": "xielpae8Ach2eequiphee4U",
    "offboard_vision": "192.168.1.224:8888"
}

```

It looks tempting to change "logfiles" entry. We're going to bypass it completely.

7.2.2 Now add more scripts

Download the **rcm-log-upload** script and place it in the '/anki/bin/' directory on your Vector.

(We can improve the name later)

Edit this file. (We could use your help to use a proper .env file for configuration here) Look for the line:

```
: ${VIC_LOG_URL:="http://192.168.1.224:8888"}
```

Change the IP address and port number to the one your server uses.

Editing vic-log-uploader

Next step is to edit `/anki/bin/vic-log-uploader` so that it will use the modified uploader.

Change the line

```
UPLOADER="/anki/bin/vic-log-upload"
```

to

```
UPLOADER="/anki/bin/rcm-log-upload"
```

Editing vic-crashuploader.env

Now edit `/anki/etc/vic-crashuploader.env` so that the crash dump script will send the minidumps to your server.

Look for the line that starts with `VIC_CRASH_UPLOAD_URL`

```
VIC_CRASH_UPLOAD_URL='https://anki.sp.backtrace.io:6098/post?
format=minidump&token=6fd2bd053e8dd542ee97c05903b1ea068f090d37c7f6bbfa873c5f3b9c40b1d9'
```

And change that to your local server. For instance:

```
VIC_CRASH_UPLOAD_URL='http://192.168.1.224:8888/'
```

7.2.3 What about the server on my computer ?

We need help creating a python or node.js program to receive the variety of log and crash files. Contact Randy (randym@randym.name) if you can help, or for a reference C# program that works on Windows.... (it does require granting a lot of permissions tho')

7.2.4 Finally reboot, if you want

Vector won't use the new server addresses (in most cases) until you do a reboot

7.3 How to convert animation bin files to JSON

The animation binary files are based on Google's flatbuffers using a binary format. Fortunately it is easy to read, since Anki left the description file in the Vector software, and it is an evolution of what was used in Cozmo.

The files can be turned into JSON, and then back. Google's tools will do this for you, see "[Using flac as a JSON Conversion Tool](#)"

You can also turn the JSON file back into a binary file using the same tool.

7.3.1 Developer Animation JSON files

The developer releases of Vector software includes animation JSON files. These are the equivalent to animation binaries, but in JSON format. The developer software -- and perhaps the production software as well -- can read the animation in the JSON form.

7.4 How to create a soundbank

Vector's audio engine does not directly use `mp3` or other common audio files. Vector uses AudioKinetiс's WWise sound engine. This engine uses a proprietary set of file `.bnk` and `.wem` files. The result is a sophisticated mechanism to create audible responses, little physiological effects, and more.

Unfortunately it is not intuitive to add sounds. WWise is free for non-commercial use; but this is not an easy tool to use. That is why I've written up this how-to. It should make the process a lot more straight-forward.

I won't describe how to hook the new sounds into the animations or behavior tree here. That has its own multi-step process.

The sample WWise project that we create below can be downloaded [here](#)

7.4.1 Preparation

Tools You will need

You will need AudioKinetiс WWise, version 2017.2. This version is the one that creates file with the same version id that Vector is expecting. (Other version may work, but the internet reports version mismatch is a very common cause of WWise errors.).

- Download and install AudioKinetiс WWise by using teh [WWise Launcher](#) From there you will have to select this version.
- [WWise 2017.2 documentation](#)

The free version of WWise has a cap of 200 audio files; it is unlikely you will ever create that many in a single sound bank. If you do, just break the sound bank up to two or more.

Your sound files

You will need to convert your sound files to `WAV` files ahead of time. That is not described here.

7.4.2 WWise to create the soundbank

This section we'll describe how to build a "media only" soundbank that can be added to Vector.

Starting a Project

Launch WWise, from either your application menu or the WWise launcher. When WWise starts it will give you a window create a new project

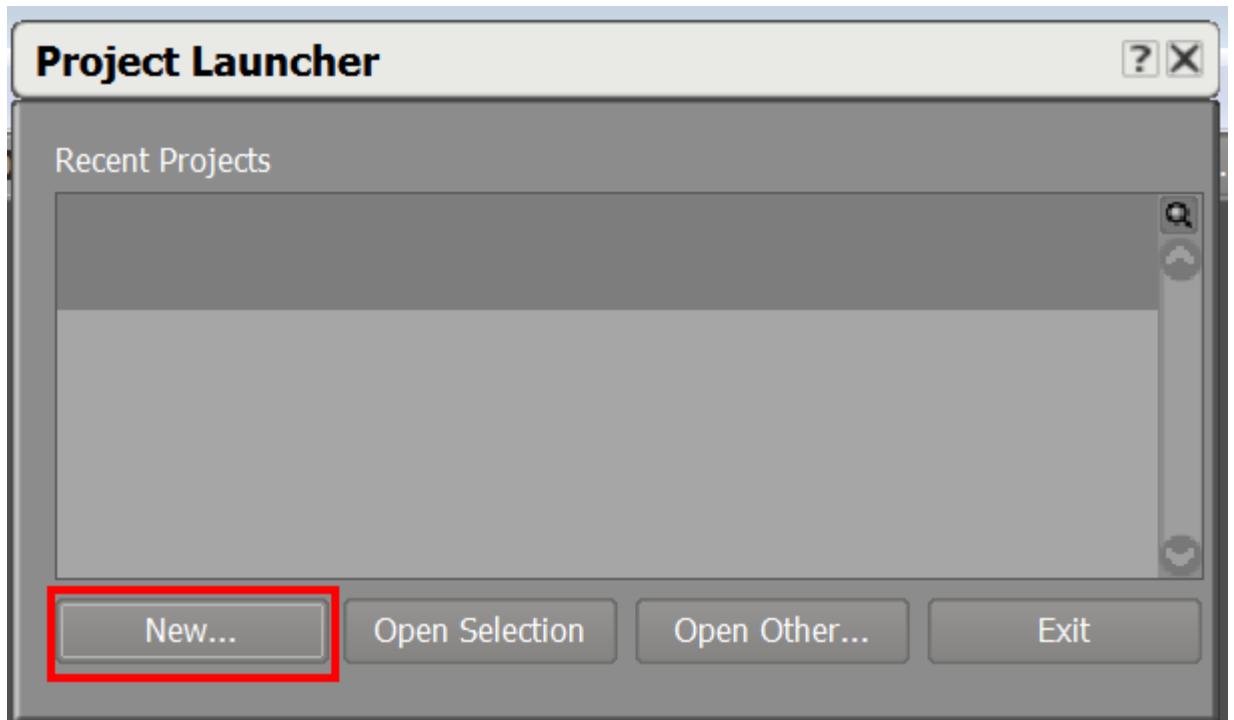


Figure: Starting WWise

Click "New"

Note: Along the way WWise may present pop-ups to let you know that you don't have a license -- that this is only for non-commercial and evaluation use. Click ok whenever that happens.

After clicking new, it gives a pop-up to do a little initial paperwork to create the project:

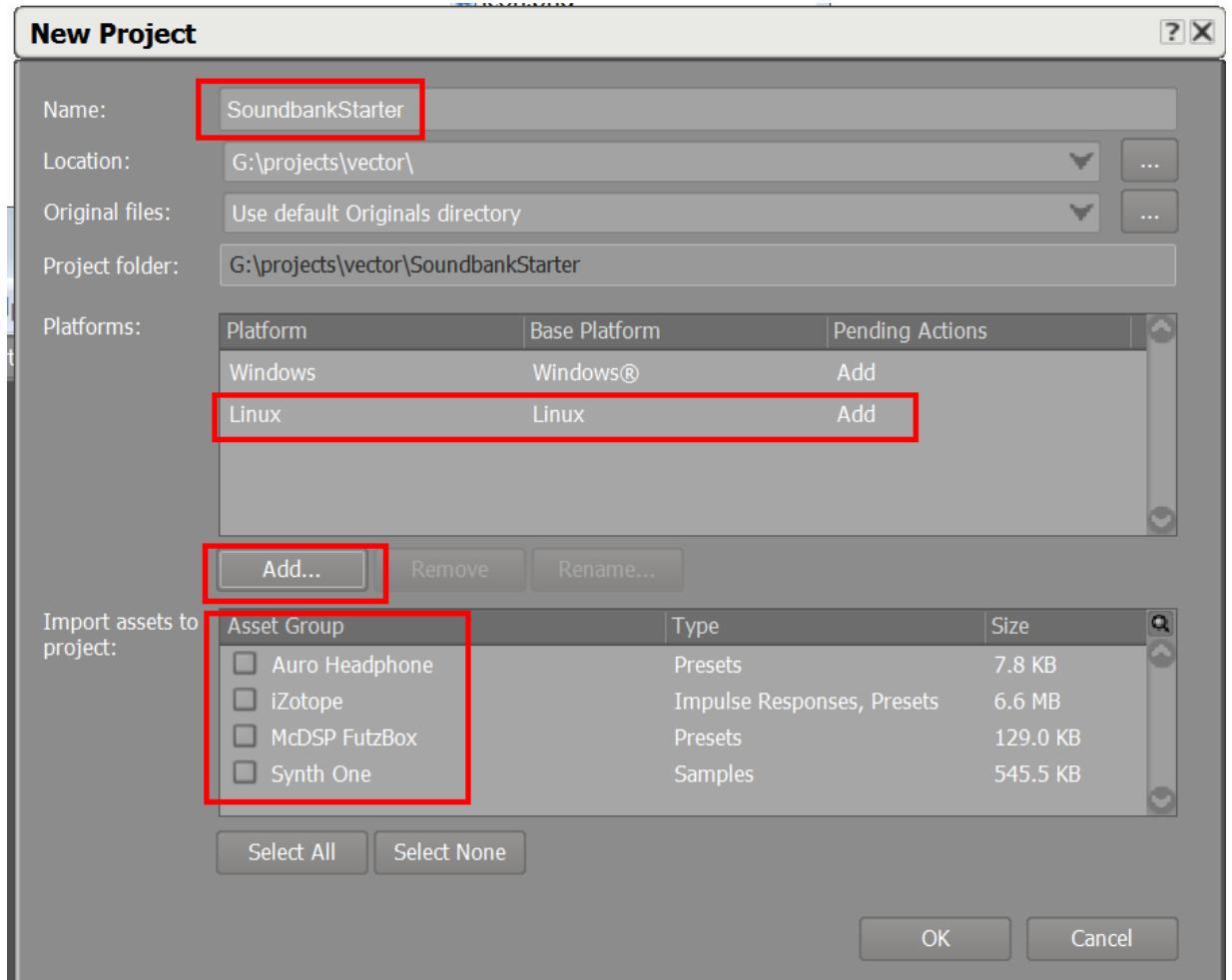


Figure: Create a new project

1. Fill in the name of the project with whatever you want. Be unique
2. Add the linux platform: click the "Add" and then select Linux. (I don't know that this strictly necessary)
3. Uncheck all of the other assets groups.
4. Click "ok"

Creating a soundbank

The next step is to create our SoundBank. Look for the project pane:

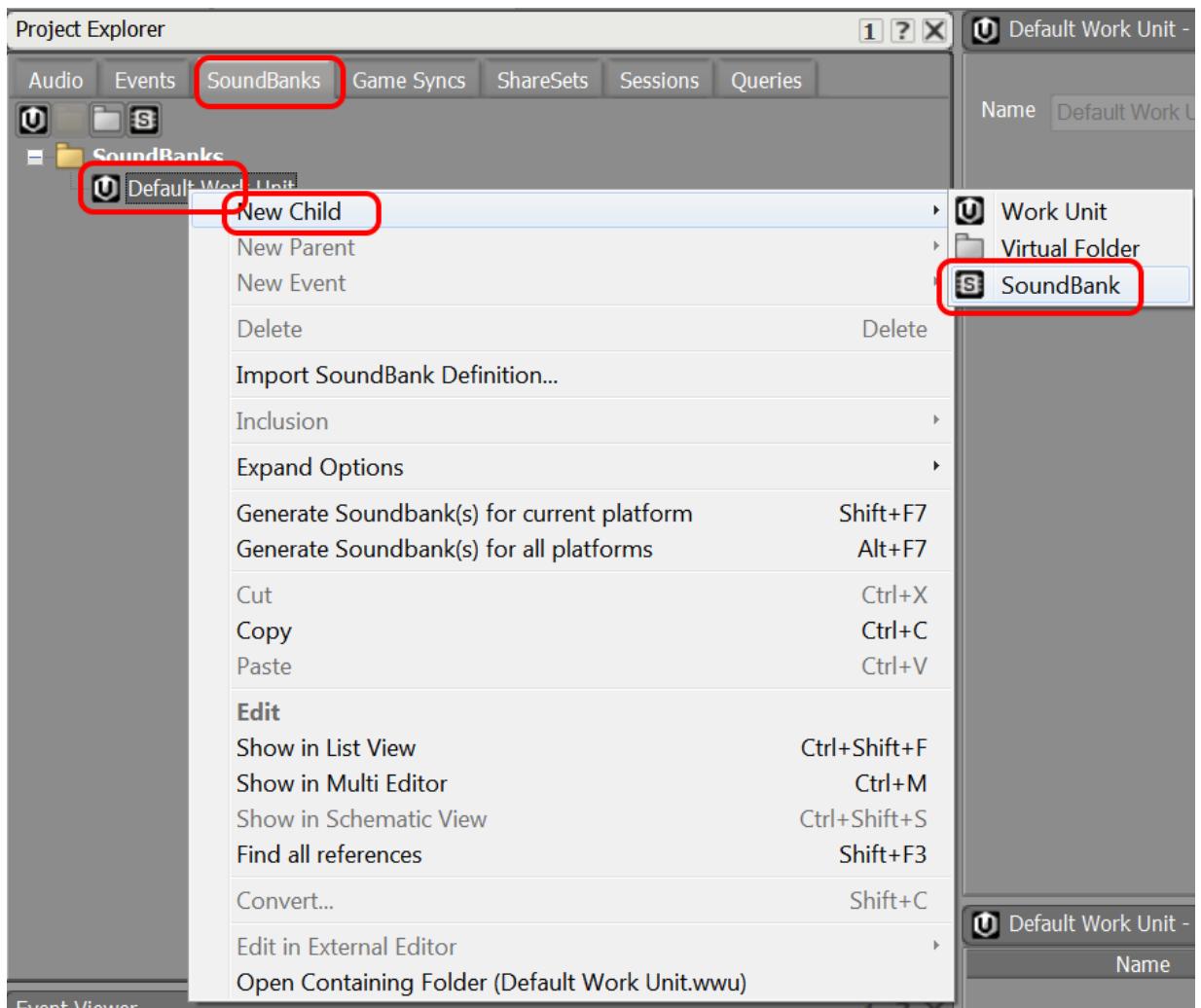


Figure: Create a new soundbank

1. Click on the "SoundBanks" tab
2. Right click on the "Default Work Unit" item under the "SoundBanks" tree
3. Go into the "New Child" submenu
4. Select "SoundBank"

This will create a panel to edit the sound bank. If not, double click on your new sound bank in the tree. You should get a SoundBank Editor:

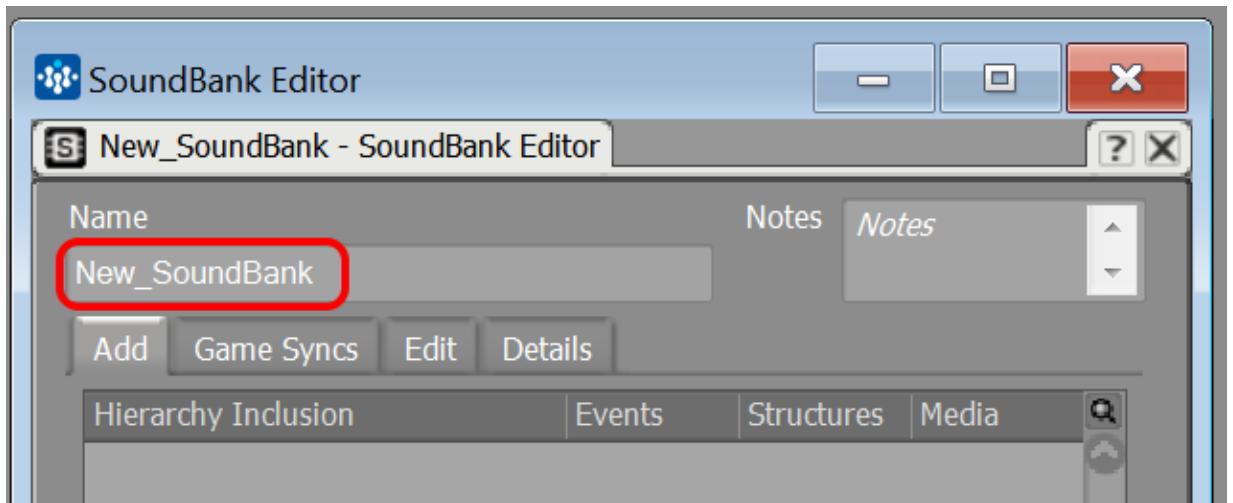


Figure: Naming a new sound bank

Give your sound bank a unique name. This will be the name on the robot, so make it descriptive, but unique.

Importing Audio files

Next is importing the audio files. You will need to convert your audio files into the `WAV` format, if you have not done so already.

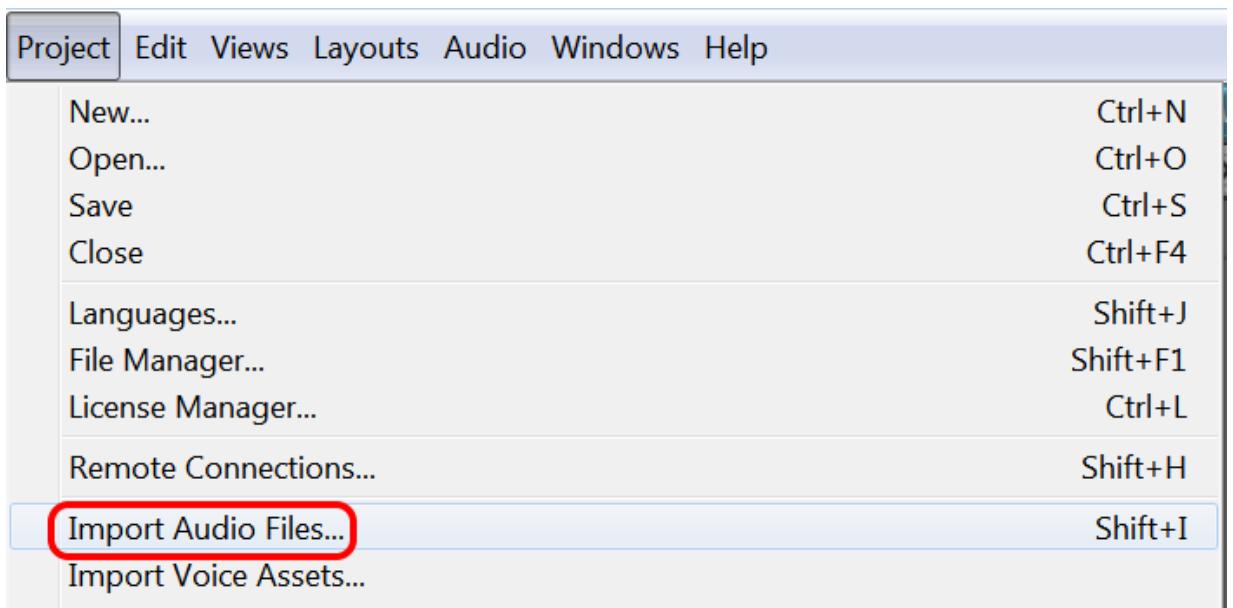


Figure: Import audio files

1. Open the Projects menu
2. Select "Import Audio files"

This will bring up a dialog:

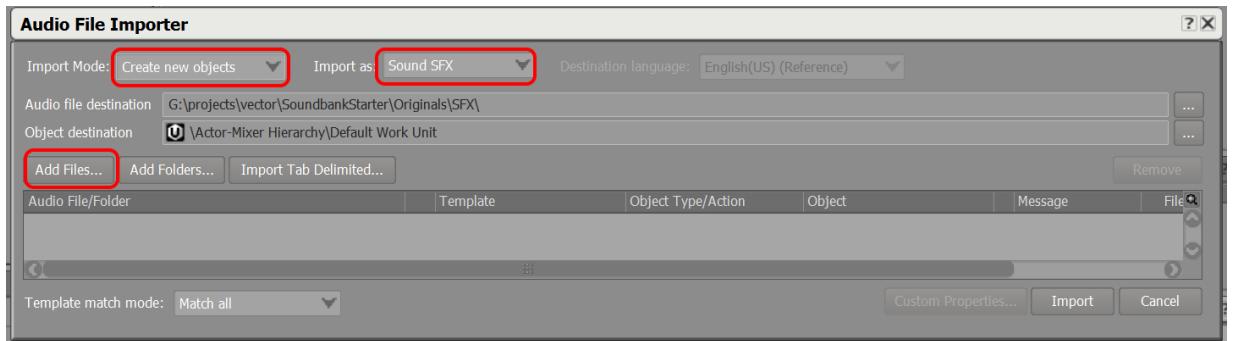


Figure: Add audio files

1. Change the "Import Mode" to "Create new objects"
2. Change the "Import as" to "Sound SFX"
3. Click "Add Files" button
4. Select the files you wish through the usual dialog

Click "Import"

Setting the file properties, ie, name, and conversion

Next, let's set the audio conversion. Find the audio file in the project tree:

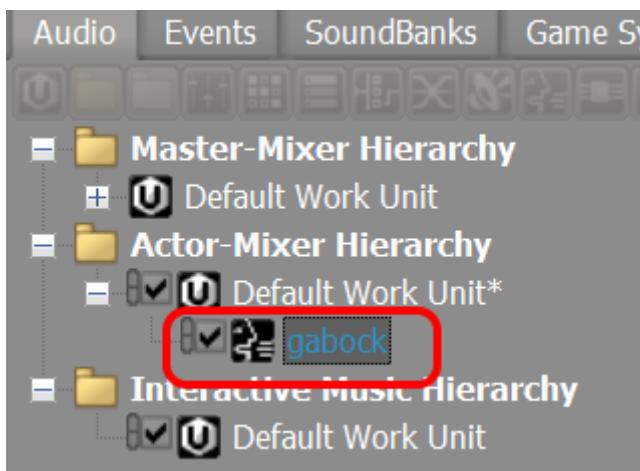


Figure: The audio files in the tree

Click on the file. It should open a panel on the right to configure the properties of this file:

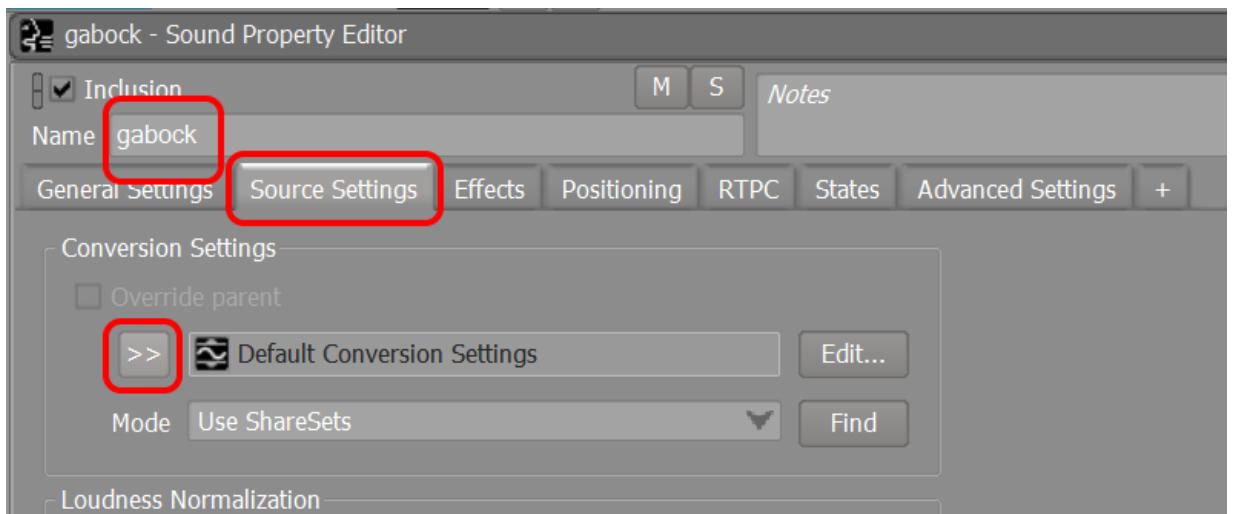


Figure: The audio file properties

1. Set the name of the file. Optional, but this is a good time to change the name of the file to have a nice consistent, clean name.
2. Click the "Source Settings" tab
3. Under than click the chevrons next to the word "Default Conversion Settings"

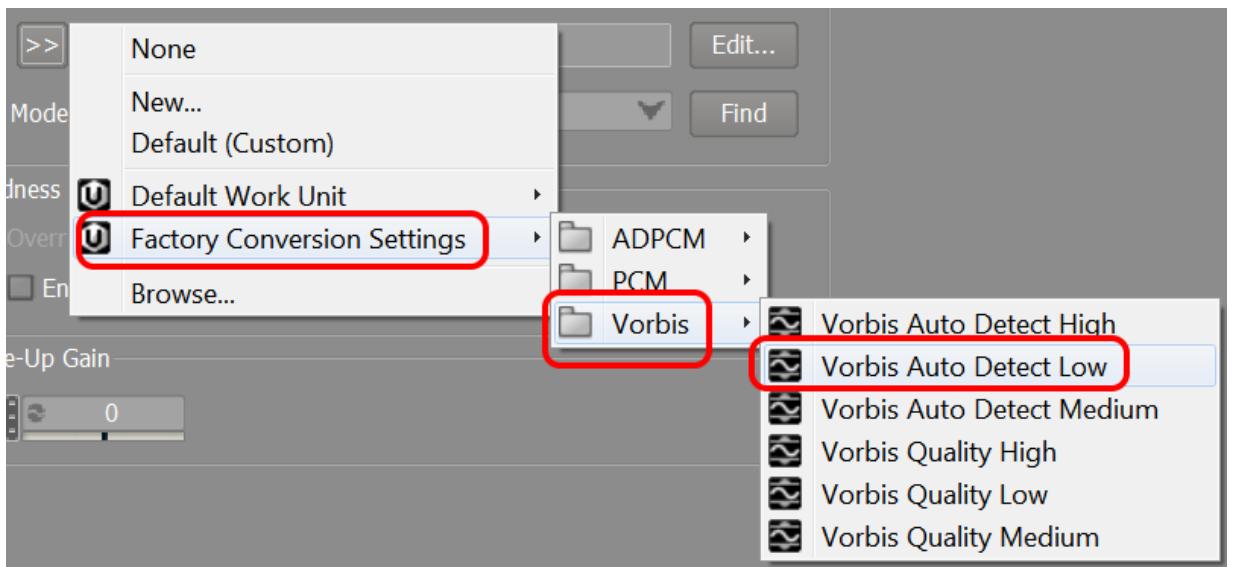


Figure: The conversion settings

Clicking on the chevrons will bring up a menu

1. Click on "Factory Conversion Settings"
2. Select "Vorbis"
3. Select one of the Vorbis formats. Probably any will do. (Probably any ADPCM will do to, but I haven't confirmed it. I don't have guidance for which to choose.)

Finally, we need tell it to create a separate WEM file.

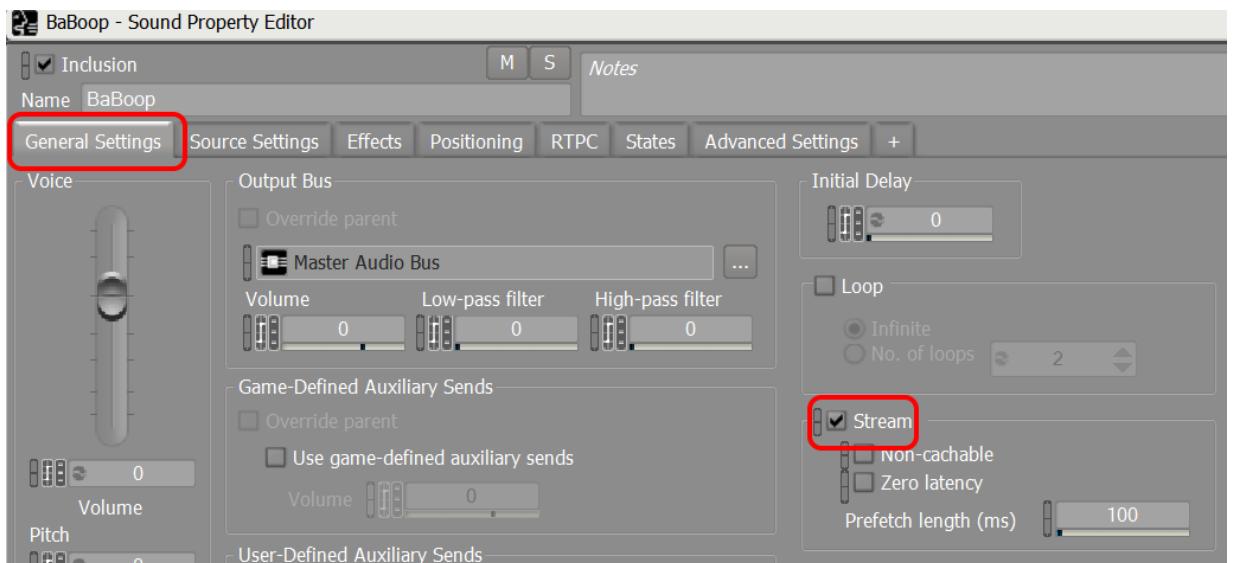


Figure: The stream setting

1. Click on the "General Settings" tab.
2. Check the "Stream" check box.

Create an event and action to play it

Next we need tell the audio engine that this is playable. To do that we need to create a Event with a play action. Click on the "Event" tab:

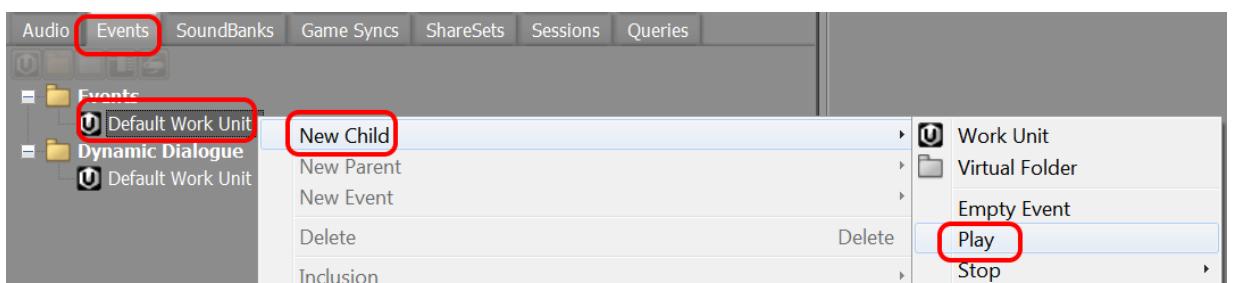


Figure: Creating a play event

1. Right click on the "Default Work Unit" This will bring up a menu
2. Select "New Child"
3. Then click on "Play"

This will add an item to the tree on the left under "Default Work Unit", in edit mode:

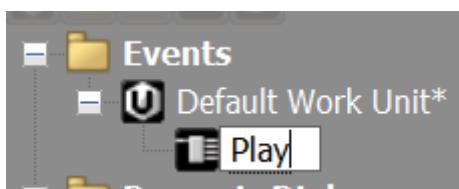


Figure: New a play event

Give the name something like "Play_sound name"

On the right side a panel should appear with the properties for this event. It doesn't know yet to play this particular sound. We'll connect that now.

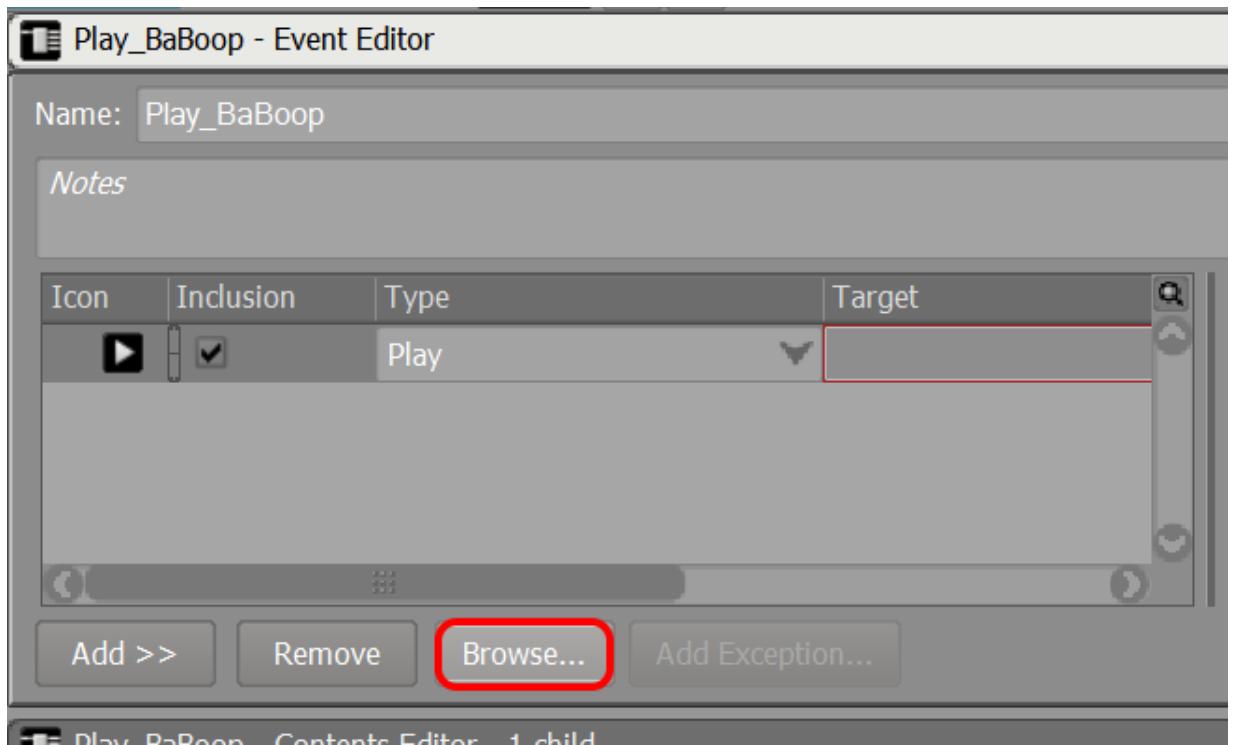


Figure: Attach a sound to the play event

Click on "Browse". This will pop up a window to select which sound.

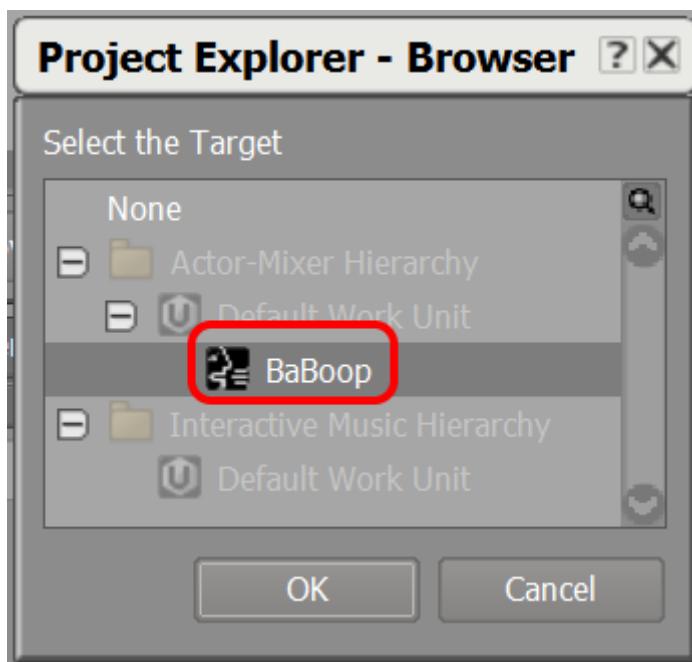


Figure: Selecting a sound to attach to the play event

We need to add it to the sound bank. If the sound bank panel isn't open, click on the SoundBanks tab, and double click on the sound bank.

Click on the Events tab and drag the new event into the soundbank:

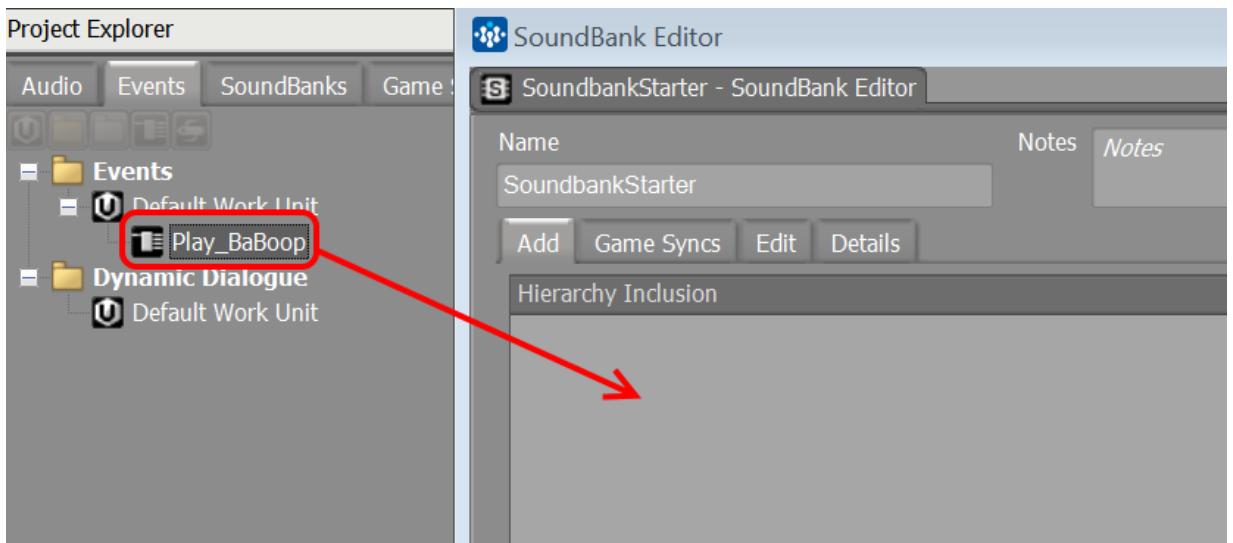


Figure: Adding the play event to the sound bank

You should then see:

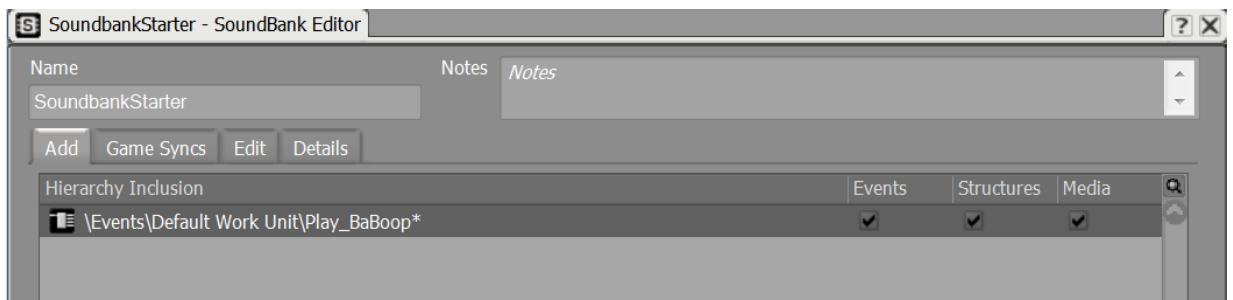


Figure: The play event in the sound bank

Click on the Audio tab, and drag the audio file into the soundbank as well:

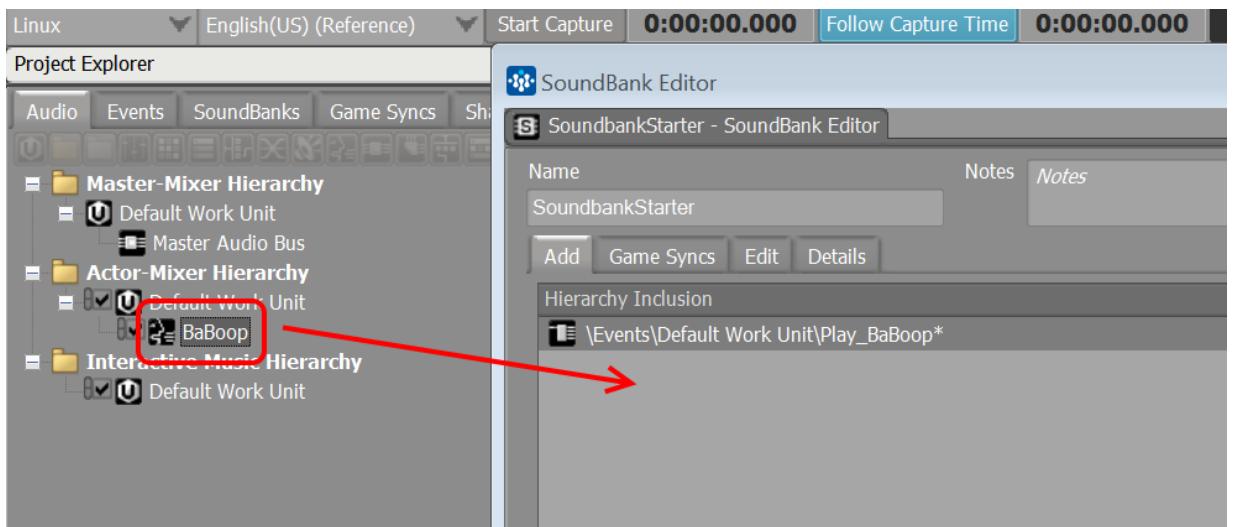


Figure: Adding the audio file to the sound bank

You should then see:

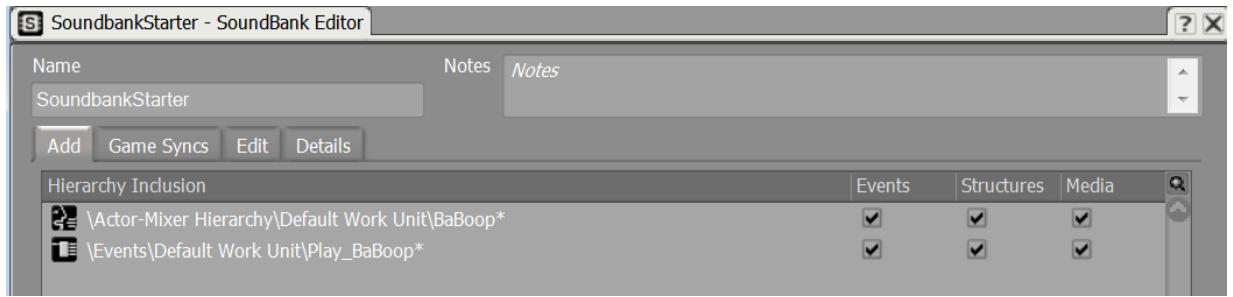


Figure: The play event and audio file in the sound bank

Generating the Soundbank

Now it is time to convert the files and generate the sound bank.

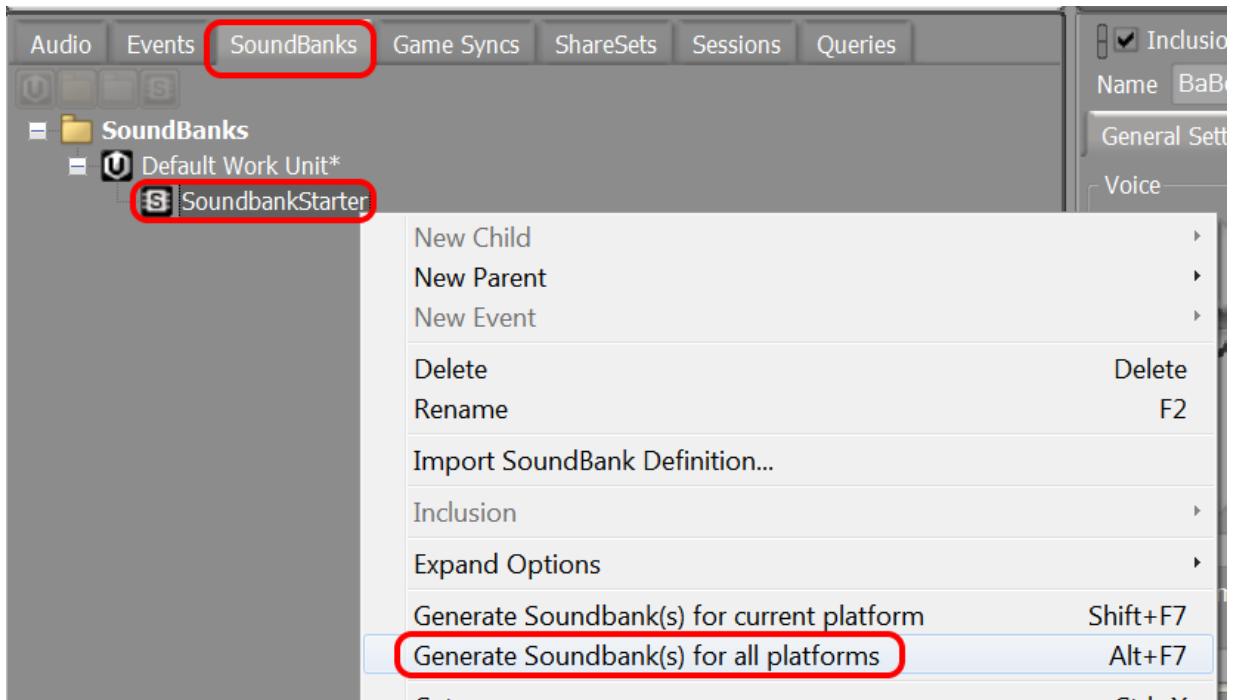


Figure: Generate the sound bank

1. Click on the SoundBanks tab.
2. Right click on our SoundBank. This will pop up a menu
3. Choose "Generate SoundBank(s) for all platforms"

WWise will convert all of the audio files and create a sound bank.

7.4.3 Packaging and Installations

The folder with the files

Lets look at the generated files now. Open the folder you created for your WWise project. It should look like:

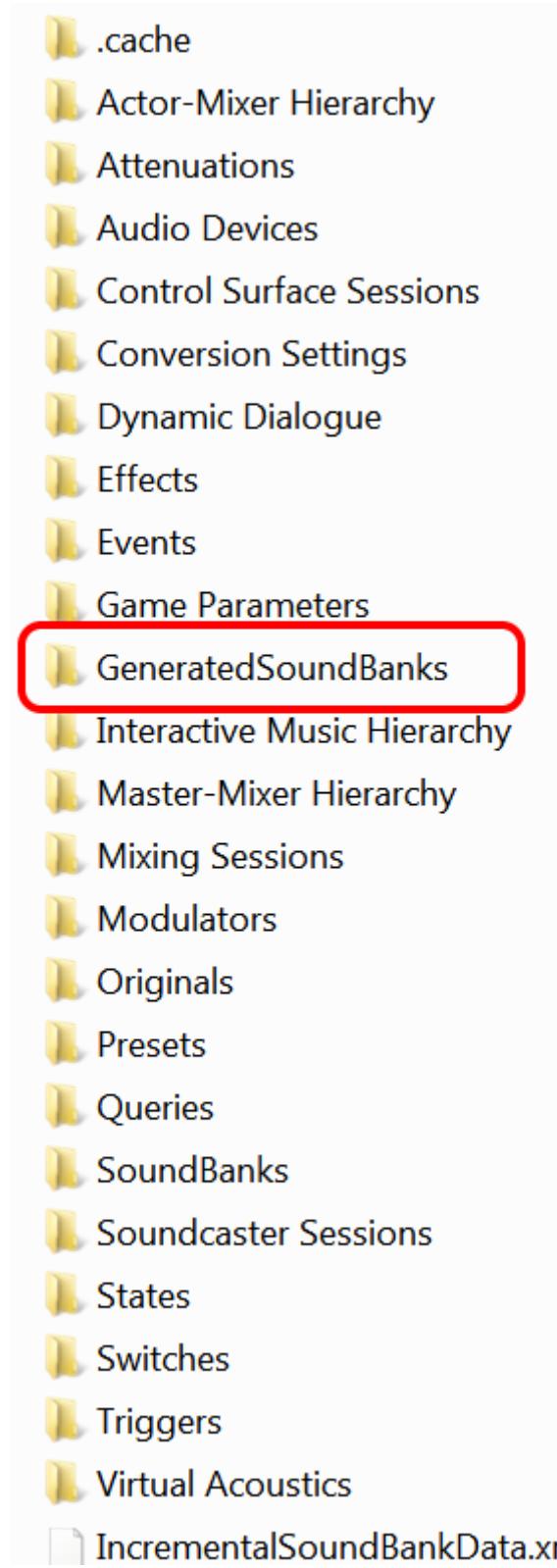


Figure: The Wwise project folder

Open the "GeneratedSoundBanks" folder; inside of that open the "Linux" folder. You should see a folder like:

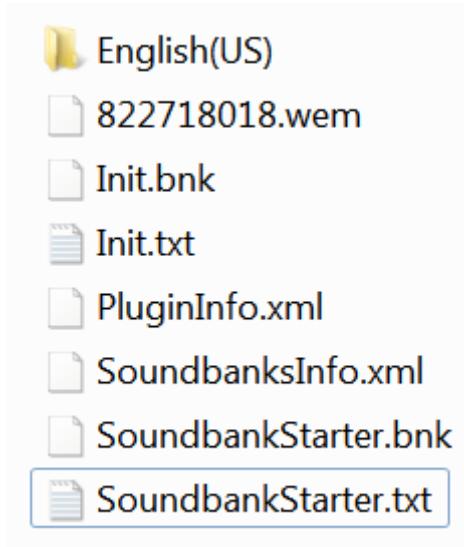


Figure: The soundbanks folder

(The numbers and names will be different.)

Make a note of the ".txt" file with the soundbank name. We will need that later.

Making a package

We need to get the .wem files and out .bnk file (ignore the Init.bnk) onto Vector and placed in the following folder:

```
/anki/data/assets/cozmo_resources/sound/
```

One way to do this is to make a `vpkg`. The `.ini` for the package file might look something like:

```
[META]
name=SoundbankStarter
rel_num=1
restart_type=maintenance-restart

[files]
/anki/data/assets/cozmo_resources/sound/SoundbankStarter.bnk=SoundbankStarter.bnk
/anki/data/assets/cozmo_resources/sound/SoundbankStarter.txt=SoundbankStarter.txt
/anki/data/assets/cozmo_resources/sound/822718018.wem=822718018.wem

[permissions]
/anki/data/assets/cozmo_resources/assets/cozmo_resources/sound=anki:anki 0444
```

Then create a vpkg, in this example called "SoundbankStarter":

```
vector-pkg.py install --pkg=SoundbankStarter.vpkg
```

You will then copy the file on the bot and then install it with a command line like

```
vector-pkg.py install --pkg=SoundbankStarter.vpkg
```

You will also need to edit a file so that Vector's audio engine knows to load it. This file is

```
/anki/data/assets/cozmo_resources/sound/SoundbankBundleInfo.json
```

By default in 1.7 it looks like:

```
[{"bundle_name": "Victor_Global_Data_English(US)", "language": "English(US)", "path": "English(US)/Victor_Global_Data.bnk", "soundbank_name": "Victor_Global_Data"}, {"bundle_name": "Init", "language": "SFX", "path": "Init.bnk", "soundbank_name": "Init"}, {"bundle_name": "Victor_UI", "language": "SFX", "path": "Victor_UI.bnk", "soundbank_name": "Victor_UI"}, {"bundle_name": "Victor_VO", "language": "SFX", "path": "Victor_VO.bnk", "soundbank_name": "Victor_VO"}, {"bundle_name": "Victor_Alexa", "language": "SFX", "path": "Victor_Alexa.bnk", "soundbank_name": "Victor_Alexa"}, {"bundle_name": "Victor_SFX", "language": "SFX", "path": "Victor_SFX.bnk", "soundbank_name": "Victor_SFX"}, {"bundle_name": "Victor_Dev_English(US)", "language": "English(US)", "path": "English(US)/Victor_Dev.bnk", "soundbank_name": "Victor_Dev"}]
```

(Yes, this one long run-on line.)

We want to add a like that it, like so:

```
[{"bundle_name": "Victor_Global_Data_English(US)", "language": "English(US)", "path": "English(US)/Victor_Global_Data.bnk", "soundbank_name": "Victor_Global_Data"}, {"bundle_name": "Init", "language": "SFX", "path": "Init.bnk", "soundbank_name": "Init"}, {"bundle_name": "Victor_UI", "language": "SFX", "path": "Victor_UI.bnk", "soundbank_name": "Victor_UI"}, {"bundle_name": "Victor_VO", "language": "SFX", "path": "Victor_VO.bnk", "soundbank_name": "Victor_VO"}, {"bundle_name": "Victor_Alexa", "language": "SFX", "path": "Victor_Alexa.bnk", "soundbank_name": "Victor_Alexa"}, {"bundle_name": "Victor_SFX", "language": "SFX", "path": "Victor_SFX.bnk", "soundbank_name": "Victor_SFX"}, {"bundle_name": "Victor_Dev_English(US)", "language": "English(US)", "path": "English(US)/Victor_Dev.bnk", "soundbank_name": "Victor_Dev"}, {"bundle_name": "SoundbankStarter(US)", "language": "English(US)", "path": "SoundbankStarter.bnk", "soundbank_name": "SoundbankStarter"}]
```

Next, restart the Vector application by:

```
systemctl stop anki-robot.target
sleep 5
systemctl start anki-robot.target
```

Then we need to check the logs that the file loaded:

```
grep SoundBank /var/log/messages
```

This shouldn't show a problem. If you see something like the following, there was a problem.

```
12-09 04:40:43.725 warning vic-anim 2103 2103 vic-anim: AudioEngineController.LoadSoundbank: Failed to load soundbank 'SoundbankStarter'
```

(The name of the soundbank being your soundbank.)

(Check that the time stamp is about "now" -- just so that we aren't confused with old errors)

7.4.4 Testing

When you wish to play the animation, lets open the text file we saw earlier. In the example case it was called "SoundbankStarter.txt". This file has the info we need to play the sound.

Event	ID	Name	Wwise Object Path	Notes
2894319965		Play_BaBoop	\Default Work Unit\Play_BaBoop	
Streamed Audio	ID	Name	Audio source file	Generated audio file
1056225654	BaBoop	G:\projects\vector\SoundbankStarter\.cache\W: Work Unit\BaBoop		

Figure: The soundbank event ids

The number is the event id to be used inside of animations. The name can be used in some JSON files; but it is also helpful when working with multiple sounds in the file, to know which one is the right event.

The sound file can be tested using the console vars. Please see [Development Web Servers](#) for how to set up access to these.

Go to <http://localhost:8889/>

The screenshot shows the Victor Web Server interface. The URL bar is highlighted with a red box and shows "localhost:8889". The title bar says "Victor Web Server (Anim process)" and "This web server is running in the Anim process". Below the title bar are tabs: MAIN (selected), CONSOLE VARS/FUNCS, FILES, PERF, PROCESSES, ENGINE, and PERF METRIC. A message says "These are for the console variables and console functions in THIS process only." Below this is a table with columns "description" and "url". The table rows are:

description	url
View and edit console variables	/consolevars
List console variables	/consolevarlist
List console variables matching	/consolevarlist?key=search_key
Set console variable	/consolevarset?key=name_of_variable&value=new_value_of_variable
Get console variable	/consolevarget?key=name_of_variable
List console functions	/consolefunclist
List console functions matching	/consolefunclist?key=search_key
Call console function	/consolefuncall?func=name_of_function&args=arguments

At the bottom of the page are buttons: "consolevars" (highlighted with a red box), "LOAD console vars", "SAVE console vars", "DELETE console vars save file", and "RESET console vars to default values".

Figure: Console vars button

Click on the "consolevars". This will bring up a panel of tabs. Click on the "Audio" tab:

The screenshot shows the "Console Vars and Functions" panel. The "Audio" tab is highlighted with a blue box. Below the tabs are sections for "AnimationStreamer" and "Controller". Under "Controller", there are several input fields and buttons. One of the buttons, "PostAudioEvent", is highlighted with a red box.

Figure: Audio Console vars

In the "PostAudioEvent" you can paste the Event Name (from your txt above). Then click "Call" This should cause your new sound to play. The Event ID will not work here.

7.4.5 Future improvements

It would be nice to be able to bundle the soundbank and files into a folder, so that it was clear which files belonged to which soundbank.

7.5 How to make a companion cube

7.5.1 3D Print your own cube

Anki Vector Dummy Cube Box by Dauler. This also includes a PDF with the symbols for the cube sides

You can buy [STL files](#) from etsy.

7.5.2 Emulate the cubes electronics

[Efforts to create a "clone" of the cubes electronics.] (<https://forums.anki.com/t/communicating-with-vectors-cube/43042>)

SparkFun Pro nRF52840 Mini bluetooth development

7.6 How to bring back the Snowglobe effect

It came up in the forums that Vector no longer played the SnowGlobe effect when shaken. Here is how to re-enable it.

7.6.1 Preparation

You'll have to know how to SSH in, make the file system modifiable and edit a file. To make the file system modifiable:

```
mount -o rw,remount /
```

You will need to edit the following file:

```
/anki/data/assets/cozmo_resources/config/engine/behaviorComponent/behaviors/victorBehaviorTree/
globalInterruptions.json
```

first, make it write able (you can skip this if you know how to override it in vi)

```
chmod +w /anki/data/assets/cozmo_resources/config/engine/behaviorComponent/behaviors/victorBehaviorTree/
globalInterruptions.json
```

7.6.2 Edit the top list of behaviors

Next edit the file:

```
vi /anki/data/assets/cozmo_resources/config/engine/behaviorComponent/behaviors/victorBehaviorTree/
globalInterruptions.json
```

Look for the lines

```
"WeatherResponses",
"TakeAPhotoCoordinator",
"ReactToRobotShaken",
"ReactToTouchPetting",
```

Change the line

```
"ReactToRobotShaken",
```

to

```
"ReactToRobotShakenSnowGlobe",
```

You can also leave both. The first item has higher priority.

7.6.3 Adjusting the shake threshold

you can tweak the threshold for the shaking:

```
/anki/data/assets/cozmo_resources/config/engine/behaviorComponent/behaviors/victorBehaviorTree/reactions/
reactToRobotShakenSnowGlobe.json
```

Look for the block

```
"wantsToBeActivatedCondition":  
{  
    "conditionType" : "RobotShaken",  
    "minAccelMagnitudeThreshold" : 16000  
}
```

Change the "16000" a lower or higher number for the threshold.

The robot shaken file has a similar config:

```
/anki/data/assets/cozmo_resources/config/engine/behaviorComponent/behaviors/victorBehaviorTree/reactions/  
reactToRobotShaken.json
```

Look for the same block as above, and change the threshold.

If you leave both "ReactToRobotShaken" and "ReactToRobotShakenSnowGlobe", have the first item with a higher number. If it is lower, it will always win.

7.6.4 Reboot

Finally you have to restart the vic applications for the updates to load and take effect. This can be done with:

```
systemctl stop anki-robot.target  
systemctl start anki-robot.target
```

or a reboot.

7.7 How to set up a new Yocto-linux build environment for Vector's base OS

This is how to create a new build environment for Vector's base OS -- Yocto Linux and his drivers. *Note: this does not include the Vector application software!*

Steps.

1. Install Ubuntu (or reuse a machine with Ubuntu)
2. Get Yocto installed, e.g. using Docker
3. Install the base OS source code
4. Test build

7.7.1 Install Ubuntu

Your options are:

1. You already use Ubuntu, so you don't need this (skip to the next section)
2. You want to install it on a VirtualBox on your computer:
 - Follow the instructions here to set up the basics (this sets up Ubuntu 16.04 but you can use others) <https://medium.com/@tushar0618/install-ubuntu-16-04-lts-on-virtual-box-desktop-version-30dc6f1958d0>
 - Double the size of the harddrive though!
 - As part of this you will need the "ISO" file for the Ubuntu OS. Select your particular version of Ubuntu and download the ISO from here: [Ubuntu 16.04 download](#) (This is 16.04, switch to version that matches your preference)
3. You want to install it on your Raspberry Pi or on something else. (You'll have to let us know what those instructions are!)

7.8 Install Docker image

We'll use a docker image (vaddio/yocto-16.04) to preinstall Yocto dependencies.

1. First start a command shell. This done by clicking on the Ubuntu logo at the top left, typing "command line" and selecting the terminal application.
2. Next, install docker.

```
sudo apt install docker.io
```

1. Install vaddio/yocto-16.0.04

```
sudo docker run -it vaddio/yocto-16.04:16.04-latest /bin/bash
```

7.8.1 Install the base OS source code

Now that Docker and Yocto are installed, we need to install the source code specific for Vector:

```
sudo chmod 0777 . && sudo su builduser
curl https://anki-vic-pubfiles.anki.com/license/prod/1.0.0/licences/OStarball.v160.tgz | tar -xz
```

7.8.2 Perform a test build

Finally, it's time to perform a test build. This will run a **long** time:

```
cd opensource/poky && source build/conf/set_bb_env.sh && build-victor-robot-image
```

To remove the intermediate files then:

```
buildclean
```

The **&&** are used to avoid multiple run commands. Each run "command creates a new container with the deltas."

7.8.3 Credits:

Information from [nammo on discord](#)

7.9 How to unzip the OTA files

See the [Project Victor Firmware folder](#) for a description how to download the .ota files and how to verify them. It also includes a tool that can aid with the extraction.

There are three parts

1. First, the OTA's have to be decrypted
2. Next, the system files are extracted from the sysfs archive
3. Finally boot initramfs files can be extracted. (Their archive is a bit different)

7.9.1 Decrypting the OTA arcrhives

The OTA files are tar.gz files, so they can be opened with tar (or similar tool). Among the files inside are two files:

```
apq8009-robot-boot.img.gz (encrypted)
```

```
apq8009-robot-sysfs.img.gz (encrypted)
```

Decrypting these files is done by:

```
openssl enc -d -aes-256-ctr -pass file:ota.pas -in apq8009-robot-boot.img.gz -out apq8009-robot-boot.img.dec.gz
```

```
openssl enc -d -aes-256-ctr -pass file:ota.pas -in apq8009-robot-sysfs.img.gz -out apq8009-robot-sysfs.img.dec.gz
```

With OpenSSL 1.1.0 or later, add “-md md5” to the command:

```
openssl enc -d -aes-256-ctr -pass file:ota.pas -md md5 -in apq8009-robot-boot.img.gz -out apq8009-robot-boot.img.dec.gz
```

```
openssl enc -d -aes-256-ctr -pass file:ota.pas -md md5 -in apq8009-robot-sysfs.img.gz -out apq8009-robot-sysfs.img.dec.gz
```

The keys can be found in the [detail/keys folder](#) in the Project Victor repository.

7.9.2 Unzipping the system filesystem (sysfs) archive

On windows, the decoded `.img` files can extracted with 7zip

On linux, you can mount the file

1. gunzip the decrypted `apq8009-robot-sys.img.dec.gz`
2. `sudo mkdir /media/iso`
3. `sudo mount -o loop apq8009-robot-sys.img.dec /media/iso`

7.9.3 Unzipping the boot initramfs filesystem (boot) archive

There are a couple of alternatives for tool sets:

- With Linux and Windows 10, there is a convenient tool
- For other systems, imgtool/imjtool from the New Android Book works

Linux and Windows 10 WSL method

1. Go to [How to unpack and repack boot and ramdisk files easily](#) and follow the directions for the tool download and installation
2. Added them to my path,
3. Opened wsl
4. gunzip the decrypted `apq8009-robot-boot.img.dec.gz`
5. Finally "unpack apq8009-robot-boot.img"

imgtool / imjtool

For other systems there is a help tool already exists

1. Download, build and install [imjtool](#)
2. gunzip the decrypted `apq8009-robot-boot.img.dec.gz`
3. Extracted the files using the image tool

```
imjtool boot.dec.img extract
```

That creates an extract folder with the ramdisk. The ramdisk is in "cpio" format.

Finally Extracted the files with

```
cd extract | gzip -d | cpio -idmv
```

7.9.4 References and Resources

The decryption was originally posted to the [Anki Vector Rooting google group](#)

[How to unpack and repack boot and ramdisk files easily](#) on Linux and windows 10

- imgtool — now called [imjtool](#)

7.10 How to use Cozmo animation files

Cozmo's animation .bin files can be used on Vector, mostly. You do need know how to trigger them.

7.10.1 Why does this even work?

Cozmo's animation schema is very similar to Vector's.

When Vector reads and interprets the animation file it uses the flatbuffers library. This library uses default values for fields that are missing in a file — fields that Vector uses but that the Cozmo animation files doesn't provide. And the library ignores fields in the file that it doesn't know about — fields that Cozmo uses but Vector doesn't. So that gives it a lot of compatibility for faces, lights, motions.

Where Vector completely ignores Cozmo features is the sound. The sound features in the animation files is completely different between the two. (If cozmos sounds tracks work without fuss, Id be surprised ... or maybe they have a Cozmo compatibility layer?)

7.10.2 How to get a Cozmo animation file

7.10.3 How to put it on Vector

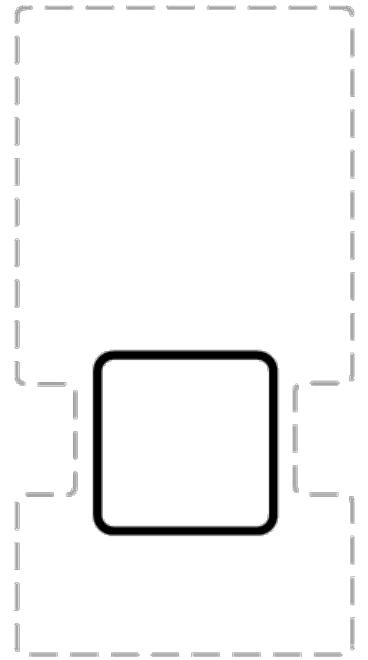
- Include how to link it into the behavior or what not

7.10.4 What about fixing up the audio stuff?

A bit of background the animation files send audio events, or audio trigger names (plus some audio parameter adjustments) that are used to tell the audio engine to play a particular sound.

You will have to convert the animation to JSON Then edit them to the new schema and change the audio trigger name to one that Vector supports. Then repack it into an animation bin file.

7.11 Making paper dolls for Vector to play with



7.11.1 Laser Printer Version

1. Download one of the two version of the pattern template:
 - Without the symbols: [PDF](#) or [Visio](#)
 - One includes little symbols on them
 - The other doesn't (You can add the pictures using stickers)
2. Make any changes, like adding color patterns (Optional)
3. Print. If you're like me, the printer doesn't like card stock
4. Cut out
5. Use a glue, like a spray glue, to attach to cardstock
6. Cut that.
7. Color it in (Optional)
8. Add little tails so it will stay upright

7.11.2 Cricut Version

1. Download one of the two version of the pattern template:
 - Without the symbols: [PDF](#) or [Visio](#)
 - One includes little symbols on them
 - The other doesn't (You can add the pictures using stickers)
 - One has the cut pattern
 - Two have the print patterns. Pick one.
2. Make any changes, like adding color patterns (Optional)

3. Use Cricut, print-then-cut mode
 - Print
 - Cut out
 - Cut out card stock
4. Print on cardstock? If you're like me, the printer doesn't like card stock
5. Use a glue, like a spray glue, to attach to cardstock
6. Color it in (Optional)
7. Add little tails so it will stay upright

8. Service

8.1 Arms

In a fall, Vector's lift arms may pop apart. This was an intentional design to prevent them from breaking.

8.1.1 Broken lift gear

From Discord:

Sometimes, when Vector or Cozmo take a particularly unlucky fall, the force of impact is transferred from the arm into the gearbox. There's a repair that works about half the time: You need to remove the arms, rotate the lift gear 180 degrees (you can use the arm as a tool to do this), and reinstall the arms. When this works, it's because you're moving the broken gear tooth out of the way, and using the "other half" of the gear teeth.

Cozmo and Vector have the same basic arm design and arm disassembly/reassembly is one of the safer operations you can perform.

To disassemble:

1. "Pull at the upper set of arms at the shoulder (the joint where they connect to the body, in back). Pull hard enough to pop both off their joints.
2. "Tilt the lift up - higher than it normally can, over the head.
3. "When the lift is high enough, you'll find a point where you can pull gently on the lower arms and they'll pop free.

Reassembly is the reverse of the above. The important thing to notice during disassembly is that the lower arms have a certain angle where they easily come out. You have to use that angle to pop them in and out. If they are not coming out/going in easily, the angle is not high enough or too high.

8.1.2 Spare parts

[Anki Vector Lifting Forks](#) by Dauler July 05, 2019

[3D Model .stl Vector Robot Lift Forks FDM and Resin Models](#) DesignsByDauler

8.2 Replacing the Battery

Please fill this in!

See this [iFixit instruction](#)

Replacement battery options:

- <https://www.ebay.com/item/3-7V-320-mAh-Polymer-Li-battery-Lipo-For-GPS-Mp4-DVD-PDA-Camera-Tablet-PC-402535/122584822407>
- A bigger battery: <https://www.aliexpress.com/item/32956226523.html>

Note: neither of these is the same "toy safe" kind as the original, and so have a few different characteristics

Desolder the battery's positive lead first. Then wrap the end of the lead in electrical tape to insulate it -- to help prevent it from touching sensitive electronics.

See also https://www.reddit.com/r/AnkiVector/comments/i48qg8/vector_story_with_happy_ending/



8.3 Disassembly notes

Summary:

- Avoid shorting anything
- Wear gloves
- Don't disassemble / move the time of flight sensor & window
- Don't disassemble / move the camera and its lens/window

See also [iFixit's services guides for Vector](#)

8.3.1 Avoid Shorts, disconnect the battery

Tip from Discord:

Take care to avoid shorting anything while the battery is connected. I had a habit of desoldering the battery's positive lead as soon as I could reach it, before pulling the guts entirely out of the robot - just to avoid damage.

Wrap the end of the positive lead in electrical tape to seal it off, and be sure that it gets no where near any of the electronics.

8.3.2 Wear gloves

Wear gloves to keep fingerprints off of the inside of the camera lens and time of flight sensor lens.

Tip from Discord:

Sometimes a fingerprint or smudge on the [time of flight sensor] window can mess it up.

That can be hard to clean, especially if it is on the inside. Nitrile gloves can help prevent this.

8.3.3 Don't muck with the time of flight sensor

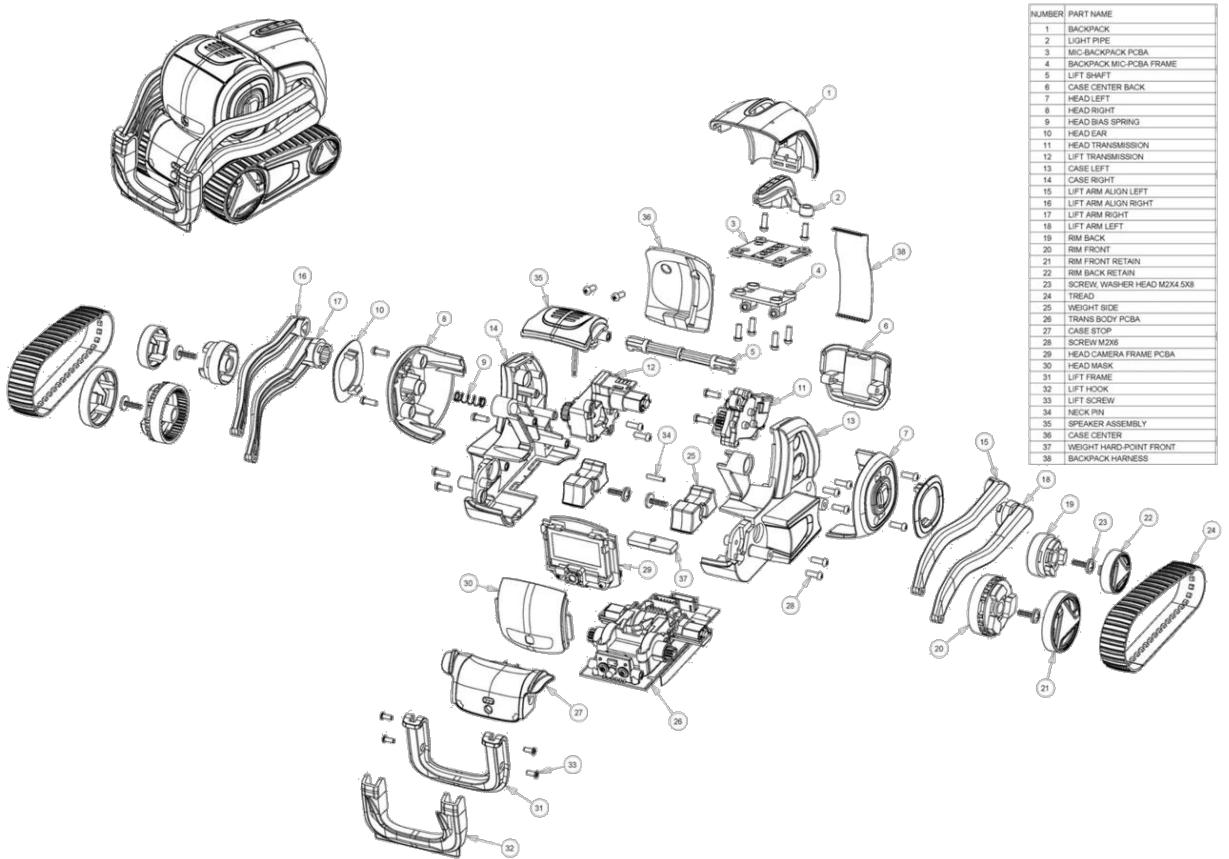
Tip from Discord:

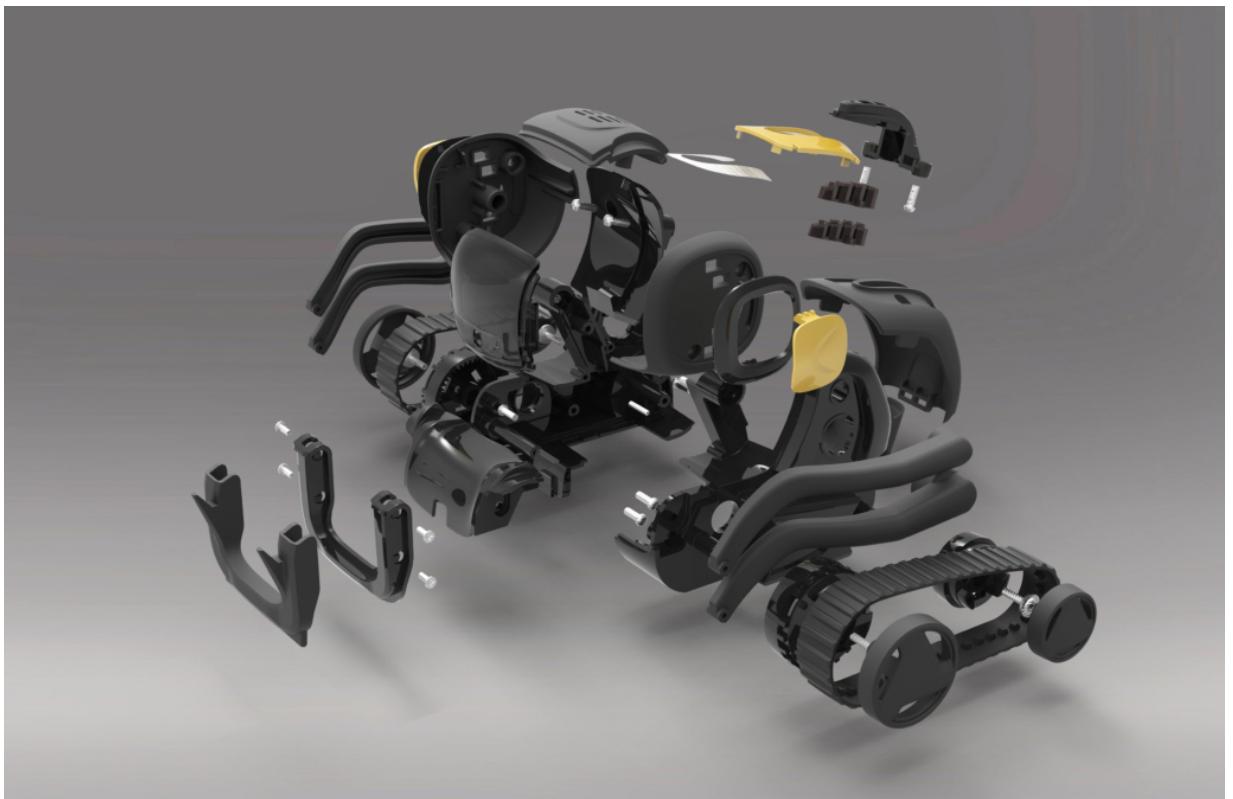
Disassembling a Vector can cause a change in the relationship between the [time of flight] sensor window and [time of flight] sensor behind it. Any change like that requires re-calibration.

And we can't recalibrate.

8.4 Exploded View

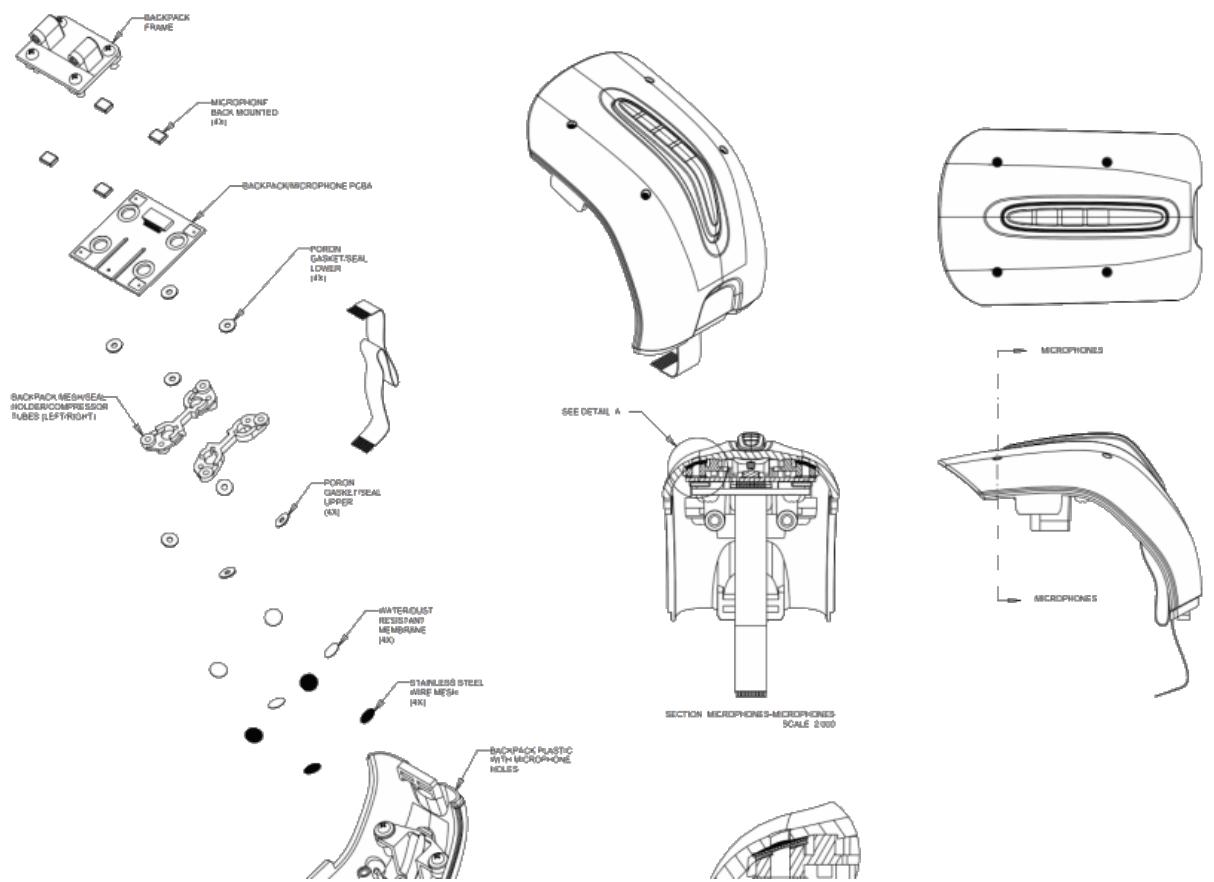
8.4.1 Exploded Views of Vector's assembly





Zoom in on the exploded view of head



An exploded view of backpack assembly

8.5 LCD Replacement

A batch of Vectors have LCD screens that form lines on them. The lines often start at the bottom, both marring the eyes and making the Bluetooth LE pairing pin codes illegible.

The community initially thought that the LCD connections to the head-board became delaminate with falls, lots of head motion, shaking and bad luck. This was wrong.

It was a bad batch of LCDs with a faulty gasket on the glass/plastic pieces that let humidity in and corrodes the electrical bits.

Project Victor has done some work to locate a replacement LCD LCD replacement

- ST0103A3W from <http://www.santechnology.com/products/>

[terminator3d3700](#) has been working on a home set up to replace LCD displays, with some success:

- See https://www.reddit.com/r/AnkiVector/comments/jwu77d/vector_displays/
- https://www.reddit.com/r/AnkiVector/comments/ju7i4i/vectors_new_screen/
- Contact him if interested



8.6 Parts kits

- Replacement Parts: Wheel hubs, wheels, treads, lift arms, body boards, back pack boards, ears, gears, etc.
- A listing 3D printable parts

8.6.1 Cube service

The cube uses a 1.5V "N" battery, aka "E90" or "LR1". **DO NOT USE AN A23 -- IT WILL DESTROY THE ELECTRONICS**

- Kinvert how to [change the battery](#)
- Official how to [change the battery](#)

[3D Printable cube battery door](#)

8.6.2 Replacement boards

We do not have these, but it would be nice:

- Body boards
- Time of flight boards
- LCD module
- Motor encoder
- Backpack boards

Modifying board firmware:

- Mechanism to sign new body board FW?

9. Software design

9.1 Animation Triggers

Trigger Name	Description
AlexaError2Idle	
AlexaErrorLoop	
AlexaErrorLoop	
AlexaIdle2Listen	
AlexaIdle2Speak	
AlexaListen2Error	
AlexaListen2Idle	
AlexaListen2Speak	
AlexaListen2Think	
AlexaListenLoop	
AlexaNotification	
AlexaSignOut	
AlexaSpeak2Error	
AlexaSpeak2Idle	
AlexaSpeak2Listen	
AlexaSpeakLoop	
AlexaThink2Error	
AlexaThink2Idle	
AlexaThink2Speak	
AlexaThinkLoop	
AlreadyAtFace	
AudioOnlyHuh	
BlackJack_Deal	
BlackJack_GetIn	
BlackJack_GoodLuck	
BlackJack_Idle	
BlackJack_Quit	
BlackJack_Response	
BlackJack_RtpIdle	
BlackJack_RtpPlayerNo	
BlackJack_RtpPlayerYes	
BlackJack_RtpRequest	
BlackJack_RtpTimeOut	
BlackJack_SpeechGetIn	
BlackJack_SpeechShortStatement	

Trigger Name	Description
BlackJack_Spread	
BlackJack_Swipe	
BlackJack_VictorBlackJackLose	
BlackJack_VictorBlackJackWin	
BlackJack_VictorBust	
BlackJack_VictorLose	
BlackJack_VictorPush	
BlackJack_VictorWin	
BumpObjectFastGetIn	
BumpObjectFastGetOut	
BumpObjectFastLoop	
BumpObjectSlowGetIn	
BumpObjectSlowGetOut	
BumpObjectSlowLoop	
Carrying	
ChargerDockingAlreadyHere	
ChargerDockingDrivingEnd	
ChargerDockingDrivingLoop	
ChargerDockingDrivingStart	
ChargerDockingFailure	
ChargerDockingLeftTurn	
ChargerDockingRaiseLift	
ChargerDockingRequest	
ChargerDockingRequestGetout	
ChargerDockingRequestPickup	This animation is played by <i>EmergencyModelInAir</i> behavior to ask a human companion to put Vector in the charger.
ChargerDockingRequestWaitLoop	
ChargerDockingRightTurn	
ChargerDockingSearchAfterCompletedSearch	
ChargerDockingSearchSingleTurn	
ChargerDockingSearchSingleTurnEnd	
ChargerDockingSearchWaitForImages	
ChargerDockingSettle	
ChargerDockingSevereRequest	
ChargerDockingSevereRequestGetout	

Trigger Name	Description
ChargerDockingSorryButLowBattery	This animation is played by <i>EmergencyModeAnimDispatcher</i> behavior to show that Vector's battery is low
ChargerReaction	
ClockGetIn	
ClockGetOut	
ComeHereStart	
ComeHereSuccess	
ConnectToCubeFailure	
ConnectToCubeGetIn	
ConnectToCubeLoop	
ConnectToCubeLostConnection	
ConnectToCubeSuccess	
ConnectWakeUp	
ConnectWakeUpLights	
Connected	
CountingFastLoop	
CountingGetInEven	
CountingGetInOdd	
CountingGetOut	
CountingSlowLoop	
CubePounceBackup	
CubePounceDriveGetIn	
CubePounceDriveGetOut	
CubePounceDriveLoop	
CubePounceFake	
CubePounceGetIn	
CubePounceGetOutBored	
CubePounceGetReady	
CubePounceGetUnready	
CubePounceIdleLiftDown	
CubePounceIdleLiftUp	
CubePounceLoseHand	
CubePounceLoseSession	
CubePouncePlayerLose	
CubePouncePlayerWin	
CubePouncePounceClose	

Trigger Name	Description
CubePouncePounceNormal	
CubePounceReactToCube	
CubePounceWinHand	
CubePounceWinSession	
DEPRECATED_AcknowledgeFaceNamed	
DEPRECATED_AcknowledgeFaceUnnamed	
DEPRECATED_AcknowledgeObject	
DEPRECATED_ComeHere_SearchForFace	
DEPRECATED_CubeMovedSense	
DEPRECATED_CubeMovedUpset	
DEPRECATED_DizzyReactionHard	
DEPRECATED_DizzyReactionMedium	
DEPRECATED_DizzyReactionSoft	
DEPRECATED_DizzyShakeLoop	
DEPRECATED_DizzyShakeStop	
DEPRECATED_DizzyStillPickedUp	
DEPRECATED_LaserAcknowledge	
DEPRECATED_LaserDriveEnd	
DEPRECATED_LaserDriveLoop	
DEPRECATED_LaserDriveStart	
DEPRECATED_LaserGetOut	
DEPRECATED_LaserPounce	
DEPRECATED_LookDownForLaser	
DEPRECATED_NamedFaceInitialGreeting	
DEPRECATED_SearchForFace_FoundFace	
DEPRECATED_SearchForFace_Search	
DEPRECATED_StackBlocksSuccess	
DanceBeatCantDoThat	
DanceBeatEyeHold	
DanceBeatGetIn	
DanceBeatGetOut	
DanceBeatGetReady	
DanceBeatListening	
DanceBeatNoBeatDetected	
DanceToTheBeat	

Trigger Name	Description
DealerCardLayout	
DockEndDefault	
DockLoopDefault	
DockStartDefault	
DriveEndAngry	
DriveEndDefault	
DriveEndHappy	
DriveEndLaunch	
DriveLoopAngry	
DriveLoopDefault	
DriveLoopHappy	
DriveLoopLaunch	
DriveOffChargerFarLeft	
DriveOffChargerFarRight	
DriveOffChargerLeft	
DriveOffChargerRight	
DriveOffChargerStraight	
DriveStartAngry	
DriveStartDefault	
DriveStartHappy	
DriveStartLaunch	
DrivingTo	
ExploringHuhClose	
ExploringHuhFar	
ExploringLookAround	
ExploringLookAtHuman	
ExploringQuickScan	
ExploringReactToHandDrive	
ExploringReactToHandGetIn	
ExploringReactToHandGetOut	
ExploringReactToHandLift	
ExploringReactToHandReaction	
ExploringScanCenterFromLeft	
ExploringScanCenterFromRight	
ExploringScanToLeft	

Trigger Name	Description
ExploringScanToRight	
EyeColorGetIn	
EyeColorGetOut	
EyeColorIdle	
EyeColorSwitch	
EyeContactLookLoop	
FacePlantRoll	
FacePlantRollArmUp	
FailedToRightFromFace	
Feedback_Apology	
Feedback_BadRobot	
Feedback_BeQuiet	This animation is used when Vector enters quiet mode.
Feedback_GoodRobot	
Feedback_ILoveYou	
Feedback_MeanWords	
Feedback_ShutUp	This animation is used when Vector enters quiet mode, after being told to "shut up."
FetchCubeFailure	
FetchCubeSetDown	
FetchCubeSuccess	
FindCubeReactToCube	
FindCubeTurns	
FindCubeWaitLoop	
FistBumpIdle	
FistBumpLeftHanging	
FistBumpRequestOnce	
FistBumpRequestRetry	
FistBumpSuccess	
Flash	
FlipDownFromBack	
FoundFace	
FrustratedByFailureMajor	
GatherCubesAllCubesInBeacon	
GatherCubesCubeInBeacon	
GazingLookAtFacesGetInLeft	
GazingLookAtFacesGetInRight	

Trigger Name	Description
GazingLookAtFacesTurnLeft	
GazingLookAtFacesTurnRight	
GazingLookAtSurfaceReaction	
GazingLookAtSurfaceTurnLeft	
GazingLookAtSurfacesGetInLeft	
GazingLookAtSurfacesGetInRight	
GazingLookAtSurfacesTurnRight	
GazingLookAtVectorReaction	
GoToSleepGetIn	This animation is used when Vector enters sleep mode.
GoToSleepOff	
GoToSleepSleeping	This animation is used while Vector is sleeping.
GreetAfterLongTime	
HeldOnPalmEdgeNervous	
HeldOnPalmEdgeRelaxed	
HeldOnPalmGetInNervous	
HeldOnPalmGetInRelaxed	
HeldOnPalmLookingNervous	
HeldOnPalmNestling	
HeldOnPalmPickupNervous	
HeldOnPalmPickupRelaxed	
HeldOnPalmPutDownNervous	
HeldOnPalmPutDownRelaxed	
HeldOnPalmReactToJolt	
HeldOnPalmRollOff	
HeldOnPalmTransitionToRelaxed	
HighTemperatureWarningFace	This animation is played by <i>EmergencyModeAnimDispatcher</i> behavior to show that Vector's battery is too hot.
ICantDoThat	
Idle_09	
InitialWakeUp	This is used by the <i>InitNormalOperationBehavior</i>
InteractWithFaceTrackingIdle	
InteractWithFacesInitialNamed	
InteractWithFacesInitialUnnamed	
Interacting	
InteractingBehaviorLock	
InvalidAnimTrigger	

Trigger Name	Description
InvestigateHeldCubeGetIn	
InvestigateHeldCubeGetOutBored	
InvestigateHeldCubeGetOutCubeLost	
InvestigateHeldCubeOnSetDown	
InvestigateHeldCubeTrackingLoop	
KnowledgeGraphAnswer	
KnowledgeGraphGetIn	
KnowledgeGraphGetOut	
KnowledgeGraphListening	
KnowledgeGraphSearching	
KnowledgeGraphSearchingFail	
KnowledgeGraphSearchingFailGetOut	
KnowledgeGraphSearchingGetIn	
KnowledgeGraphSearchingGetOutSuccess	
KnowledgeGraphSuccessReaction	
LookAround	
LookAtDevice	
LookAtDeviceGetIn	
LookAtDeviceGetOut	
LookAtUserEndearingly	
LookInPlaceForFacesBodyPause	
LookInPlaceForFacesBodyPause_Active	
LookInPlaceForFacesHeadMovePause	
LowBattery	
MeetVictor	
MeetVictorConfusion	
MeetVictorDuplicateName	
MeetVictorGetIn	
MeetVictorLookFace	
MeetVictorLookFaceInterrupt	
MeetVictorSawWrongFace	
MeetVictorSayName	
MeetVictorSayNameAgain	
MessagingMessageDeletedShort	
MessagingMessageGetIn	

Trigger Name	Description
MessagingMessageGetOut	
MessagingMessageLoop	
MessagingMessageRecordReaction	
MessagingMessageRewind	
MovementDriveBackward	
MovementDriveForward	
MovementTurnAround	
MovementTurnLeft	
MovementTurnRight	
Muted	
NeutralFace	
NoCloudGetIn	This animation is played when the NoCloud behavior starts. Note that this is same as the NoWifiGetIn animation group.
NoCloudIcon	This animation is used with the NoCloud behavior . This will play the <i>face_nowifi_trouble_icon</i> sprite sequence.
NoWifiGetIn	This animation is played when the NoWifi behavior starts
NoWifiIcon	This animation is used with the NoWifi behavior . This will play the <i>face_nowifi_icon</i> sprite sequence.
NoWifiSearching	This animation is used while Vector is looking for a Wifi SSID; This will play the <i>face_nowifi_signal</i> sprite sequence.
NothingToDoBoredIdle	
ObservingIdleEyesOnly	This animation is used when Vector is sitting and only looking around.
ObservingIdleWithHeadLookingStraight	
ObservingIdleWithHeadLookingUp	
ObservingLookStraight	
ObservingLookUp	
ObservingOnCharger	
ObservingOnChargerGetIn	
ObservingOnChargerGetOut	
Off	
Offline	
Offline_Off	
Onboarding	
OnboardingComeHere	
OnboardingComeHereGetOut	
OnboardingCubeDriveGetIn	
OnboardingCubeDriveGetOut	

Trigger Name	Description
OnboardingCubeDriveLoop	
OnboardingCubeHuh	
OnboardingDriveOffCharger	
OnboardingDriveOffCharger_1p0	
OnboardingListenGetIn	
OnboardingListenGetOut	
OnboardingLookAround	
OnboardingLookAtPhoneDown	
OnboardingLookAtPhoneLoop	
OnboardingLookAtPhoneUp	
OnboardingLookAtUser	
OnboardingLookAtUserGetOut_1p0	
OnboardingLookDown	
OnboardingLookForCube	
OnboardingReactToFaceHappy	
OnboardingWakeUp	
OnboardingWakeWordGetIn	
OnboardingWakeWordSuccess	
PRDemoGreeting	
PettingBlissGetout	
PettingBlissLoop	
PettingLevel1	
PettingLevel1Getout	
PettingLevel2	
PettingLevel2Getout	
PettingLevel3	
PettingLevel3Getout	
PettingLevel4	
PettingLevel4Getout	
PickupCubePreperation	
PickupCubeRetry	
PickupCubeSuccess	
PlaceCubeByChargerFail	
PlaceCubeByChargerReactToCharger	
PlaceCubeByChargerSuccess	

Trigger Name	Description
PlanningGetIn	
PlanningGetOut	
PlanningLoop	
PlayerCardLayout	
PokeObjectDriveLoop	
PokeObjectGetIn	
PokeObjectGetOut	
PopAWheelieInitial	
PopAWheeliePreActionNamedFace	
PopAWheeliePreActionUnnamedFace	
PopAWheelieRealign	
PopAWheelieRetry	
PounceFail	
PounceSuccess	
PounceWProxForward	
PutDownBlockKeepAlive	
PutDownBlockPutDown	
RTS_OffCharger_Awake_120Left	
RTS_OffCharger_Awake_120Right	
RTS_OffCharger_Awake_150Left	
RTS_OffCharger_Awake_150Right	
RTS_OffCharger_Awake_30Left	
RTS_OffCharger_Awake_30Right	
RTS_OffCharger_Awake_60Left	
RTS_OffCharger_Awake_60Right	
RTS_OffCharger_Awake_Ambient	
RTS_OffCharger_Awake_Back	
RTS_OffCharger_Awake_Front	
RTS_OffCharger_Awake_Left	
RTS_OffCharger_Awake_Right	
RTS_OffCharger_Sleep_120Left	
RTS_OffCharger_Sleep_120Right	
RTS_OffCharger_Sleep_150Left	
RTS_OffCharger_Sleep_150Right	
RTS_OffCharger_Sleep_30Left	

Trigger Name	Description
RTS_OffCharger_Sleep_30Right	
RTS_OffCharger_Sleep_60Left	
RTS_OffCharger_Sleep_60Right	
RTS_OffCharger_Sleep_Ambient	
RTS_OffCharger_Sleep_Back	
RTS_OffCharger_Sleep_Front	
RTS_OffCharger_Sleep_Left	
RTS_OffCharger_Sleep_Right	
RTS_OnCharger_Awake_120Left	
RTS_OnCharger_Awake_120Right	
RTS_OnCharger_Awake_150Left	
RTS_OnCharger_Awake_150Right	
RTS_OnCharger_Awake_30Left	
RTS_OnCharger_Awake_30Right	
RTS_OnCharger_Awake_60Left	
RTS_OnCharger_Awake_60Right	
RTS_OnCharger_Awake_Ambient	
RTS_OnCharger_Awake_Back	
RTS_OnCharger_Awake_Front	
RTS_OnCharger_Awake_Left	
RTS_OnCharger_Awake_Right	
RTS_OnCharger_Sleep_120Left	
RTS_OnCharger_Sleep_120Right	
RTS_OnCharger_Sleep_150Left	
RTS_OnCharger_Sleep_150Right	
RTS_OnCharger_Sleep_30Left	
RTS_OnCharger_Sleep_30Right	
RTS_OnCharger_Sleep_60Left	
RTS_OnCharger_Sleep_60Right	
RTS_OnCharger_Sleep_Ambient	
RTS_OnCharger_Sleep_Back	
RTS_OnCharger_Sleep_Front	
RTS_OnCharger_Sleep_Left	
RTS_OnCharger_Sleep_Right	
ReactToCliff	

Trigger Name	Description
ReactToCliffBack	
ReactToCliffBackLeft	
ReactToCliffBackRight	
ReactToCliffFront	
ReactToCliffFrontLeft	
ReactToCliffFrontRight	
ReactToCliffTurnLeft120	
ReactToCliffTurnLeft180	
ReactToCliffTurnLeft60	
ReactToCliffTurnRight120	
ReactToCliffTurnRight180	
ReactToCliffTurnRight60	
ReactToCubeSearchForCubeLvl1	
ReactToCubeSearchForCubeLvl2	
ReactToCubeSearchForCubeLvl3	
ReactToCubeTapCubeFound	
ReactToCubeTapCubeNotFound	
ReactToCubeTapCubeTappedLvl1	
ReactToCubeTapCubeTappedLvl2	
ReactToCubeTapCubeTappedLvl3	
ReactToCubeTapInteractionGetOut	
ReactToCubeTapInteractionLoop	
ReactToDarkness	
ReactToGoodBye	
ReactToGoodMorning	
ReactToGoodNight	
ReactToGreeting	
ReactToHabitat	
ReactToMotionLeft	
ReactToMotionLeftGetout	
ReactToMotionRight	
ReactToMotionRightGetout	
ReactToMotionTurnLeft	
ReactToMotionTurnRight	
ReactToMotionTurnUp	

Trigger Name	Description
ReactToMotionUp	
ReactToMotionUpGetout	
ReactToObstacle	
ReactToOnLeftSideGetIn	
ReactToOnLeftSideLoop	
ReactToOnRightSideGetIn	
ReactToOnRightSideLoop	
ReactToOnSideEffort	
ReactToOnSideGetOut	
ReactToPerchedOnBlock	
ReactToPickupInitial	
ReactToPickupLoop	
ReactToPutDown	
ReactToShakeSnowGlobe_GetIn	
ReactToShakeSnowGlobe_Lvl1InHand	
ReactToShakeSnowGlobe_Lvl1Loop	
ReactToShakeSnowGlobe_Lvl1OnGround	
ReactToShakeSnowGlobe_Lvl1Waiting	
ReactToShake_GetIn	
ReactToShake_Lvl1InHand	
ReactToShake_Lvl1Loop	
ReactToShake_Lvl1OnGround	
ReactToShake_Lvl1Waiting	
ReactToShake_Lvl2InHand	
ReactToShake_Lvl2Loop	
ReactToShake_Lvl2OnGround	
ReactToShake_Lvl2Waiting	
ReactToShake_Lvl3InHand	
ReactToShake_Lvl3Loop	
ReactToShake_Lvl3OnGround	
ReactToShake_Lvl3Waiting	
ReactToTouchInitial	
ReactToTriggerWordOffChargerBehind	
ReactToTriggerWordOffChargerBehindLeft	
ReactToTriggerWordOffChargerBehindRight	

Trigger Name	Description
ReactToTriggerWordOffChargerFrontLeft	
ReactToTriggerWordOffChargerFrontRight	
ReactToTriggerWordOffChargerLeft	
ReactToTriggerWordOffChargerRight	
ReactToUnclaimedIntent	
ReactToUnclaimedIntentInAir	
ReactToUnexpectedMovement	
RollBlockRealign	
RollBlockRetry	
RollBlockSuccess	
SeasonalHappyHolidays	
SeasonalHappyNewYear	
ShutDown	
Sleep	
SleepNoFade	
SoundOnlyLiftEffortPickup	
SoundOnlyLiftEffortPlaceHigh	
SoundOnlyLiftEffortPlaceLow	
SoundOnlyLiftEffortPlaceRoll	
SpeedTapLose	
SpeedTapWin	
SpinnerBlueCelebration	
SpinnerBlueCycle	
SpinnerBlueHoldTarget	
SpinnerBlueLockIn	
SpinnerBlueLocked	
SpinnerBlueLockedPulse	
SpinnerBlueSelectTarget	
SpinnerGreenCelebration	
SpinnerGreenCycle	
SpinnerGreenHoldTarget	
SpinnerGreenLockIn	
SpinnerGreenLocked	
SpinnerGreenLockedPulse	
SpinnerGreenSelectTarget	

Trigger Name	Description
SpinnerPlayerError	
SpinnerPurpleCelebration	
SpinnerPurpleCycle	
SpinnerPurpleHoldTarget	
SpinnerPurpleLockIn	
SpinnerPurpleLocked	
SpinnerPurpleLockedPulse	
SpinnerPurpleSelectTarget	
SpinnerRedCelebration	
SpinnerRedCycle	
SpinnerRedHoldTarget	
SpinnerRedLockIn	
SpinnerRedLocked	
SpinnerRedLockedPulse	
SpinnerRedSelectTarget	
SpinnerStartGame	
SpinnerYellowCelebration	
SpinnerYellowCycle	
SpinnerYellowHoldTarget	
SpinnerYellowLockIn	
SpinnerYellowLocked	
SpinnerYellowLockedPulse	
SpinnerYellowSelectTarget	
Streaming	
StuckOnEdgeGetIn	
StuckOnEdgeIdle	
StuckOnEdgeLeftGetIn	
StuckOnEdgeLeftIdle	
StuckOnEdgeRightGetIn	
StuckOnEdgeRightIdle	
SuccessfulWheelie	
TakeAPictureCapture	
TakeAPictureFocusing	
TapResponsePulse	
TemperatureDoubleDig	

Trigger Name	Description
TemperatureNegDoubleDig	
TemperatureNegSingleDig	
TemperatureNegTripleDig	
TemperatureSingleDig	
TemperatureTripleDig	
TestAllLeds	
TestOffset	
TestRotation	
TextToSpeechGetIn	
TextToSpeechGetLoop	
TextToSpeechGetOut	
TimerCancelGetIn	
TimerCancelTimer	
TimerCheckTimeGetIn	
TimerCheckTimeGetOut	
TimerRing	
TimerRingGetIn	
TimerRingGetOut	
TimerSetGetIn	
TimerSetGetOut	
UnitTestAnim	
VC_IntentNeutral	
VC_ListeningGetIn	
VC_ListeningGetOut	
VC_ListeningLoop	
VC_SleepingToListeningGetIn	
VC_SleepingToListeningGetOut	
VC_SleepingToListeningLoop	
Visible	
VolumeLevel1	
VolumeLevel2	
VolumeLevel3	
VolumeLevel4	
VolumeLevel5	
WakeUp	

Trigger Name	Description
WakeupGetout	
WeatherCondCloudy_01	
WeatherCondColdClear_01	
WeatherCondRain_01	
WeatherCondSnow_01	
WeatherCondStars_01	
WeatherCondSunny_01	
WeatherCondThunderstorms_01	
WeatherCondWindy_01	

9.2 Behaviour IDs

Behavior ID	Description
AcknowledgeCharger	
AcousticTestMode	This behavior is the first behavior called when Vector starts in an acoustic testing mode
ActiveLookForFaces	
AlexaSignInOut	
Alexa	
AskForHelpOnSide	
AskForHelp	
Asleep	
BasicVoiceCommands	
BeQuietAnims	This behavior is used to animate Vector going into a quiet state, and animate his eyes looking around. See quiet mode
BeQuietLoop	This behavior is used to animate Vector's eyes looking around. See quiet mode
BlackJackGoodLuckTTS	
BlackJackHandleRTPResponses	
BlackJackHitOrStandPrompt	
BlackJackLookAtFaceInFront	
BlackJackRequestToPlayAgain	
BlackJackRequestToPlay	
BlackJackTextToSpeech	
BlackJackVoiceCommand	
BlackJack	
ChangeEyeColor	
CheckForAndReactToHand	
ClearChargerArea	
ComeHereVoiceCommand	
ConfirmCharger	
ConfirmCube	
ConfirmHabitat	
ConnectToCube	
CoordinateGlobalInterrups	
CoordinateInHabitat	
CoordinateWhileHeldInPalm	
CoordinateWhileInAir	
CubeSpinnerConnectionGate	
CubeSpinnerLookAroundInPlace	
CubeTrickDispatcher	

Behavior ID	Description
DanceBig	
DanceForwardBackFlower	
DanceFrontRightLeftPoint	
DanceSTwoways	
DanceSwell	
DanceToTheBeatCoordinator	
DanceToTheBeatVoiceCommand	
DanceToTheBeat	
DanceWiggleForwardWiggleBack	
DefaultTextToSpeechLoop	
DemoTimerUtilityCoordinator	
DevBaseBehavior	
DevBatteryLogging	
DevCubeSpinnerConsole	
DevCubeSpinner	
DevDesignCubeLights	
DevDisplayReadingsOnFace	
DevEventSequenceCapture	
DevImageCapture_PetsAndHands	
DevImageCapture	
DevPlannerTest	
DevSquawkBoxTest	
DevTestBlackjackViz	
DevTestConnectToCube	
DevTestPersonDetectorBehavior	
DevTestPromptUser	
DevTouchDataCollection	
DevTurnInPlaceTest	
DevViewCubeBackpackLights	
DoATrickVoiceCommand	
DockingTestSimple	
DriveOffChargerCube	
DriveOffChargerFace	
DriveOffChargerIntoSocializing	
DriveOffChargerRandomlyAnim	

Behavior ID	Description
DriveOffChargerRandomly	
DriveOffChargerStraight	
EmergencyModeAnimDispatcher	This behavior gives a visual animation why Vector about the emergency mode.
EmergencyModeFindAndGoToHome	This specific behavior initiates the <i>FindAndGoToHome</i> behavior when in emergency mode.
EmergencyModelnAir	This behavior animates a request to be picked up and placed in the dock when he has fallen or picked up.
EmergencyModeOffCharger	This behavior coordinates driving back to the charging dock
EmergencyModeTriggerWord	This animates a response to the trigger word, usually why it can't respond to commands right now.
EmergencyMode	This behavior coordinates Vector driving to the charging dock, or requesting help.
ExploringBumpObject	
ExploringExamineObstacle	
ExploringGetIn	
ExploringReferenceHuman	
ExploringVoiceCommand	
Exploring	
FactoryCentroidExtractor	
FetchCubeVoiceCommand	
FetchCube	
FindAndGoToHome	
FindAndRequestHome	
FindCubeAndPlayKeepaway	
FindCubeAndThen	
FindCube	
FindFacesFetchCube	
FindFacesPhoto	
FindHomeForSleeping	
FindHomeInHabitat	
FindHome	
FindYourCubeVoiceCommand	
FistBumpVoiceCommand	
FistBump	
ForceStuckOnEdge	
FrameFaces	
GlobalInterruptions	
GoHomeVoiceCommand	

Behavior ID	Description
GoHome	
GoToSleep	
GreetAfterLongTime	
HabitatMutedDispatcher	
HabitatMutedVoiceCommandResponse	
HeldInPalmDispatcher	
HeldInPalmResponses	
HighLevelAI	
HowOldAreYouCounting	
HowOldAreYou	
InitNormalOperation	This behavior is the first behavior called when Vector starts normally.
InitPRDemo	This behavior is the first behavior called when Vector starts in a PR demo mode.
InitialHeldInPalmReaction	
InitialPickupAnimation	
IntentUnmatched	
InteractWithFaces	
InteractWithStaticCube	
InterruptingVoiceReactions	
InvestigateCubeConnectionGate	
InvestigateHeldCube	
KeepawayVoiceCommand	
Keepaway	
KnowledgeGraphQuestion	
KnowledgeGraphTTS	
LeaveAMessage	
LiftLoadTest	
ListenForBeatsLong	
ListenForBeatsVoiceCommand	
ListenForBeats	
LookAtMeVoiceCommand	
LookInPlaceHeadDownInAir	
LookInPlaceHeadUpInAir	
LookInPlaceHeadUp	
LookOverThereVoiceCommand	
MandatoryPhysicalReactions	

Behavior ID	Description
MeetVictorAlreadyKnowYouPrompt	
MeetVictor	
MessagingPlaybackTTS	
MessagingRecordTTS	
ModeSelector	Top level dispatcher; this is called by many different start up modes. See power management for a description.
MoveCube	
MovementBackward	
MovementForward	
MovementTurnAround	
MovementTurnLeft	
MovementTurnRight	
NoCloud	The behavior is invoked when Vector can't reach the voice server; see Communication trouble behaviors
NoWifi	The behavior is invoked when Vector can't connect to a Wifi SSID; see Communication trouble behaviors
NormalWakeUp	This is called by InitNormalBehavior on start. It plays the wake up animation --- if it isn't night time, and this isn't a maintenance reboot.
NothingToDo_Idle	
ObservingDriveOffCharger	
ObservingEyeContact	
ObservingFindFaces	
ObservingLookAtFacesInAir	
ObservingLookAtFaces	
ObservingOffChargerHeadOnly	
ObservingOnChargerEyeContact	
ObservingOnChargerGetIn	
ObservingOnChargerGetOut	
ObservingOnChargerIdleAnim	
ObservingOnChargerIdle	
ObservingOnCharger	
Observing	
OnboardingComeHere	
OnboardingEmulate1p0WaitForVC	
OnboardingLookAtPhone	
OnboardingLookAtUserOffCharger	
OnboardingLookAtUserOnCharger	

Behavior ID	Description
OnboardingLookAtUser	
OnboardingPowerOff	
OnboardingTeachComeHere	
OnboardingTeachMeetVictor	
OnboardingTeachWakeWord	
OnboardingWakeUp	
Onboarding	This behavior is the first behavior called when Vector starts "fresh" (new from factory or a clearing of user data) and is now onboarding a new human companion.
PRDemoBigGreeting	
PRDemoComeHere	
PRDemoExploring	
PRDemoObserving	
PRDemoSleeping	
PRDemoStateMachine	
PickUpCubeVoiceCommand	
PickupCubeNoInitialReaction	
PickupCube	
PlaceCubeByCharger	
PlayAGameVoiceCommand	
PlayRollBlock	
PlayWithCube	
PlaybackMessage	
PlaypenCameraCalibration	
PlaypenDistanceSensor100mm	
PlaypenDistanceSensor300mm	
PlaypenDistanceSensor80mm	
PlaypenDriftCheck	
PlaypenDriveForwards	
PlaypenEndChecks	
PlaypenInitChecks	
PlaypenMotorCalibration	
PlaypenPickupCube	
PlaypenSoundCheck	
PlaypenTest	
PlaypenWaitToStart	
PopAWheelieVoiceCommand	

Behavior ID	Description
PopAWheelie	
PowerSaveStressTest	
PowerSaveTest	
ProceduralTurnToMicDirection	
PutDownBlockAtPose	
PutDownBlock	
PutDownDispatch_LookForFaceAndCube	
PuzzleMaze	
QuietModeEmergencyModeGoHome	This behavior coordinates driving back to the charging dock when the battery is low or overheated in quiet mode. See power management for more details.
QuietMode	The <i>QuietMode</i> behavior is when Vector's has been asked to be silent. See quiet mode
ReactToAbuse	
ReactToAffirmative	
ReactToApology	
ReactToBatteryTooHotToCharge	
ReactToBody	
ReactToCliffDuringFetch	
ReactToCliff	
ReactToDarkness	
ReactToFrustrationMajor	
ReactToGazeDirectionSurface	
ReactToGazeDirection	
ReactToGoodBye	
ReactToGoodMorning	
ReactToHand	
ReactToHello	
ReactToJoltInPalm	
ReactToLove	
ReactToMotion	
ReactToMotorCalibration	
ReactToNegative	
ReactToObstacle	
ReactToPalmTilt	
ReactToPickupFromPalm	
ReactToPlacedOnSlope	
ReactToPutDownFromPalm	

Behavior ID	Description
ReactToPutDown	
ReactToRobotOnBack	
ReactToRobotOnFace	
ReactToRobotOnSide	
ReactToRobotShakenSnowGlobe	
ReactToRobotShaken	
ReactToSoundAsleep	
ReactToSoundAwake	
ReactToSoundDirectionAsleep	
ReactToSoundDirectionAwake	
ReactToTouchPetting	
ReactToTriggerDirectionAwake	
ReactToUncalibratedHeadAndLift	
ReactToUnclaimedIntent	
ReactToUnexpectedMovement	
RequestHomeBecauseStuck	
RequestToGoHome	
ResetSafely	
RespondToRenameFace	
RollBlockIfNotVertical	
RollCubeVoiceCommand	
SDKDefault	
SDKOverrideAll	
SayName	
SearchWithinBoundingBox	
SeasonalHappyHolidays	
SeasonalHappyNewYear	
SelfTestButton	
SelfTestDockWithCharger	
SelfTestDriftCheck	
SelfTestDriveForwards	
SelfTestInitChecks	
SelfTestLookAtCharger	
SelfTestMotorCalibration	
SelfTestPickup	

Behavior ID	Description
SelfTestPutOnCharger2	
SelfTestPutOnCharger	
SelfTestScreenAndBackpack	
SelfTestSoundCheck	
SelfTestTouch	
SelfTest	
ShortLookAroundForFaceAndCube	
ShowWallTime	
ShutUpAnims	This behavior is used to animate Vector going into a quiet state (after being told to shutup), and animate his eyes looking around. See quiet mode
ShutUpMode	The <i>ShutUpMode</i> behavior is when Vector's has been asked to "shut up." See quiet mode
SingletonAnticShowClock	
SingletonCancelTimer	
SingletonFindFaceInFrontWallTime	
SingletonICantDoThat	
SingletonPounceApproachWithProx	
SingletonPounceDispatcher	
SingletonPounceTurnLeft	
SingletonPounceTurnRight	
SingletonPounceWithProx	
SingletonPoweringRobotOff	This behavior is active when Vector is powering down. See power management
SingletonTimerAlreadySet	
SingletonTimerAntic	
SingletonTimerCheckTime	
SingletonTimerRing	
SingletonTimerSet	
SingletonWallTimeCoordinator	
SleepCycle	This behavior is manages Vector going to sleep, playing and interacting. See power management
SleepingPersonCheck	
SleepingTriggerWord	
SleepingWakeUpLights	
SleepingWakeUp	
SocializeGame	
Socialize	
StayOnChargerUntilCharged	

Behavior ID	Description
StuckOnEdge	
TakeAPhotoCoordinator	
TestStackMonitors	
TimerRingingPRDemo	
TimerUtilityCoordinator	
TrackCubeTest	
TrackCube	
TrackFaceTest	
TrackingEyeContact	
TriggerWordDetected	
TriggerWordWithoutIntent	
TurnToLastFace	
UserDefinedBehaviorSelector	
UserDefinedBehaviorTreeConfirmNewBehavior	
UserDefinedBehaviorTreeRouter	
UserDefinedBehaviorTreeTextToSpeech	
VectorPlaysCubeSpinner	
Volume	
Wait	
WeatherCloudyGeneric	
WeatherColdClearGeneric	
WeatherRainGeneric	
WeatherResponses	
WeatherSnowGeneric	
WeatherStarsGeneric	
WeatherSunnyGeneric	
WeatherTextToSpeech	
WeatherThunderstormsGeneric	
WeatherWindyGeneric	
WhatsMyNameVoiceCommand	
WhileInAirDispatcher	
WhileInAirResponsesPRDemo	
WhileInAirResponses	
WiggleBackOntoChargerFromPlatform	

9.3 Behavior Classes

Behavior Classes	Description
AdvanceClock	
AestheticallyCenterFaces	
Alexa	
AlexaSignInOut	
AnimGetInLoop	
AnimSequence	This kind of behavior plays an animation.
AnimSequenceWithFace	
AnimSequenceWithObject	
AskForHelp	
AttentionTransferIfNeeded	
BlackJack	
BumpObject	
CheckForAndReactToSalientPoint	
ClearChargerArea	
ConfirmHabitat	
ConfirmObject	
ConnectToCube	
CoordinateGlobalInterrups	
CoordinateInHabitat	
CoordinateWeather	
CoordinateWhileHeldInPalm	
CoordinateWhileInAir	
CountingAnimation	
DanceToTheBeat	
DanceToTheBeatCoordinator	
DevBatteryLogging	
DevCubeSpinnerConsole	
DevDesignCubeLights	
DevDisplayReadingsOnFace	
DevEventSequenceCapture	
DevImageCapture	
DevSquawkBoxTest	
DevTestBlackjackViz	
DevTouchDataCollection	
DevTurnInPlaceTest	

Behavior Classes	Description
DevViewCubeBackpackLights	
DispatchAfterShake	
DispatcherPassThrough	
DispatcherQueue	This behavior runs each of the behaviors in the <code>behavior</code> array in order.
DispatcherRandom	
DispatcherStrictPriority	This behavior runs each of the behaviors in the <code>behavior</code> array in order.
DispatcherStrictPriorityWithCooldown	This behavior runs each of the behaviors in the <code>behavior</code> array in order. Behaviors still in a cooldown period are skipped.
DisplayWallTime	
DisplayWeather	
DockingTestSimple	
DriveOffCharger	
DriveToFace	
EnrollFace	
Exploring	
ExploringExamineObstacle	
EyeColor	
FactoryCentroidExtractor	
FetchCube	
FindCube	
FindCubeAndThen	
FindFaceAndThen	
FindFaces	
FindHome	
FistBump	
GoHome	
GreetAfterLongTime	
HighLevelAI	
HowOldAreYou	
InspectCube	
InteractWithFaces	
Keepaway	
KnowledgeGraphQuestion	
LeaveAMessage	
LiftLoadTest	
ListenForBeats	

Behavior Classes	Description
LookAroundInPlace	
LookAtFaceInFront	
LookAtMe	
LookForFaceAndCube	
MoveHeadToAngle	
ObservingLookAtFaces	
ObservingWithoutTurn	
OnboardingCoordinator	
OnboardingEmulate1p0WaitForVC	
OnboardingLookAtPhone	
OnboardingLookAtUser	
OnboardingTeachWakeWord	
OnboardingWakeUp	
PickUpCube	
PlaceCubeByCharger	
PlannerTest	
PlaybackMessage	
PlaypenCameraCalibration	
PlaypenDistanceSensor	
PlaypenDriftCheck	
PlaypenDriveForwards	
PlaypenEndChecks	
PlaypenInitChecks	
PlaypenMotorCalibration	
PlaypenPickupCube	
PlaypenSoundCheck	
PlaypenTest	
PlaypenWaitToStart	
PopAWheelie	
PounceWithProx	
PowerSaveStressTest	
PowerSaveTest	
PoweringRobotOff	This behavior is active when Vector is powering down. See power management
PRDemo	
PRDemoBase	

Behavior Classes	Description
ProceduralClock	
PromptUserForVoiceCommand	
ProxGetToDistance	
PutDownBlock	
PutDownBlockAtPose	
PuzzleMaze	
QuietModeCoordinator	
ReactToBatteryTooHotToCharge	
ReactToBody	
ReactToCliff	
ReactToDarkness	
ReactToFrustration	
ReactToGazeDirection	
ReactToHand	
ReactToMicDirection	
ReactToMotion	
ReactToMotorCalibration	
ReactToPlacedOnSlope	
ReactToPutDown	
ReactToRobotOnBack	
ReactToRobotOnFace	
ReactToRobotOnSide	
ReactToRobotShaken	
ReactToSound	
ReactToTouchPetting	
ReactToUncalibratedHeadAndLift	
ReactToUnclaimedIntent	
ReactToUnexpectedMovement	
ReactToVoiceCommand	
RequestToGoHome	
ResetState	
RespondToRenameFace	
RollBlock	
SayName	
SDKInterface	

Behavior Classes	Description
SearchWithinBoundingBox	
SelfTest	
SelfTestButton	
SelfTestDockWithCharger	
SelfTestDriftCheck	
SelfTestDriveForwards	
SelfTestInitChecks	
SelfTestLookAtCharger	
SelfTestMotorCalibration	
SelfTestPickup	
SelfTestPutOnCharger	
SelfTestScreenAndBackpack	
SelfTestSoundCheck	
SelfTestTouch	
SleepCycle	This behavior is manages Vector going to sleep, playing and interacting. See power management
Sleeping	
StayOnChargerUntilCharged	
TakeAPhotoCoordinator	
TextToSpeechLoop	
TimerUtilityCoordinator	
TrackCube	
TrackFace	
Turn	
TurnToFace	
UserDefinedBehaviorSelector	
UserDefinedBehaviorTreeRouter	
VectorPlaysCubeSpinner	
Volume	
Wait	
WallTimeCoordinator	
WiggleOntoChargerContacts	

9.4 Behavior Tree

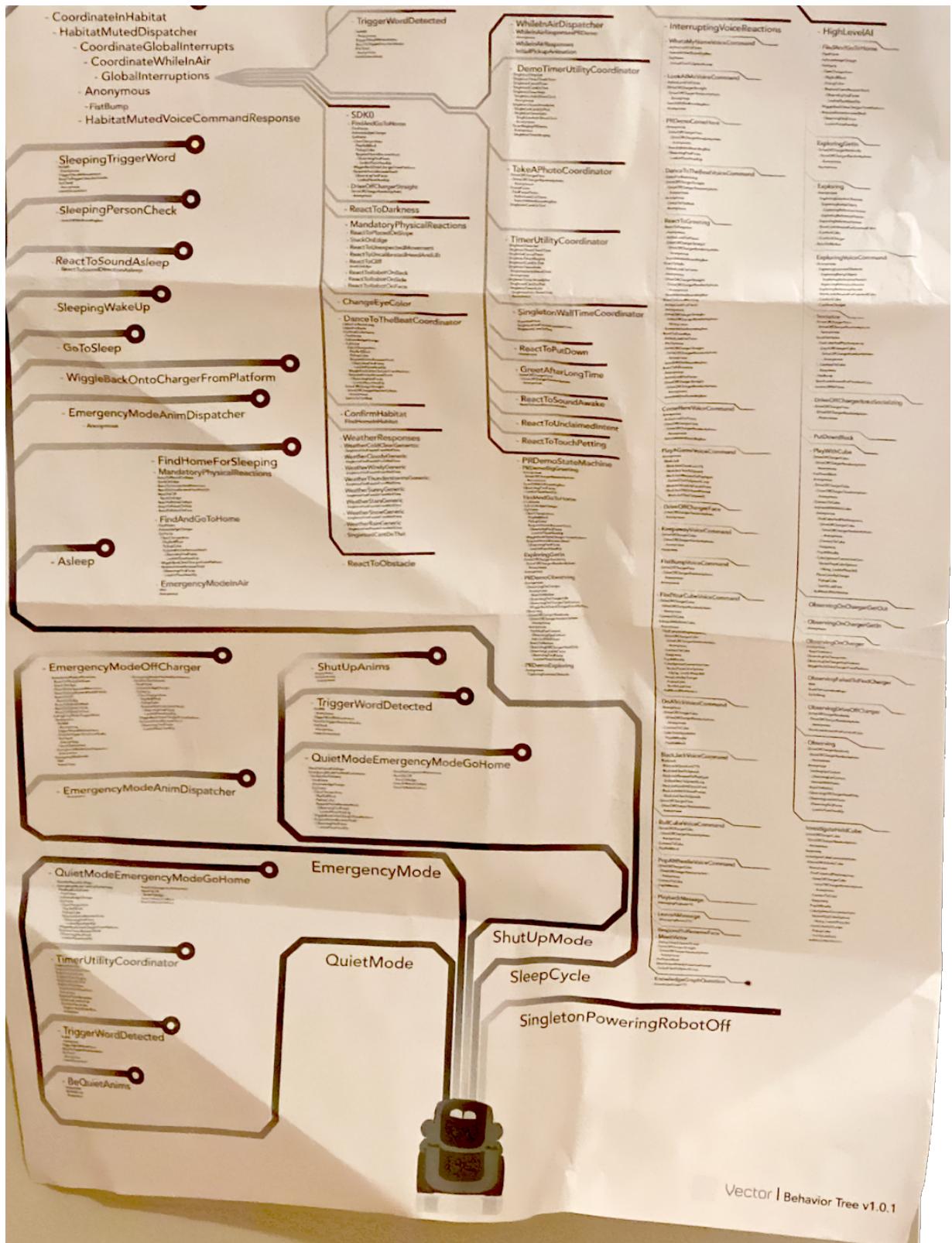


Figure: Vector Behavior Tree v1.0.1

Note: all of the behavior related files are in the following directory, and sub-directories:

```
/anki/data/assets/cozmo_resources/config/engine/behaviorComponent
```

Habitat: I am not sure if this term refers to the desk / table in general, or is specific to the Vector Field (tray).

These are not referred to by the rest of the behavior tree, but the names are in `libcozmo_engine`. I am not sure if these are unused, or invoked internally by the C++. If they are, the C++ should be refactored to use the behavior tree.

9.4.1 Self-maintenance behaviors

Self-maintenance behaviors:

- **Startup** related to Vector turning on and setting up the behavior tree.
- **Power management** related to turning on and off, initiating return to charger when the battery is low, as well as self-protection behaviors like very low battery, and over temperature.
- **Reacting to environmental conditions** while driving around
- Drive home
- **Communication trouble behaviors** are invoked when Vector can't connect to a Wifi SSID or can't reach the voice server.
- **Quiet mode** related to Vector being quiet -- not interacting with a person or toy, but also not asleep.
- Sleep

9.4.2 Social behaviors

- Petting
- Being held
- Playing
- Helping out
 - Question-Answer
 - Timer
 - Weather

9.4.3 Toys and Accessories

9.4.4 Change history synopsis

Date	Change
2020-12-1	Created

9.5 Console variables

9.5.1 Console Variables

Console Variables are part of the developer build. They allow the developer to test, diagnose, and tweak (inject data into) the various modules.

This note is to help gather a description of each of console variables. This format lets us gather information on them, and help understand where they fit in.

These tables are not suitable for the TRM at this time; they may go better in the software design description in the future.

Note: the k seems to be dropped or optional in matching

A/B Testing console variables

Variable	Type	Units	Description
kForceDisableABTesting			

AIWhiteboard console variables

Variable	Type	Units	Description
kBW_PossibleObjectClose_mm			

Alexa console variables

Variable	Type	Units	Description
kAcousticTestMode			
kAlexaEnabledInAU			
kAlexaEnabledInUK			
kAlexaHackCheckForSystemClockSyncPeriod_s			
kAlexaIdleDelay_s			
kAlexaMaxIdleDelay_s			
kAllowAudioOnCharger			
kDEV_ONLY_EnableAlexaTemplateRendererStub			
kLogAlexaDirectives			
kNotchPower			

Alexa.Init console variables

Variable	Type	Units	Description
kDumpAlexaTriggerAudio			

Alexa.Messaging console variables

Variable	Type	Units	Description
kLogAlexaMessages			
kStealAlexaWakewordAudio			

Animation console variables

Variable	Type	Units	Description
kShouldPreCacheSprites			
kEyeDartFocusValue_pix			
kIgnoreAnimWhitelist			

AnimationStreamer console variables

Variable	Type	Units	Description
kEnableBackpackLightsTrack			
kShouldDisplayPlaybackTime			

AnimationStreamer.System console variables

Variable	Type	Units	Description
kDisplayCPUThrottling			
kDisplayHighTemperature			
kDisplayMemoryPressure			
kThermalAlertTemp_C			

Audio.AnimationStream console variables

Variable	Type	Units	Description
kAudioAnimationOffset_ms			

Audio.KeepAlive console variables

Variable	Type	Units	Description
kEnableKeepAliveEyeBlinkAudioEvents			
kEnableKeepAliveEyeDartAudioEvents			
kEnableKeepAliveEyeSquintAudioEvents			

Audio.Microphone console variables

Variable	Type	Units	Description
kNoiseFloorMin			
kNoiseFloorRange			

Audio.Procedural console variables

Variable	Type	Units	Description
kEnableHeadProceduralMovement			
kEnableLiftProceduralMovement			
kEnableTreadProceduralMovement			
kHeadCoolDown_ms			
kHeadMovementThreshold_rpms			
kLiftCoolDown_ms			
kLiftMovementThreshold_rpms			
kMaxHeadAccel_rpms2			
kMaxHeadSpeed_rpms			
kMaxLiftAccel_rpms2			
kMaxLiftSpeed_rpms			
kMaxTreadAccel_mmpms2			
kMaxTreadSpeed_mmmps			
kMaxTurnSpeed_mmmps			
kTreadMovementThreshold_mmmps			
kTreadCoolDown_ms			

BackpackLights console variables

Variable	Type	Units	Description
kOfflineCheckFreq_ms			
kOfflineTimeBeforeLights_ms			

BasicActions.TurnTowardsObject console variables

Variable	Type	Units	Description
kInsertWaitsInTurnTowardsObjectVerify			

Behavior.BehaviorGoHome console variables

Variable	Type	Units	Description
kGoHome_VisualVerification_SaveImages			

Behavior.CheckForAndReactToSalientPoint console variables

Variable	Type	Units	Description
kCFARTSP_ColdownOverride_sec			

BehaviorCountingAnimation console variables

Variable	Type	Units	Description
kSlowLoopBeginSize_loops			

BehaviorDanceToTheBeatCoordinator console variables

Variable	Type	Units	Description
kDancingCooldown_sec			

Behaviors.BehaviorSystemManager console variables

Variable	Type	Units	Description
kDebugBehaviorStack			

Behavior.EnrollFace console variables

Variable	Type	Units	Description
kEnrollFace_TimeoutForReLookForFace_ms			

BehaviorExploring console variables

Variable	Type	Units	Description
kExploringPostBumpReferenceProb			
kMinObjectWidthToBump_rad			
kProbReferenceOnResume			

BehaviorHighLevelAI console variables

Variable	Type	Units	Description
kTimeMultiplier			

Behavior.InteractWithFaces console variables

Variable	Type	Units	Description
kInteractWithFaces_DriveForwardIdealDist_mm			
kWiggle_ForwardDist_mm			

Behavior.InternalStatesBehavior console variables

Variable	Type	Units	Description
kDebugInternalStatesBehavior			

Behavior.LookAroundInPlace console variables

Variable	Type	Units	Description
kVizConeOfFocus			

BehaviorPlannerTest console variables

Variable	Type	Units	Description
kCubeDistance_mm			

Behavior.PutDownBlock console variables

Variable	Type	Units	Description
kBPDB_finalHeadAngle_deg			

Behavior.PuzzleMaze console variables

Variable	Type	Units	Description
kPuzzleTimeout_sec			

Behavior.ReactToCliff console variables

Variable	Type	Units	Description
kMaxNumRobotStopsBeforeGivingUp			

Behavior.ReactToHand console variables

Variable	Type	Units	Description
kHandReaction_DriveForwardSpeed_mmmps			

Behavior.ReactToPalmEdge console variables

Variable	Type	Units	Description
kMaxNumInitialReactAttemptsBeforeGivingUp			

Behavior.TakeAPhoto console variables

Variable	Type	Units	Description
kHeadAngleDeg			

Console console variables

Variable	Type	Units	Description
kSaveModifiedConsoleVarsOnly			

CpuProfiler console variables

Variable	Type	Units	Description
kMessageProfilerDuration			
maxProcessingTimePerDrop_ms			

CubeLightDesign console variables

Variable	Type	Units	Description
kLED1_s1_red			

CubeSpinner console variables

Variable	Type	Units	Description
kAdjustHeightOfSpinnerLift			
kDedupTimeAfterLock_ms			
kIReallyReallyWantToBreakCubeSpinner			

Dev console variables

Variable	Type	Units	Description
kForceDisableAnkiDevFeatures			

DevBaseBehavior console variables

Variable	Type	Units	Description
kDevDispatchAfterShake			

DevSquawkBoxBehavior console variables

Variable	Type	Units	Description
kLiftMovementDuration_s			

DevViewLights console variables

Variable	Type	Units	Description
kCubeTriggerIdx			

DockingMethod(B:0 T:1 H:2) console variables

Variable	Type	Units	Description
kDefaultDockingMethod			

DockingTest console variables

Variable	Type	Units	Description
kMaxNumAttempts			

DriveToActions console variables

Variable	Type	Units	Description
kEnablePredockDistanceCheckFix			

Face.KeepAlive console variables

Variable	Type	Units	Description
kKeepAliveBlink_SpacingMaxTime_ms			
kKeepAliveBlink_SpacingMinTime_ms			
kKeepAliveEyeDart_DownMinScale			
kKeepAliveEyeDart_HotSpotPositionMultiplier			
kKeepAliveEyeDart_LongDistanceThresh_pix			
kKeepAliveEyeDart_LongShiftFraction1			
kKeepAliveEyeDart_LongShiftFraction2			
kKeepAliveEyeDart_LongSquashFraction1			
kKeepAliveEyeDart_LongSquashFraction2			
kKeepAliveEyeDart_MaxDistFromCenter_pix			
kKeepAliveEyeDart_MaxDistFromCenterFocused_pix			
kKeepAliveEyeDart_MediumDistanceThresh_pix			
kKeepAliveEyeDart_MediumShiftFraction			
kKeepAliveEyeDart_MediumSquashFraction			
kKeepAliveEyeDart_OuterEyeScaleIncrease			
kKeepAliveEyeDart_ShiftLagFraction			
kKeepAliveEyeDart_SpacingMaxTime_ms			
kKeepAliveEyeDart_SpacingMinTime_ms			
kKeepAliveEyeDart_UpMaxScale			
kMaxBlinkSpacingTimeForScreenProtection_ms			

Habitat console variables

Variable	Type	Units	Description
kDevForceBeginConfirmHabitat			

TrackingActions console variables

Variable	Type	Units	Description
kOverride_PanDuration_s			

Face.ParameterizedFace console variables**WallTime console variables**

Variable	Type	Units	Description
kProcFace_AntiAliasingFilter			
kProcFace_AntiAliasingSigmaFraction			
kProcFace_AntiAliasingSize			
kProcFace_Display			
kProcFace_EllipseDelta			
kProcFace_EnableAntiAliasing			
kProcFace_EyeLightnessMultiplier			
kProcFace_Gamma			
kProcFace_GammaType			
kProcFace_HotspotFalloff			
kProcFace_HotspotRender			
kProcFace_InterpolationType			
kProcFace_LineType			
kProcFace_NoiseMaxLightness			
kProcFace_NoiseMinLightness			
kProcFace_NoiseNumFrames			
kProcFace_NominalEyeSpacing			
ProcFace_OverrideEyeParams			
ProcFace_OverrideRightEyeParams			
ProcFace_FromLinear			
ProcFace_ToLinear			
ProcFace_DefaultScanlineOpacity			
ProcFace_NominalEyeSpacing			
ProcFace_NoiseFraction			
ProcFace_UseAntiAliasedLines			
ProcFace_GlowRender			
ProcFace_GlowSizeMultiplier			
ProcFace_GlowLightnessMultiplier			
ProcFace_GlowGaussianFilter			
ProcFace_AntiAliasingGaussianFilter			

Face.ScanlineDistortion console variables

Variable	Type	Units	Description
kProcFaceScanline_MaxShiftNoise			
kProcFaceScanline_OffNoiseMaxWidth			
kProcFaceScanline_OffNoiseProb			

FaceInfoScreenManager console variables

Variable	Type	Units	Description
kAlexaNotificationTimeout_s			
kButtonPressDurationForShutdown_ms			
kFakeButtonPressType			
kToggleMuteTimeout_s			

GlitchLights console variables

Variable	Type	Units	Description
kGlitchLightDelay_ms			
kGlitchLightDuration_ms			

HeldInPalm.Coordinator console variables

Variable	Type	Units	Description
kMaxTimeForInitialHeldInPalmReaction_ms			

kWebvizUpdatePeriod console variables

Variable	Type	Units	Description
kWebvizUpdatePeriod			

LiftLoadTest console variables

Variable	Type	Units	Description
kNumLiftRaises			

ManualAnimationPlayback console variables

Variable	Type	Units	Description
kShouldDisplayKeyframeNumber			
kNumberOfFramesToIncrement			

MicData console variables

Variable	Type	Units	Description
kBeatDetectorUseProcessedAudio			
kDevForceProcessState			
kMicData_ClipRecordTime_ms			
kMicData_CollectRawTriggers			
kMicData_ForceDisableMicDataProc			
kMicData_ForceEnableMicDataProc			
kMicData_QuietTimeCooldown_ms			
kMicData_SaveRawFullIntent			
kMicData_SaveRawFullIntent_WakeWordless			
kMicData_SpeakerNoiseDisablesMics			
kSaveNotches			

Network console variables

Variable	Type	Units	Description
kEnableVerboseNetworkLogging			
kMaxPingTimesToTrackOverride			
kPrintNetworkStats			
kPrintNetworkStatsTimeSpacingMS			

Network.Emulator console variables

Variable	Type	Units	Description
gUDPMaxLatency			
gUDPMinLatency			
gUDPNetEmulatorEnabled			
gUDPNetEmulatorRuntimeToggling			
gUDPRandomPacketLossPercentage			

NetworkStats console variables

Variable	Type	Units	Description
kLogMessageLatencyOnce			
gNetStat1NumConnections			
gNetStat2LatencyAvg			
gNetStat3LatencySD			
gNetStat4LatencyMin			
gNetStat5LatencyMax			
gNetStat6PingArrivedPC			
gNetStat7ExtQueuedAvg_ms			
gNetStat8ExtQueuedMin_ms			
gNetStat9ExtQueuedMax_ms			
gNetStatAQueuedAvg_ms			
gNetStatBQueuedMin_ms			
gNetStatCQueuedMax_ms			
kNetConnStatsUpdate			

OSState.DiskInfo console variables

Variable	Type	Units	Description
kHighDiskPressureMultiple			
kMediumDiskPressureMultiple			

OSState.MemoryInfo console variables

Variable	Type	Units	Description
kHighMemPressureMultiple			
kMediumMemPressureMultiple			

OSState.Temperature console variables

Variable	Type	Units	Description
kFakeCpuTemperature_degC			
kSendFakeCpuTemperature			

OSState.Timezone console variables

Variable	Type	Units	Description
kOSState_FakeNoTime			
kOSState_FakeNoTimezone			

OSState.WifiInfo console variables

Variable	Type	Units	Description
kHighWifiErrorRate			
kMediumWifiErrorRate			

SpeechRecognizer console variables

Variable	Type	Units	Description
kSuppressTriggerResponse			

SpeechRecognizer.Alexa console variables

Variable	Type	Units	Description
kAlexaRecognizerModel			
kDefaultDetectThreshold			
kForceRunNotchDetector			
kSaveRawMicInput			

SpeechRecognizer.AlexPlayback console variables

Variable	Type	Units	Description
kAlexaPlaybackRecognizerModel			
kPlaybackRecognizerSampleCountThreshold			

SpeechRecognizer.Vector console variables

Variable	Type	Units	Description
kVectorRecognizerModel			
kVectorRecognizerModelSensitivity			

StayOnCargerUntilCharged console variables

Variable	Type	Units	Description
kSafeguardTimeout_s			

TextToSpeech console variables

Variable	Type	Units	Description
kEnablePausePrams			
kLeadingSilence_ms			
kMinPlayableFrames			
kPauseBracket_ms			
kPauseComma_ms			
kPausePunctuation_ms			
kPauseSemicolon_ms			
kPauseSpelling_ms			
kTrailingSilence_ms			
kVoicePitch			
kVoiceShaping			
kVoiceSpeed			
kWriteTTSFile			

Vision.GazeDirection console variables

Variable	Type	Units	Description
kFaceDirectedAtRobotMinXThres_mm			

VoiceMessage console variables

Variable	Type	Units	Description
kRequireKnownUser			

WallTime console variables

Variable	Type	Units	Description
kFakeWallTimeIsSynced			

Not Yet Classified

Variable	Type	Units	Description

9.6 URLs listed in the code

There are a bunch of URLs in Anki binary files... these may be part of schemas, random comments, etc.

9.6.1 Servers

- <http://s3.amazonaws.com/doc/2006-03-01/>
- <https://developer.amazon.com/docs/alexa-voice-service/settings.html#settingsupdated> The listed documentation for Alexa services
- anki.com/v github.com/anki/sai-token-service/proto/tokenpb
- support.anki.com

9.6.2 Github repos

- github.com/anki/sai-chipper-voice/client/chipper
- github.com/anki/sai-chipper-voice/proto/anki/chipperpb
- github.com/anki/opus-go/libopus
- github.com/anki/opus-go/ogg
- github.com/aws/aws-sdk-go/private/protocol/query
- github.com/aws/aws-sdk-go/private/protocol/query
- github.com/aws/aws-sdk-go/aws/credentials/ec2rolecreds
- github.com/aws/aws-sdk-go/private/protocol/eventstream
- github.com/aws/aws-sdk-go/private/protocol/xml/xmlutil
- github.com/aws/aws-sdk-go/vendor/github.com/go-ini/ini
- github.com/aws/aws-sdk-go/aws/credentials/ec2rolecreds
- github.com/aws/aws-sdk-go/private/protocol/eventstream
- github.com/aws/aws-sdk-go/private/protocol/xml/xmlutil
- github.com/aws/aws-sdk-go/vendor/github.com/go-ini/ini
- github.com/aws/aws-sdk-go/private/protocol/query/queryutil
- github.com/aws/aws-sdk-go/vendor/github.com/jmespath/go-jmespath
- github.com/grd/ogg
- github.com/google/uuid
- github.com/cenkalti/backoff
- github.com/dgrijalva/jwt-go
- github.com/gwatts/rootcerts
- github.com/aws/aws-sdk-go/aws
- github.com/golang/protobuf/proto
- github.com/aws/aws-sdk-go/aws/csm

- github.com/golang/protobuf/ptypes

9.6.3 Other

- google.golang.org/genproto/googleapis/rpc/status
- <http://logo.verisign.com/vslogo.gif>
- google.golang.org/grpc/peer
- google.golang.org/grpc/status
- google.golang.org/grpc/balancer
- google.golang.org/grpc/encoding
- google.golang.org/grpc/metadata
- google.golang.org/grpc/resolver
- google.golang.org/grpc/keepalive
- google.golang.org/grpc/transport
- google.golang.org/genproto/googleapis/rpc/status

9.6.4 Some built in certificates?

- <http://www.certplus.com/CRL/class2.crl>
- <http://fedir.comsign.co.il/crl/ComSignCA.crl>
- <http://crl.securetrust.com/STCA.crl>
- <http://crl.netsolssl.com/NetworkSolutionsCertificateAuthority.crl>
- <http://www.trustdst.com/certificates/policy/ACES-index.html>
- <http://crl.comodoca.com/COMODOCertificationAuthority.crl>
- <http://crl.xrampsecurity.com/XGCA.crl>
- www.xrampsecurity.com
- <http://crl.comodoca.com/AAACertificateServices.crl>
- <http://crl.comodo.net/AAACertificateServices.crl>
- <http://www.usertrust.com>
- <http://crl.usertrust.com/UTN-USERFirst-ClientAuthenticationandEmail.crl>
- <http://logo.verisign.com/vslogo.gif>
- <http://www.chambersign.org>
- <http://repository.swissign.com/>
- <https://ocsp.quovadisoffshore.com>
- <http://www.quovadis.bm>
- <http://www.firmaprofesional.com/cps>
- <http://www.certicamara.com/dpc/0Z>
- <http://www.quovadisglobal.com/cps>
- <http://www.startssl.com/policy.pdf>

- <http://www.startssl.com/intermediate.pdf>

9.7 Channels

I'm not sure what these are. They may be part of the logging of information and routing it internally and to a log file.

This note is to help gather a description of each of the channels. This format lets us gather information on them, and help understand where they fit in.

Channel	Description
Actions	
AIWhiteboard	
Alexa	
Audio	
Behaviors	
BlockPool	
BlockWorld	
CpuProfiler	
FaceRecognizer	
FaceWorld	
JdocsManager	the cloud storage?
Keyboard	
MessageProfiler	
Microphones	
NeuralNets	
PerfMetric	
PoseConfirmr	
SpeechRecognizer	
VisionComponent	
VisionSystem	

9.8 Software Classes

Vector's software has a lot of modules -- I'm assuming these are C++ classes. They are not all annotated or understood. Here are some that we've spotted:

Module	Description
AIComponent	
AIWhiteboard	
AccountSettingsManager	
ActionList	
ActionQueue	
Actions	
ActiveFeatureComponent	
AddActiveObject	
AdvertisementService	
AkAlsaSink	
Alexa	
AlexaAudioInput	
AlexaClient	
AlexaComponent	
AlexaImpl	
AlexaMediaPlayer	
AlexaObserver	
AlexaPlaybackRecognizerComponent	
AlignWithObjectAction	
AnimComms	
AnimContext	
AnimEngine	
AnimProcessMessages	
Animation	
AnimationAudioClient	
AnimationComponent	
AnimationGroup	
AnimationGroupContainer	
AnimationGroupEntry	
AnimationStreamer	
Animations	
AnkiLab	
AppCubeConnectionSubscriber	
Array2d	
AttentionTransferComponent	

Module	Description
AudienceTags	
Audio	
AudioBehaviorStackListener	
AudioEngineController	
AudioEventGroupRef	
AudioMultipleFileLocation	
AudioMultiplexer	
AudioMuxClient	
AudioScene	
AudioSceneEvent	
AudioSceneParameter	
AudioSceneStateGroup	
AudioWaveFileReader	
BEIConditionFactory	
BEIConditionMessageHelper	
BackpackLightAnimationContainer	
BackpackLightComponent	
BackpackLightsKeyFrame	
BackupOntoChargerAction	
Battery	
BatteryComponent	
BeatDetector	
BeatDetectorComponent	
Behavior	
BehaviorAcknowledgeFace	
BehaviorAcknowledgeObject	
BehaviorAlexa	
BehaviorAnimSequenceWithObject	
BehaviorAskForHelp	
BehaviorBlackJack	
BehaviorBumpObject	
BehaviorClearChargerArea	
BehaviorComponent	
BehaviorConfirmObject	
BehaviorConnectToCube	

Module	Description
BehaviorCoordinateInHabitat	
BehaviorCoordinateWeather	
BehaviorCountingAnimation	
BehaviorDanceToTheBeat	
BehaviorDanceToTheBeatCoordinator	
BehaviorDevCubeSpinnerConsole	
BehaviorDevSquawkBoxTest	
BehaviorDevTurnInPlaceTest	
BehaviorDispatchAfterShake	
BehaviorDispatcherPassThrough	
BehaviorDispatcherQueue	
BehaviorDispatcherRandom	
BehaviorDispatcherStrictPriorityWithCooldown	
BehaviorDisplayWallTime	
BehaviorDisplayWeather	
BehaviorDockingTest	
BehaviorDockingTestSimple	
BehaviorDriveOffCharger	
BehaviorEnrollFace	
BehaviorExploring	
BehaviorExploringExamineObstacle	
BehaviorEyeColorVoiceCommand	
BehaviorFactoryCentroidExtractor	
BehaviorFetchCube	
BehaviorFindCube	
BehaviorFindFaceAndThen	
BehaviorFindHome	
BehaviorFistBump	
BehaviorGoHome	
BehaviorGreetAfterLongTime	
BehaviorHowOldAreYou	
BehaviorInspectCube	
BehaviorInteractWithFaces	
BehaviorKeepaway	
BehaviorKnowledgeGraphQuestionc	

Module	Description
BehaviorLiftLoadTest	
BehaviorLookForFaceAndCube	
BehaviorObservingLookAtFaces	
BehaviorObservingWithoutTurn	
BehaviorOnboardingCoordinator	
BehaviorPRDemo	
BehaviorPlaceCubeByCharger	
BehaviorPlaypenCameraCalibration	
BehaviorPlaypenDistanceSensor	
BehaviorPlaypenDriftCheck	
BehaviorPlaypenEndChecks	
BehaviorPlaypenPickupCube	
BehaviorPlaypenTest	
BehaviorPopAWheelie	
BehaviorPounceOnMotion	
BehaviorPoweringRobotOff	
BehaviorPromptUserForVoiceCommand	
BehaviorPuzzleMaze	
BehaviorQuietModeCoordinator	
BehaviorReactToBody	
BehaviorReactToCliff	
BehaviorReactToCubeTap	
BehaviorReactToDarkness	
BehaviorReactToHand	
BehaviorReactToMicDirection	
BehaviorReactToMotion	
BehaviorReactToMotorCalibration	
BehaviorReactToPlacedOnSlope	
BehaviorReactToRobotOnBack	
BehaviorReactToRobotOnFace	
BehaviorReactToTouchPetting	
BehaviorReactToUncalibratedHeadAndLift	
BehaviorReactToUnexpectedMovement	
BehaviorReactToVoiceCommand	
BehaviorRequestToGoHome	

Module	Description
BehaviorResetState	
BehaviorRespondToRenameFace	
BehaviorRobustChargerObservation	
BehaviorSDKInterface	
BehaviorSDKLock	
BehaviorSayName	
BehaviorSelfTest	
BehaviorSelfTestDockWithCharger	
BehaviorSelfTestDriftCheck	
BehaviorSelfTestLookAtCharger	
BehaviorSleepCycle	
BehaviorSystem	
BehaviorSystemManager	
BehaviorTakeAPhotoCoordinator	
BehaviorTextToSpeechLoop	
BehaviorTrackCube	
BehaviorTrackFace	
BehaviorUserDefinedBehaviorTreeRouter	
BehaviorUserDefinedBehaviorTreeSelector	
BehaviorVolume	
Behaviors	
BehaviorsBootLoader	
BlackJackGame	
BlackJackSimulation	
BlackJackVisualizer	
Block	
BlockPool	
BlockTapFilterComponent	
BlockWorld	
BodyMotionKeyFrame	
CalculateExperimentHashBucket	
Camera	
CameraCalibrator	
CameraParamsController	
CannedAnimationContainer	

Module	Description
CannedAnimationLoader	
CardSimulation	
CarryingComponent	
ChannelFilter	
CladEnumToStringMap	
CliffAlignToWhiteAction	
CliffSensor	
CliffSensorComponent	
ColorRGBA	
CompositeImage	
CompositeImageLayer	
CompoundActionParallel	
CompoundActionSequential	
ComputePlacementApproachAngle	
ComputePreActionPoseDistThreshold	
ConditionCompound	
ConditionEngineErrorCodeReceived	
ConditionIlluminationDetected	
ConditionMotionDetected	
ConfirmHabitat	
ConnectionFlow	
Console	
ConsoleSystem	
Context	
ContinuityComponent	
CoreTech	
CozmoAPI	
CozmoAnimMain	
CozmoAudioController	
CozmoEngine	
CozmoGameImpl	
CropScheduler	
CubeAccelComponent	
CubeBatteryComponent	
CubeComms	

Module	Description
CubeCommsComponent	
CubeConnectionCoordinator	
CubeInteractionTracker	
CubeLightAnimationContainer	
CubeLightAnimationHelpers	
CubeLightComponent	
CubeLightController	
CubeSpinnerGame	
CustomObject	
DTRawPixelsClassifier	
DanceAnimMetadata	
DancePhrase	
DanceSession	
DasToSdkHandler	
DasToSdkManager	
DataPlatform	
Demo	
DevEventSequenceCapture	
DoleAvailableAnimations	
DriveAndFlipBlockAction	
DriveStraightAction	
DriveToActions	
DriveToFlipBlockPoseAction	
DriveToObjectAction	
DriveToPlaceCarriedObjectAction	
DriveToPlaceRelObjectAction	
DriveToPoseAction	
DrivingAnimationHandler	
EmotionAffector	
EmotionEvent	
EmotionEventMapper	
EmotionScorer	
EngineRobotAudioClient	
EngineRobotAudioInput	
EnrolledFaceEntry	

Module	Description
EraseAllFaces	
Error	
EventKeyFrame	
Expected	
Experiment	
FaceDisplay	
FaceInfoScreenManager	
FaceLayerManager	
FacePlantAction	
FaceRecognizer	
FaceTrackerImpl	
FaceWorld	
Factory	
FactoryTestLogger	
FeatureGate	
FileTransfer	
FindFaces	
FlipBlockAction	
FormatBytesAsHex	
GMMRawPixelsClassifier	
GetAnimationName	
GetBroadcastAddressFromIfAddr	
GetIPv6LinkLocalAddress	
GetLocalIpAddress	
GetLocalIpAddressFromIfAddr	
GetLocallpv6LinkLocalAddress	
GetMaxOffsetObjectStillVisible	
GetNextAlbumEntryToUse	
GetNextPacketFromEngine	
GetNextPacketFromRobot	
GetRecognitionData	
GetSerializedAlbum	
GoogleBreakpad	
GraphEvaluator2d	
GroundPlaneClassifier	

Module	Description
HabitatDetectorComponent	
HandleAnimationEvent	
HandleMotorAutoEnabled	
HandleMotorCalibration	
HashStringTable	
HeldInPalmTracker	
HueSatWrapper	
IAction	
IActionRunner	
IBEICondition	
IBehavior	
IBehaviorPlaypen	
IBehaviorSelfTest	
ICompoundAction	
IConditionUserIntent	
ICozmoBehavior	
IDockAction	
IDriveToInteractWithObject	
IFormattedLoggerProvider	
IKeyFrame	
INeuralNetMain	
INeuralNetModel	
IPathPlanner	
IPv6	
IScoredBehavior	
ISensorComponent	
ITrackAction	
ITrackLayerManager	
IVisuallyVerifyAction	
Id	
IdCount	
Image	
ImageBase	
ImageBrightnessHistogram	
ImageCache	

Module	Description
ImageSaver	
ImageSensor	
ImuComponent	
InternalStatesBehavior	
Interruption	
IsCloseEnoughToPreActionPose	
IsExternalSdkConnection	
JdocsManager	
JsonTools	
KnowledgeGraph	
KnownMarker	
LOG	
LaserPointDetector	
LinearClassifier	
LocalUdpSocketComms	
Locale	
LocaleComponent	
Location	
Looking	
LoopBoundOverflow	
MapComponent	
Marker	
MarkerDetector	
Mask	
MenuConsoleChannel	
Message	
MicComponent	
MicDataInfo	
MicDataProcessor	
MicDataSystem	
MicDirectionHistory	
MicTriggerConfig	
Microphones	
MinimalAnglePlanner	
Mood	

Module	Description
MoodDecayEvaluator	
MoodManager	
MoodScorer	
MountChargerAction	
MoveHeadToAngleAction	
MoveLiftToAngleAction	
MoveLiftToHeightAction	
Movement	
MovementComponent	
MultiClientComms	
MusicConductor	
NVStorage	
NVStorageComponent	
NamedColors	
NativeAnkiUtilConsoleCallFunction	
NativeAnkiUtilConsoleIsDefaultValue	
NativeAnkiUtilConsoleResetValueToDefault	
NativeAnkiUtilConsoleSetValueWithString	
NativeAnkiUtilConsoleToggleValue	
NetEmulatorUDPSocket	
Network	
NeuralNetModel	
NeuralNetParams	
NeuralNetRunner	
NeuralNets	
ObjectInteractionInfoCache	
ObservableObject	
ObservableObjectLibrary	
ObservableObjectsLibrary	
OffboardModel	
OverheadMap	
PackMaskedId	
PackMaskedIds	
PanAndTiltAction	
ParamTraits	

Module	Description
PathComponent	
PathDolerOuter	
PerfMetric	
PetTracker	
PhotographyManager	
PickupObjectAction	
PlaceObjectOnGroundAction	
PlaceRelObjectAction	
Planner	
PlayAnimationAction	
PopAWheelieAction	
Pose3d	
PoseBase	
PowerStateManager	
PowerStates	
PreActionPose	
ProceduralFace	
ProcessRegistrationMsg	
ProxSensorComponent	
PublicStateBroadcast	
PublicStateBroadcaster	
Puzzle	
QuadTree	
QuadTreeNode	
QuestEngine	
Ran	
RandomGenerator	
RandomVectorSampler	
ReactionStrategyFacePositionUpdate	
ReadBMP	
RecentOccurrenceTracker	
RecognizeFace	
Rectangle	
RegisterNewUser	
RejectIfChargerOutOfView	

Module	Description
RejectIfWouldCrossCliff	
ReliableConnection	
ReliableTransport	
RemoveUser	
RequestAvailableAnimations	
ReselectingLoopAnimationAction	
RetryWrapperAction	
Robot	
RobotActionParams	
RobotAudioKeyFrame	
RobotConnectionManager	
RobotDataLoader	
RobotEventHandler	
RobotHealthReporter	
RobotImplMessaging	
RobotInitialConnection	
RobotManager	
RobotState	
RobotStateHistory	
RobotStats	
RobotStatsTracker	
RollObjectAction	
RollingShutterCorrector	
RotationMatrixBase	
RotationVector3d	
SDKComponent	
SayNameProbabilityTable	
SayTextAction	
SdkAudioComponent	
SdkComponent	
SdkLock	
SendPacketToRobot	
SetSerializedAlbum	
SetSockOpt	
SetThreadPriority	

Module	Description
Setting	
SettingsCommManager	
SettingsManager	
ShowAudioStreamStateManager	
Shutting	
SimpleMoodScorer	
Sleep Tracker	
SoundbankBundleInfo	
SoundbankLoader	
SpeechRecognizer	
SpeechRecognizerPryonLite	
SpeechRecognizerSystem	
SpeechRecognizerTHF	
SpeedChooser	
SpriteCache	
SpriteEntry	
SpritePathMap	
SpriteSequence	
SpriteSequenceContainer	
SpriteSequenceKeyFrame	
SpriteSequenceLoader	
SpriteWrapper	
StandardWaveDataContainer	
Starting	
StaticMoodData	
Stopping	
StreamingAnimationModifier	
StreamingWaveDataInstance	
TFLiteLogReporter	
TFLiteModel	
TId	
TextToSpeech	
TextToSpeechComponent	
TextToSpeechCoordinator	
TextToSpeechProvider	

Module	Description
TextToSpeechProviderImpl	
TimerUtility	
TouchBaselineCalibrator	
TouchSensor	
TouchSensorComponent	
Track	
TrackFaceAction	
TrackGroundPointAction	
TrackLayerManager	
TrackObjectAction	
TrackPetFaceAction	
TrackpetFaceAction	
TransportAddress	
TriggerAnimationAction	
TriggerEmotionEvent	
TurnInPlaceAction	
TurnTowardsFaceAction	
TurnTowardsObjectAction	
TurnTowardsPoseAction	
UDPTransport	
UdpSocketComms	
UiComms	
UiMessageHandler	
Undistorter	
Unfiltered	
UnpackMaskedIds	
Update	
UpdateExistingAlbumEntry	
UpdateRecognitionData	
UseLoadedAlbumAndEnrollData	
UseLoadedAlbumAndEnrollmentData	
User	
UserDefinedBehaviorTreeComponent	
UserEntitlementsManager	
UserIntentComponent	

Module	Description
UserIntentMap	
Util	
VariableSnapshotComponent	
VerifyDecayGraph	
VisionComponent	
VisionModeSchedule	
VisionProcessingResult	
VisionScheduleMediator	
VisionSystem	
VisuallyVerifyObjectAction	
VizManager	
VoiceMessage	
VoiceMessageSystem	
WeatherIntentParser	
WwiseComponent	
XYPlanner	

9.9 Communication trouble behaviors

Summary: These behaviors play animations when there is communication problems. (These are self-maintenance behaviors)

These behaviors are not called by a behavior tree configuration file. Instead they are invoked by the internal behavior implementation, in the *BehaviorReactToVoiceCommand* class.

9.9.1 No Wifi behavior

The *NoWifi* (class *DispatcherQueue*) behavior is used to animate Vector's face when he is unable to connect to a WiFi SSID.

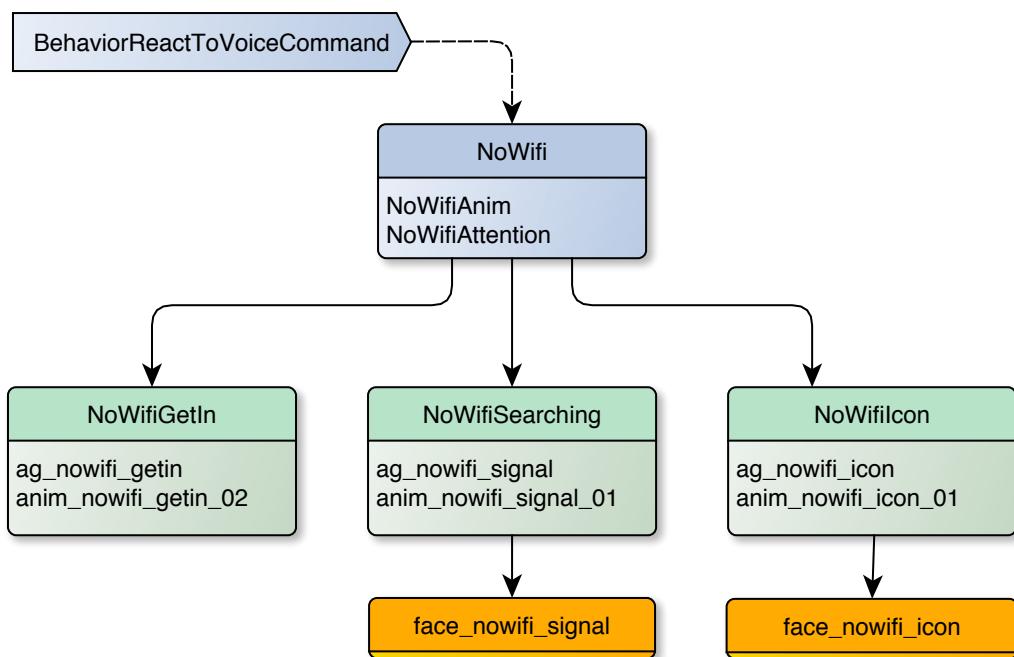


Figure: The No Wifi behavior tree

The behavior file is located at:

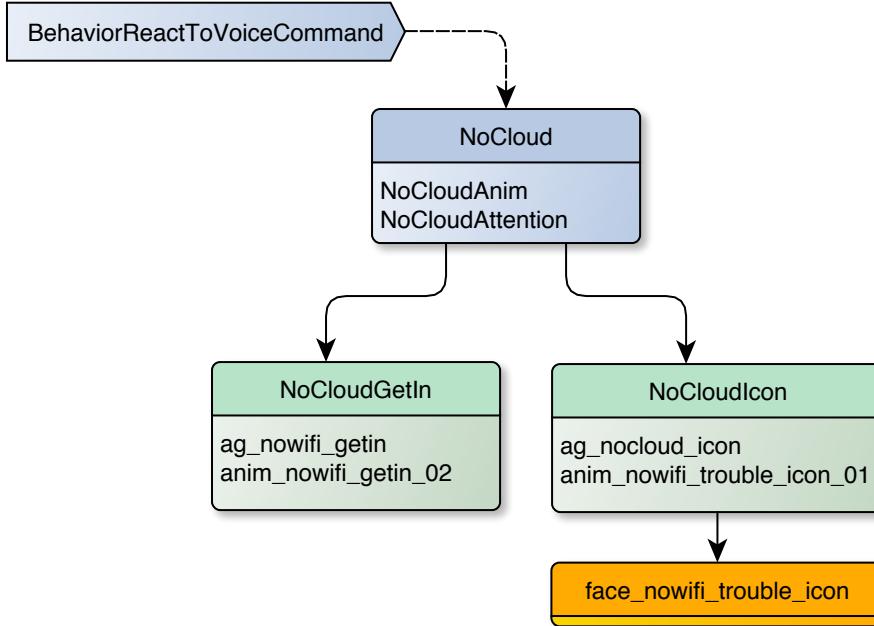
```
behaviors/victorBehaviorTree/noWifi.json
```

The behavior will play three animations:

1. The *NoWifiGetIn* animation when the behavior starts
2. The *NoWifiSearching* animation while Vector is looking for a WiFi SSID; This will play the *face_nowifi_signal** sprite sequence.
3. The *NoWifiIcon* animation when the above animation completes This will play the *face_nowifi_icon* sprite sequence.
4. Then the loop will repeat from step 2.

9.9.2 No Cloud behavior

The *NoCloud* (class *DispatcherQueue*) behavior is used to animate Vector's face when he is able to connect to a WiFi SSID, but unable to connect to the remote server.

*Figure: The No Cloud behavior tree*

The behavior file is located at:

```
behaviors/victorBehaviorTree/noCloud.json
```

The *NoCloudAnim* behavior is used to animate the face. The behavior will play two animations:

1. The *NoCloudGetIn* animation when the behavior starts. Note that this is same as the *NoWifiGetIn* animation group.
2. The *NoCloudIcon* animation will loop thereafter. This will play the *face_nowifi_trouble_icon* sprite sequence.

The *NoCloudAttention* is used to transfer attention back(?) to the previous task.

9.9.3 Other variations

Curiously there is another animation -- the *anim_cloud_icon* animation -- this not used. It is not part of an animation group, but probably was part of the *NoCloudIcon* animation group. It uses a *face_nocloud_icon* sprite animation.

9.9.4 Change history synopsis

Date	Change
2020-12-2	Created

9.10 Source Files referenced in the binaries

The following source code files were referenced in the binaries:

File
../../../../animProcess/src/cozmoAnim/alexa/alexa.cpp
../../../../animProcess/src/cozmoAnim/alexa/alexaClient.cpp
../../../../animProcess/src/cozmoAnim/alexa/alexImpl.cpp
../../../../animProcess/src/cozmoAnim/alexa/media/alexaMediaPlayer.cpp
../../../../animProcess/src/cozmoAnim/animation/animationStreamer.cpp
../../../../animProcess/src/cozmoAnim/audio/sdkAudioComponent.cpp
../../../../animProcess/src/cozmoAnim/faceDisplay/faceInfoScreenManager.cpp
../../../../animProcess/src/cozmoAnim/micData/micDataSystem.cpp
../../../../animProcess/src/cozmoAnim/micData/micImmediateDirection.cpp
../../../../animProcess/src/cozmoAnim/showAudioStreamStateManager.cpp
../../../../animProcess/src/cozmoAnim/speechRecognizer/speechRecognizerTHFSimple.cpp
../../../../cannedAnimLib/baseTypes/keyframe.cpp
../../../../cannedAnimLib/baseTypes/track.h
../../../../cannedAnimLib/spriteSequences/spriteSequenceLoader.cpp
../../../../coretech/common/engine/math/pose.cpp
../../../../coretech/common/engine/math/poseBase_impl.h
../../../../coretech/common/engine/math/poseOriginList.cpp
../../../../coretech/common/engine/math/poseTreeNode.h
../../../../coretech/common/engine/utils/recentOccurrenceTracker.cpp
../../../../coretech/common/robot/array2d.h
../../../../coretech/common/robot/arrayPatterns.h
../../../../coretech/common/robot/arraySlices.h
../../../../coretech/common/robot/interpolate.h
../../../../coretech/common/robot/matrix.h
../../../../coretech/common/robot/memory.cpp
../../../../coretech/common/robot/sequences.h
../../../../coretech/common/robot/serialize.h
../../../../coretech/vision/engine/camera.cpp
../../../../coretech/vision/engine/enrolledFaceEntry.cpp
../../../../coretech/vision/engine/faceRecognizer_okane.cpp
../../../../coretech/vision/engine/faceTrackerImpl_okane.cpp
../../../../coretech/vision/engine/imageBuffer/imageBuffer.cpp
../../../../coretech/vision/engine/imageCompositor.cpp
../../../../coretech/vision/engine/markerDetector.cpp
../../../../coretech/vision/engine/undistorter.cpp

File
<code>../../../../coretech/vision/robot/computeCharacteristicScale.cpp</code>
<code>../../../../coretech/vision/robot/computeCharacteristicScale_binomial.cpp</code>
<code>../../../../coretech/vision/robot/computeQuadrilaterals.cpp</code>
<code>../../../../coretech/vision/robot/connectedComponents.h</code>
<code>../../../../coretech/vision/robot/detectFiducialMarkers.cpp</code>
<code>../../../../coretech/vision/robot/fiducialMarkers.cpp</code>
<code>../../../../coretech/vision/robot/filtering.cpp</code>
<code>../../../../coretech/vision/robot/histogram.cpp</code>
<code>../../../../coretech/vision/robot/imageProcessing.h</code>
<code>../../../../coretech/vision/robot/integralImage.cpp</code>
<code>../../../../coretech/vision/robot/laplacianPeaks.cpp</code>
<code>../../../../coretech/vision/robot/nearestNeighborLibrary.cpp</code>
<code>../../../../coretech/vision/robot/quadRefinement.cpp</code>
<code>../../../../coretech/vision/robot/traceBoundary.cpp</code>
<code>../../../../coretech/vision/robot/transformations.cpp</code>
<code>../../../../coretech/vision/shared/compositeImage/compositeImage.cpp</code>
<code>../../../../coretech/vision/shared/compositeImage/compositeImageBuilder.cpp</code>
<code>../../../../coretech/vision/shared/compositeImage/compositeImageLayer.cpp</code>
<code>../../../../coretech/vision/shared/hueSatWrapper.cpp</code>
<code>../../../../coretech/vision/shared/spriteCache/spriteWrapper.cpp</code>
<code>../../../../coretech/vision/shared/spritePathMap.cpp</code>
<code>../../../../coretech/vision/shared/spriteSequence/spriteSequence.cpp</code>
<code>../../../../cubeBleClient/cubeBleClient.cpp</code>
<code>../../../../engine/actions/actionContainers.cpp</code>
<code>../../../../engine/actions/basicActions.cpp</code>
<code>../../../../engine/actions/dockActions.cpp</code>
<code>../../../../engine/actions/trackGroundPointAction.cpp</code>
<code>../../../../engine/aiComponent/aiWhiteboard.cpp</code>
<code>../../../../engine/aiComponent/alexaComponent.cpp</code>
<code>../../../../engine/aiComponent/behaviorComponent/activeBehaviorIterator.cpp</code>
<code>../../../../engine/aiComponent/behaviorComponent/asyncMessageGateComponent.cpp</code>
<code>../../../../engine/aiComponent/behaviorComponent/behaviorComponentMessageHandler.cpp</code>
<code>../../../../engine/aiComponent/behaviorComponent/behaviorContainer.h</code>
<code>../../../../engine/aiComponent/behaviorComponent/behaviorExternalInterface/behaviorEventComponent.cpp</code>
<code>../../../../engine/aiComponent/behaviorComponent/behaviorExternalInterface/behaviorExternalInterface.cpp</code>

File
../../../../engine/aiComponent/behaviorComponent/behaviorStack.cpp
../../../../engine/aiComponent/behaviorComponent/behaviorSystemManager.cpp
../../../../engine/aiComponent/behaviorComponent/behaviorTimers.cpp
../../../../engine/aiComponent/behaviorComponent/behaviorTypesWrapper.cpp
../../../../engine/aiComponent/behaviorComponent/behaviors/alexa/behaviorAlexa.cpp
../../../../engine/aiComponent/behaviorComponent/behaviors/animationWrappers/behaviorAnimGetInLoop.cpp
../../../../engine/aiComponent/behaviorComponent/behaviors/animationWrappers/behaviorAnimSequence.cpp
../../../../engine/aiComponent/behaviorComponent/behaviors/animationWrappers/behaviorAnimSequenceWithFace.cpp
../../../../engine/aiComponent/behaviorComponent/behaviors/animationWrappers/behaviorCountingAnimation.cpp
../../../../engine/aiComponent/behaviorComponent/behaviors/animationWrappers/behaviorTextToSpeechLoop.cpp
../../../../engine/aiComponent/behaviorComponent/behaviors/attentionTransfer/behaviorAttentionTransferIfNeeded.cpp
../../../../engine/aiComponent/behaviorComponent/behaviors/basicWorldInteractions/behaviorDriveOffCharger.cpp
../../../../engine/aiComponent/behaviorComponent/behaviors/basicWorldInteractions/behaviorInteractWithFaces.cpp
../../../../engine/aiComponent/behaviorComponent/behaviors/behaviorHighLevelAI.cpp
../../../../engine/aiComponent/behaviorComponent/behaviors/behaviorLookAroundInPlace.cpp
../../../../engine/aiComponent/behaviorComponent/behaviors/behaviorResetState.cpp
../../../../engine/aiComponent/behaviorComponent/behaviors/behaviorStayOnChargerUntilCharged.cpp
../../../../engine/aiComponent/behaviorComponent/behaviors/blackjack/behaviorBlackJack.cpp
../../../../engine/aiComponent/behaviorComponent/behaviors/blackjack/blackJackVisualizer.cpp
../../../../engine/aiComponent/behaviorComponent/behaviors/coordinators/behaviorCoordinateWhileHeldInPalm.cpp
../../../../engine/aiComponent/behaviorComponent/behaviors/coordinators/behaviorCoordinateWhileInAir.cpp
../../../../engine/aiComponent/behaviorComponent/behaviors/coordinators/behaviorQuietModeCoordinator.cpp
../../../../engine/aiComponent/behaviorComponent/behaviors/cubeSpinner/behaviorVectorPlaysCubeSpinner.cpp
../../../../engine/aiComponent/behaviorComponent/behaviors/danceToTheBeat/behaviorDanceToTheBeat.cpp
../../../../engine/aiComponent/behaviorComponent/behaviors/devBehaviors/behaviorDevViewCubeBackpackLights.cpp
../../../../engine/aiComponent/behaviorComponent/behaviors/devBehaviors/behaviorDispatchAfterShake.cpp
../../../../engine/aiComponent/behaviorComponent/behaviors/devBehaviors/behaviorReactToBody.cpp
../../../../engine/aiComponent/behaviorComponent/behaviors/dispatch/behaviorDispatcherRerun.cpp
../../../../engine/aiComponent/behaviorComponent/behaviors/dispatch/behaviorDispatcherScoring.cpp
../../../../engine/aiComponent/behaviorComponent/behaviors/dispatch/behaviorDispatcherStrictPriorityWithCooldown.cpp
../../../../engine/aiComponent/behaviorComponent/behaviors/dispatch/iBehaviorDispatcher.cpp
../../../../engine/aiComponent/behaviorComponent/behaviors/freeplay/putDownDispatch/behaviorLookForFaceAndCube.cpp
../../../../engine/aiComponent/behaviorComponent/behaviors/freeplay/userInteractive/behaviorPuzzleMaze.cpp
../../../../engine/aiComponent/behaviorComponent/behaviors/habitat/behaviorConfirmHabitat.cpp
../../../../engine/aiComponent/behaviorComponent/behaviors/iCozmoBehavior.cpp

File
../../../../engine/aiComponent/behaviorComponent/behaviors/internalStatesBehavior.cpp
../../../../engine/aiComponent/behaviorComponent/behaviors/meetCozmo/behaviorEnrollFace.cpp
../../../../engine/aiComponent/behaviorComponent/behaviors/meetCozmo/behaviorRespondToRenameFace.cpp
../../../../engine/aiComponent/behaviorComponent/behaviors/photoTaking/behaviorAestheticallyCenterFaces.cpp
../../../../engine/aiComponent/behaviorComponent/behaviors/photoTaking/behaviorTakeAPhotoCoordinator.cpp
../../../../engine/aiComponent/behaviorComponent/behaviors/prDemo/behaviorPRDemoBase.cpp
../../../../engine/aiComponent/behaviorComponent/behaviors/reactions/behaviorCheckForAndReactToSalientPoint.cpp
../../../../engine/aiComponent/behaviorComponent/behaviors/reactions/behaviorReactToCliff.cpp
../../../../engine/aiComponent/behaviorComponent/behaviors/reactions/behaviorReactToDarkness.cpp
../../../../engine/aiComponent/behaviorComponent/behaviors/reactions/behaviorReactToMotion.cpp
../../../../engine/aiComponent/behaviorComponent/behaviors/reactions/behaviorReactToPutDown.cpp
../../../../engine/aiComponent/behaviorComponent/behaviors/reactions/behaviorReactToUnexpectedMovement.cpp
../../../../engine/aiComponent/behaviorComponent/behaviors/reactions/behaviorReactToVoiceCommand.cpp
../../../../engine/aiComponent/behaviorComponent/behaviors/robotDrivenDialog/behaviorPromptUserForVoiceCommand.cpp
../../../../engine/aiComponent/behaviorComponent/behaviors/sdkBehaviors/behaviorSDKInterface.cpp
../../../../engine/aiComponent/behaviorComponent/behaviors/simpleFaceBehaviors/behaviorDriveToFace.cpp
../../../../engine/aiComponent/behaviorComponent/behaviors/simpleFaceBehaviors/behaviorFindFaceAndThen.cpp
../../../../engine/aiComponent/behaviorComponent/behaviors/simpleFaceBehaviors/behaviorSayName.cpp
../../../../engine/aiComponent/behaviorComponent/behaviors/sleeping/behaviorSleepCycle.cpp
../../../../engine/aiComponent/behaviorComponent/behaviors/timer/behaviorProceduralClock.cpp
../../../../engine/aiComponent/behaviorComponent/behaviors/timer/behaviorTimerUtilityCoordinator.cpp
../../../../engine/aiComponent/behaviorComponent/behaviors/timer/behaviorWallTimeCoordinator.cpp
../../../../engine/aiComponent/behaviorComponent/behaviors/userDefinedBehaviorTree/behaviorUserDefinedBehaviorSelector.cpp
../../../../engine/aiComponent/behaviorComponent/behaviors/victor/behaviorReactToTouchPetting.cpp
../../../../engine/aiComponent/behaviorComponent/behaviors/victor/behaviorReactToUnclaimedIntent.cpp
../../../../engine/aiComponent/behaviorComponent/behaviors/victor/behaviorTrackFace.cpp
../../../../engine/aiComponent/behaviorComponent/behaviors/weather/behaviorCoordinateWeather.cpp
../../../../engine/aiComponent/behaviorComponent/behaviors/weather/behaviorDisplayWeather.cpp
../../../../engine/aiComponent/behaviorComponent/behaviorsBootLoader.cpp
../../../../engine/aiComponent/behaviorComponent/iBehavior.cpp
../../../../engine/aiComponent/behaviorComponent/stackMonitors/stackCycleMonitor.cpp
../../../../engine/aiComponent/behaviorComponent/userDefinedBehaviorTreeComponent/userDefinedBehaviorTreeComponent.cpp
../../../../engine/aiComponent/behaviorComponent/userIntentComponent.cpp
../../../../engine/aiComponent/behaviorComponent/userIntentMap.cpp
../../../../engine/aiComponent/behaviorComponent/weatherIntents/weatherConditionRemaps.cpp

File
<code>../../../../engine/aiComponent/beiConditions/beiConditionFactory.cpp</code>
<code>../../../../engine/aiComponent/beiConditions/conditions/conditionAnyStimuli.cpp</code>
<code>../../../../engine/aiComponent/beiConditions/conditions/conditionBatteryLevel.cpp</code>
<code>../../../../engine/aiComponent/beiConditions/conditions/condition BecameTrueThisTick.cpp</code>
<code>../../../../engine/aiComponent/beiConditions/conditions/conditionBehaviorTimer.cpp</code>
<code>../../../../engine/aiComponent/beiConditions/conditions/conditionCliffDetected.cpp</code>
<code>../../../../engine/aiComponent/beiConditions/conditions/conditionCompound.cpp</code>
<code>../../../../engine/aiComponent/beiConditions/conditions/conditionEmotion.cpp</code>
<code>../../../../engine/aiComponent/beiConditions/conditions/conditionFeatureGate.cpp</code>
<code>../../../../engine/aiComponent/beiConditions/conditions/conditionObjectKnown.cpp</code>
<code>../../../../engine/aiComponent/beiConditions/conditions/conditionOffTreadsState.cpp</code>
<code>../../../../engine/aiComponent/beiConditions/conditions/conditionProxInRange.cpp</code>
<code>../../../../engine/aiComponent/beiConditions/conditions/conditionRobotPitchInRange.cpp</code>
<code>../../../../engine/aiComponent/beiConditions/conditions/conditionRobotRollInRange.cpp</code>
<code>../../../../engine/aiComponent/beiConditions/conditions/conditionSalientPointDetected.cpp</code>
<code>../../../../engine/aiComponent/beiConditions/conditions/conditionSettingsUpdatePending.cpp</code>
<code>../../../../engine/aiComponent/beiConditions/conditions/conditionSimpleMood.cpp</code>
<code>../../../../engine/aiComponent/beiConditions/conditions/conditionTimedDedup.cpp</code>
<code>../../../../engine/aiComponent/beiConditions/conditions/conditionTimerInRange.cpp</code>
<code>../../../../engine/aiComponent/beiConditions/conditions/iConditionUserIntent.cpp</code>
<code>../../../../engine/aiComponent/timerUtility.cpp</code>
<code>../../../../engine/block.cpp</code>
<code>../../../../engine/blockWorld/blockWorld.cpp</code>
<code>../../../../engine/comms/robotConnectionData.cpp</code>
<code>../../../../engine/components/animationComponent.cpp</code>
<code>../../../../engine/components/battery/batteryComponent.cpp</code>
<code>../../../../engine/components/cubes/cubeCommsComponent.cpp</code>
<code>../../../../engine/components/cubes/cubeConnectionCoordinator.cpp</code>
<code>../../../../engine/components/cubes/cubeInteractionTracker.cpp</code>
<code>../../../../engine/components/cubes/cubeLights/cubeLightAnimationHelpers.cpp</code>
<code>../../../../engine/components/mics/beatDetectorComponent.cpp</code>
<code>../../../../engine/components/pathComponent.cpp</code>
<code>../../../../engine/components/powerStateManager.cpp</code>
<code>../../../../engine/components/sdkComponent.cpp</code>
<code>../../../../engine/components/variableSnapshot/variableSnapshotComponent.h</code>

File
../../../../engine/components/visionComponent.cpp
../../../../engine/drivingAnimationHandler.cpp
../../../../engine/faceWorld.cpp
../../../../engine/moodSystem/emotion.cpp
../../../../engine/moodSystem/moodDecayEvaluator.cpp
../../../../engine/moodSystem/moodManager.cpp
../../../../engine/moodSystem/staticMoodData.cpp
../../../../engine/navMap/mapComponent.cpp
../../../../engine/petWorld.cpp
../../../../engine/robot.cpp
../../../../engine/robot.h
../../../../engine/robotDataLoader.cpp
../../../../engine/vision/imageSaver.cpp
../../../../engine/vision/visionSystem.cpp
../../../../generated/proto/external_interface/alexa.pb.cc
../../../../generated/proto/external_interface/behavior.pb.cc
../../../../generated/proto/external_interface/cube.pb.cc
../../../../generated/proto/external_interface/messages.pb.cc
../../../../generated/proto/external_interface/nav_map.pb.cc
../../../../generated/proto/external_interface/response_status.pb.cc
../../../../generated/proto/external_interface/settings.pb.cc
../../../../generated/proto/external_interface/shared.pb.cc
../../../../lib/das-client/src/DAS.cpp
../../../../lib/das-client/src/dasAppender.cpp
../../../../lib/util/source/anki/util/.util/cladHelpers/cladEnumToStringMap.h
../../../../lib/util/source/anki/util/.util/entityComponent/componentWrapper.h
../../../../lib/util/source/anki/util/.util/entityComponent/dependencyManagedEntity.h
../../../../lib/util/source/anki/util/.util/entityComponent/entity.h
../../../../lib/util/source/anki/util/.util/entityComponent/iDependencyManagedComponent.h
../../../../lib/util/source/anki/util/entityComponent/dependencyManagedEntity.h
../../../../lib/util/source/anki/util/random/randomIndexSampler.cpp
../../../../platform/switchboard/anki-wifi/connmanbus.c
pfft.cpp
randombytes/randombytes.c
/mnt/devhomes/build/work/83941694d19f355d/anki/victor/cloud/gateway/config_linux.go

File
/mnt/devhomes/build/work/83941694d19f355d/anki/victor/cloud/gateway/ipc_manager.go
/mnt/devhomes/build/work/83941694d19f355d/anki/victor/cloud/gateway/main.go
/mnt/devhomes/build/work/83941694d19f355d/anki/victor/cloud/gateway/message_handler.go
/mnt/devhomes/build/work/83941694d19f355d/anki/victor/cloud/gateway/multilimiter.go
/mnt/devhomes/build/work/83941694d19f355d/anki/victor/cloud/gateway/switchboard_proxy.go
/mnt/devhomes/build/work/83941694d19f355d/anki/victor/cloud/gateway/tokens.go
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File
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File
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/mnt/devhomes/build/work/83941694d19f355d/anki/victor/generated/go/src/proto/external_interface/cube.pb.go
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/mnt/devhomes/build/work/83941694d19f355d/anki/victor/generated/go/src/proto/external_interface/settings.pb.go
/mnt/devhomes/build/work/83941694d19f355d/anki/victor/generated/go/src/proto/external_interface/shared.pb.go
_cgo_gotypes.go

9.10.1 Signal Essence files

{Am I the only one who thinks "Signal Essence" sounds like a perfume name?}

File
<code>../../../../EXTERNALS/anki-thirdparty/signalEssence/v008/vicos/project/anki_victor/mmf_proj.c</code>
<code>../../../../EXTERNALS/anki-thirdparty/signalEssence/v008/vicos/project/anki_victor/policy_actions.c</code>
<code>../../../../EXTERNALS/anki-thirdparty/signalEssence/v008/vicos/project/anki_victor_vad/nfbn_f32_anki.c</code>
<code>../../../../EXTERNALS/anki-thirdparty/signalEssence/v008/vicos/project/anki_victor_vad/svad.c</code>
<code>../../../../EXTERNALS/opencv/vicos/include/opencv2/core/mat.inl.hpp</code>
<code>../../../../se_lib/aec_common.c</code>
<code>../../../../se_lib/aec_msu.c</code>
<code>../../../../se_lib/aec_pbfd.c</code>
<code>../../../../se_lib/aec_stereo.c</code>
<code>../../../../se_lib/aec_tapered_wts.c</code>
<code>../../../../se_lib/aec_td.c</code>
<code>../../../../se_lib/aecmonitor.c</code>
<code>../../../../se_lib/avepower_i16.c</code>
<code>../../../../se_lib/buffer_composer.c</code>
<code>../../../../se_lib/cl_agc.c</code>
<code>../../../../se_lib/cl_agc_i16.c</code>
<code>../../../../se_lib/conv.c</code>
<code>../../../../se_lib/dcremove.c</code>
<code>../../../../se_lib/dcremove_f32.c</code>
<code>../../../../se_lib/decimate31.c</code>
<code>../../../../se_lib/downsampn.c</code>
<code>../../../../se_lib/fdanalyze.c</code>
<code>../../../../se_lib/fdechomodel.c</code>
<code>../../../../se_lib/fdemphasis.c</code>
<code>../../../../se_lib/fdsearch.c</code>
<code>../../../../se_lib/fdsearch_winner.c</code>
<code>../../../../se_lib/float_dft.c</code>
<code>../../../../se_lib/float_dft_fftpack.c</code>
<code>../../../../se_lib/float_dft_pfffft.c</code>
<code>../../../../se_lib/frdelay.c</code>
<code>../../../../se_lib/gainest.c</code>
<code>../../../../se_lib/highpass_filter_array.c</code>
<code>../../../../se_lib/interp.c</code>
<code>../../../../se_lib/leakyave.c</code>
<code>../../../../se_lib/lec.c</code>

File

./././se_lib/lrhpf.c
 ./././se_lib/meta_aec.c
 ./././se_lib/meta_fda.c
 ./././se_lib/mmmfx.c
 ./././se_lib/mmmfxcalibactions.c
 ./././se_lib/mmmfxspatialfilter.c
 ./././se_lib/mmif_helper.c
 ./././se_lib/mmpreprocessor.c
 ./././se_lib/mmvalidate.c
 ./././se_lib/morpho.c
 ./././se_lib/multiaecc.c
 ./././se_lib/multichan_delay.c
 ./././se_lib/multichan_delay_f32.c
 ./././se_lib/narrowband_noisegen.c
 ./././se_lib/nfbn_f32.c
 ./././se_lib/nrgainv.c
 ./././se_lib/output_injector.c
 ./././se_lib/ref_proc.c
 ./././se_lib/rfir.c
 ./././se_lib/rfir_f.c
 ./././se_lib/sampledelayqueue.c
 ./././se_lib/sampledelayqueue_f32.c
 ./././se_lib/sat_detector.c
 ./././se_lib/scratch_mem.c
 ./././se_lib/se_crossover.c
 ./././se_lib/se_dft.c
 ./././se_lib/se_dft_fftpack.c
 ./././se_lib/se_dft_fxp.c
 ./././se_lib/se_dft_pffff.c
 ./././se_lib/se_dft_qf.c
 ./././se_lib/se_diag.c
 ./././se_lib/se_nr.c
 ./././se_lib/se_rev.c
 ./././se_lib/subbandsplitter.c
 ./././se_lib/system_tests.c

File

./././se_lib/tdinterp.c
 ./././se_lib/trackfilters.c
 ./././se_lib/upsamplen.c
 ./././se_lib/vadd.c
 ./././se_lib/wavepower.c
 ./././se_lib/wavepowerrms_i16.c
 ./././se_lib/vcmul.c
 ./././se_lib/vcmul_i16_i32.c
 ./././se_lib/vdotproduct_i16_i32.c
 ./././se_lib/vdotproductq15_i16.c
 ./././se_lib/vdotproductswithleftshift_q15_i16.c
 ./././se_lib/vfill_i16.c
 ./././se_lib/vfill_i32.c
 ./././se_lib/vfloatlib.c
 ./././se_lib/vgen_exp_ramp.c
 ./././se_lib/vgentone.c
 ./././se_lib/vgentone.c
 ./././se_lib/vgetindex.c
 ./././se_lib/vgetvalue.c
 ./././se_lib/vinvertorder.c
 ./././se_lib/vleftshifts_i16.c
 ./././se_lib/vlimitmin.c
 ./././se_lib/vmax.c
 ./././se_lib/vmin.c
 ./././se_lib/vmmadd.c
 ./././se_lib/vmove_i16.c
 ./././se_lib/vmove_i32.c
 ./././se_lib/vmovesrcstride_i16.c
 ./././se_lib/vmul.c
 ./././se_lib/vpower_i16_i32.c
 ./././se_lib/vpowerwithexponent_i16_i32.c
 ./././se_lib/vscale.c
 ./././se_lib/vsub_i16.c
 ./././se_lib/vsum_i32.c
 ./././se_lib/vtrackupavedown.c

File

../../../../se/lib/win_fcns.c

../../../../se/lib/winbufdft.c

../../../../se/lib/wola.c

9.10.2 Google BreakPad and Minidump

File

/src/client/linux/handler/minidump_descriptor.h

/src/client/linux/minidump_writer/directory_reader.h

/src/client/linux/minidump_writer/line_reader.h

/src/client/linux/minidump_writer/proc_cpuminfo_reader.h

/src/client/minidump_file_writer-inl.h

/src/common/linux/elfutils-inl.h

9.11 Mandatory physical reactions

Summary: Reactions to physical circumstances that can't be skipped.

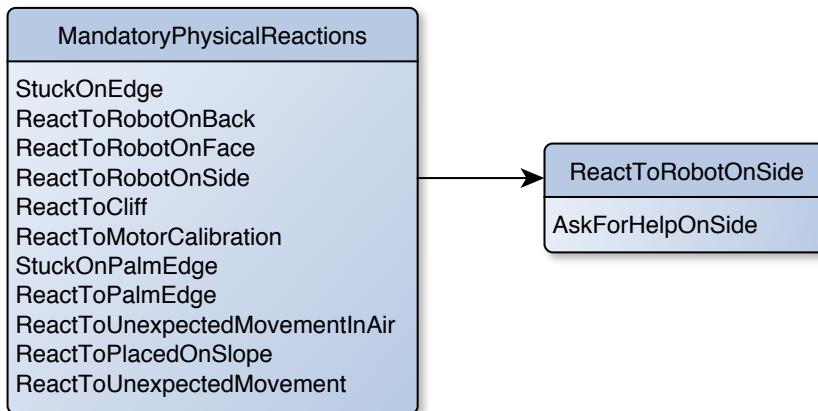


Figure: The mandatory physical reactions behavior tree

The *MandatoryPhysicalReactions* is used to react when Vector is:

- On his side, face, or back
- Encounters a cliff
- Is stuck on cliff edge
- Needs to calibrate the head or lift motors
- Some interaction with being held in the palm of a hand
- Is falling or is being picked up
- Is on a slope
- Is being moved around

The behavior file is located at:

```
behaviors/victorBehaviorTree/reactions/mandatoryPhysicalReactions.json
```

For the most part, the *MandatoryPhysicalReactions* provides a way to prioritize the internal C++ implementation; most of these behavior references do not link to other behaviors or animations.

The only one of interest is *ReactToRobotOnSide* which initiates *AskForHelpOnSide* behavior to call for someone to come and help.

- *ReactToCliff* has configuration for how fast and far Vector backs up in responds to a cliff.
- *ReactToUnexpectedMovement* has configuration for how fast and far Vector backs up when he experiences being moved by someone; as well as how much he can respond.

9.11.1 Change history synopsis

Date	Change
2020-12-1	Created

9.12 Power management behaviors

Summary: The behaviors related to turning off, handling very low-battery, sleeping, and other battery-related items. (These are self-maintenance behaviors)

This note describes the power management-related behaviors. Please refer to the [Technical Reference Manual](#) for a description of Vector's internal power states, management, and sleep debt.

The main power management behaviors are launched at a very high-level. These are launched by the *ModeSelector* (class *DispatcherStrictPriority*) behavior. This behavior is invoked by:

- *InitNormalOperation* behavior during start of normal behavior
- *AcousticTestMode* behavior during acoustic testing at the factory
- *DevBaseBehaviorInternal* behavior during start of developer mode

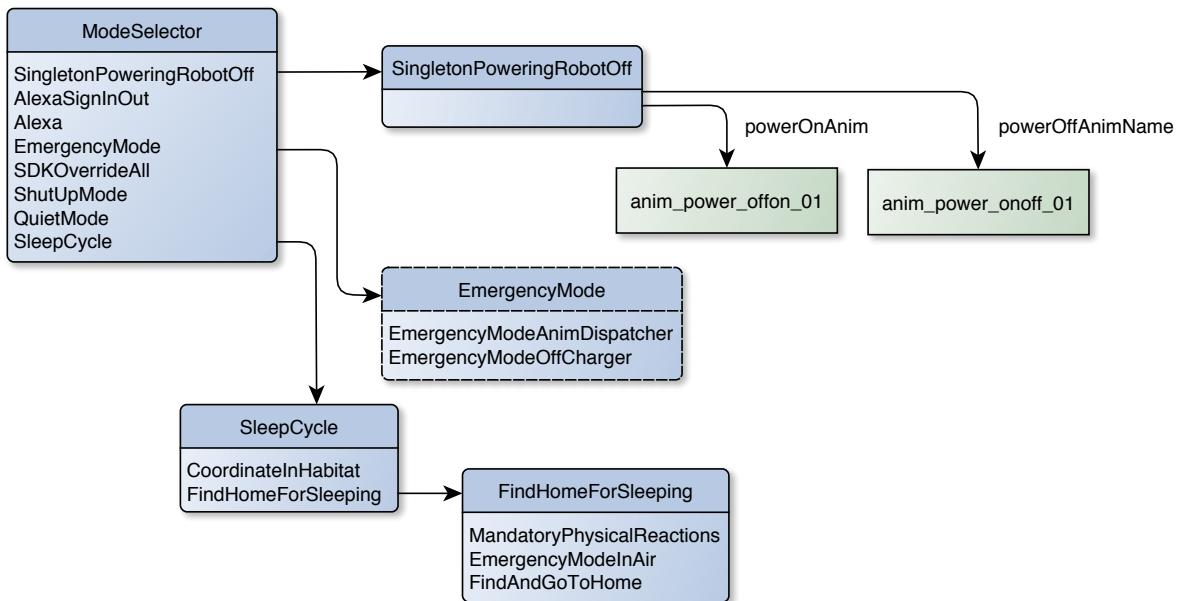


Figure: The power management behavior tree

The behavior file is located at:

```
behaviors\victorBehaviorTree\modeSelector.json
```

The behavior tree system gives things in explicit priority order. The higher item in the list has more priority than the lower; when an item calls out to other nodes, all of those still have higher priority than the items lower than the original one.

The mode selector:

- Handle powering off (the highest priority)
- Alexa-related behaviors (not related to power management)
- Handle overheating (in emergency mode)
- SDK override (not related to power management)
- Being quiet related behaviors (not related to power management)
- Handle low battery and attempt to return to charger... if unable, turn off
- A sleep/**quiet state** manager. Regular behaviors and interactions are started in this behavior tree, so are at the lowest priority.

9.12.1 Powering off

The highest priority behavior is the *SingletonPoweringRobotOff* (class *PoweringRobotOff*) behavior, that animates Vector while he is the process of turning off.

Name	Type	Value	Description
powerButtonHeldToActivate_ms	int	250 ms	The minimum time that the power button must be held down to activate the power off sequence.
powerOnAnimName	animation	anim_power_onoff_01	The animation to play if the button is released and Vector will resume.
powerOffAnimName	animation	anim_power_onoff_01	The animation to play while powering off.

Table: *PoweringRobotOff* configuration parameters

If the power button is released before Vector has turned off, the behavior begins the process of resuming,

The animation reference is unusual. It doesn't refer to the trigger of an animation group. Instead it refers to a specific animation.

9.12.2 Sleep

At the opposite end -- the *lowest* priority -- is the *SleepCycle* (class *SleepCycle*) behavior. The behavior file is located at:

```
behaviors/victorBehaviorTree/highLevelDelegates/sleeping/sleepCycle.json
```

This behavior arbitrates between:

- Vector autonomously exploring
- Interacting with a person (outside of Alexa).
- And going into a sleep state

If Vector has no reason to sleep, this behavior lets the *CoordinateInHabitat* behavior. If it decides to sleep (the decision is made in the C++ code) It initiates the *FindHomeForSleeping* behavior to drive to the charging dock, if possible, to sleep. (In turn it invokes **MandatoryPhysicalReactions** to respond to environmental hazards while driving around.)

This has a condition that keeps it in sleep, even if there is a higher priority interaction, if:

- The battery level is low,
- The temperature is high, or
- Charging is stopped because it is too hot.

Depending, it will initiate the looking for home to go to sleep. This is the *FindHomeForSleeping* behavior.

Things that wake Vector up from the different kinds of sleep:

Sleep state	Things that wake Vector
HeldInPalmSleep	Being jolted, touched, picked up (out of the hand), SDK interaction, the timer, and voice commands.
LightSleep	Being jolted, poked, touched, or picked up; any sound or the lights coming on; SDK interaction, the timer, and voice commands.
DeepSleep	Being touched, or picked up; SDK interaction, the timer, and voice commands.

Table: That wake Vector from sleep.

This behavior includes a decision tree that sets a `reason` code for based on sensors that have trigger. That reason code is used above. By editting this behavior's decision tree, you can adjust how sensitive he is to conditions like touch, poking, illumination to wake him from sleep.

Note: In power save mode -- a lower sleep state -- the camera is turned off, so Vector is not sensitive to light.

Driving to the charging dock to sleep

When Vector is going into a sleep state, *FindHomeForSleeping* (class *DispatcherStrictPriority*) behavior to drive to the charging dock, if possible, to sleep. The behavior file is located at:

```
behaviors/victorBehaviorTree/highLevelDelegates/sleeping/findHomeForSleeping.json
```

This behavior stops whatever else is going on, and runs a subset of navigation and driving related behaviors.

9.12.3 Emergency Mode

Emergency mode is quite complex, and handles conditions where:

- The battery level is low,
- The temperature is high, or
- Charging is stopped because it is too hot.

The way to exit emergency mode is for the battery level to rise above the low threshold, and for temperature to cool below the hot threshold.

This is controlled by the *EmergencyMode* (class *DispatcherQueue*) behavior.

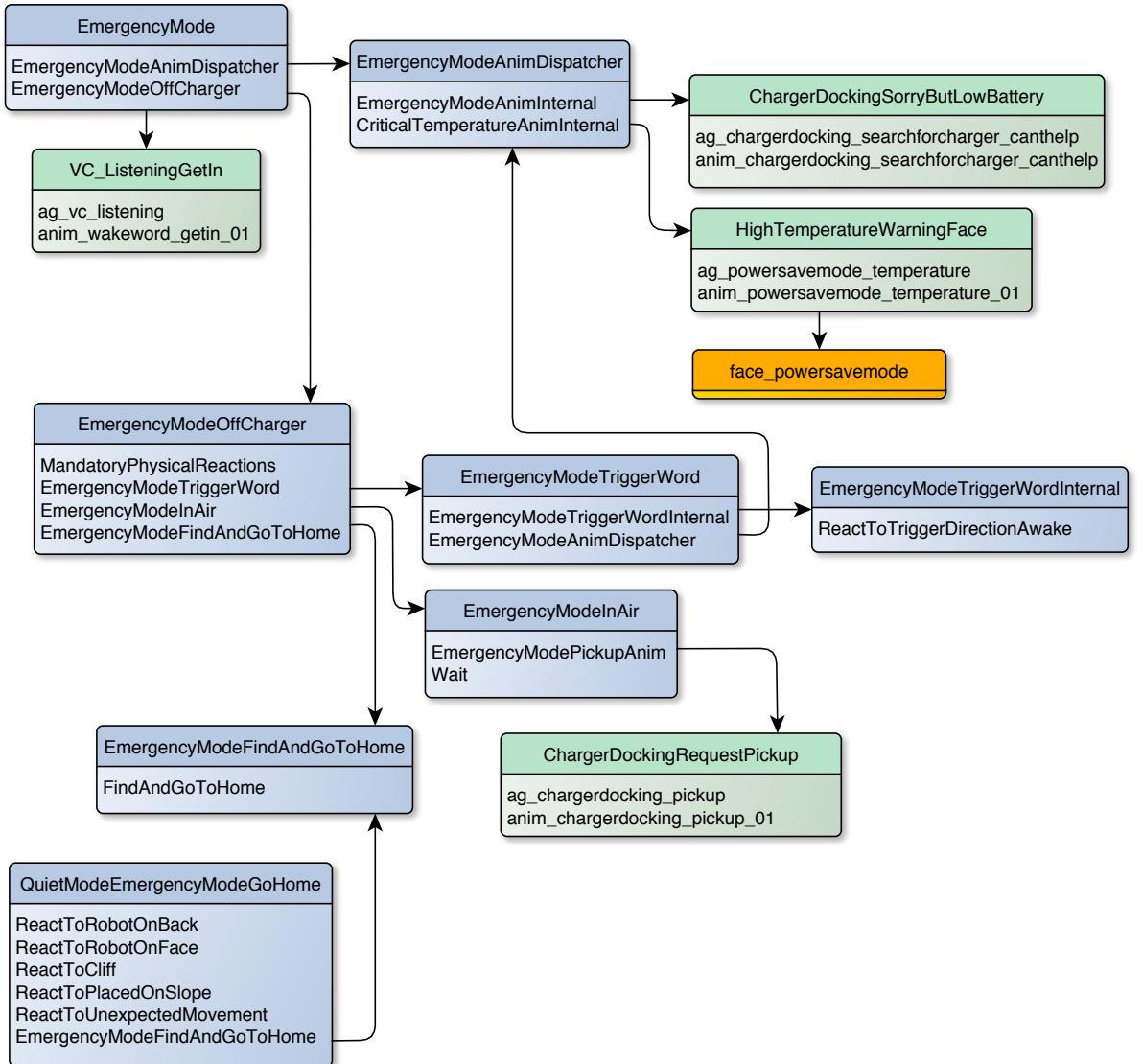


Figure: The emergency behavior tree

The behavior file is located at:

```
behaviors/victorBehaviorTree/emergencyMode/emergencyMode.json
```

Animation feedback

The behavior coordinates with working with other social interactions, albeit in a restricted manner. If the trigger word is heard, it doesn't stream the audio to the voice server. Instead it:

1. Plays the *VC_ListeningGetIn* animation, then
2. Plays the *StreamingDisabledButWithLight* animation to indicate that streaming is disabled, and finally
3. Sends the *Play_Robot_Vic_Sfx_Wake_Word_On* audio event to play a feedback sound.
4. It also links with the following animation to show the reason why

Emergency mode uses the *EmergencyModeAnimDispatcher* (class *DispatcherQueue*) behavior to play different animations based on the the emergency condition:

- If the battery is low, it will trigger the *ChargerDockingSorryButLowBattery* animation.
- If the temperature is high, or too hot charge, it will trigger the *HighTemperatureWarningFace* animation; this will play the *face_powersavemode* sprite sequence.

The behavior file is located at:

```
behaviors/victorBehaviorTree/emergencyMode/emergencyModeAnimDispatcher.json
```

If Vector is in picked up, or otherwise off his treads (but not being held), he plays the *ChargerDockingRequestPickup* animation. This is done in the *EmergencyModeInAir* behavior. The behavior file is located at:

```
behaviors/victorBehaviorTree/emergencyMode/emergencyModeInAir.json
```

Returning to the charging dock

There are a couple of behaviors that try to cause Vector to drive back to the charging dock. These run a subset of navigation and driving related behaviors to drive to the charging dock. The first is the *EmergencyModeOffCharger* (class *DispatcherStrictPriority*). The behavior file is located at:

```
behaviors/victorBehaviorTree/emergencyMode/emergencyModeOffCharger.json
```

The second is the *QuietModeEmergencyModeGoHome* (class *DispatcherStrictPriority*), which would be invoked while in quiet mode. *Commentary: This behavior appears like it should not run; the same conditions that would trigger it would also trigger the much higher priority EmergencyMode behavior. This behavior should be checked out and considered for removal.*

9.12.4 Change history synopsis

Date	Change
2020-11-30	Created
2020-12-1	Quiet mode's emergency mode, and trigger word animation

9.13 Quiet mode behaviors

Summary: The behaviors related to turning off, handling very low-battery, sleeping, and other battery-related items. (These are self-maintenance behaviors)

The quiet mode is when Vector's has been asked to be silent, either nicely ("be quiet") or abusively ("shut up").

9.13.1 Quiet Mode

The *QuietMode* behavior is when Vector's has been asked to be silent, nicely ("be quiet") using the `imperative_quiet` user intent.

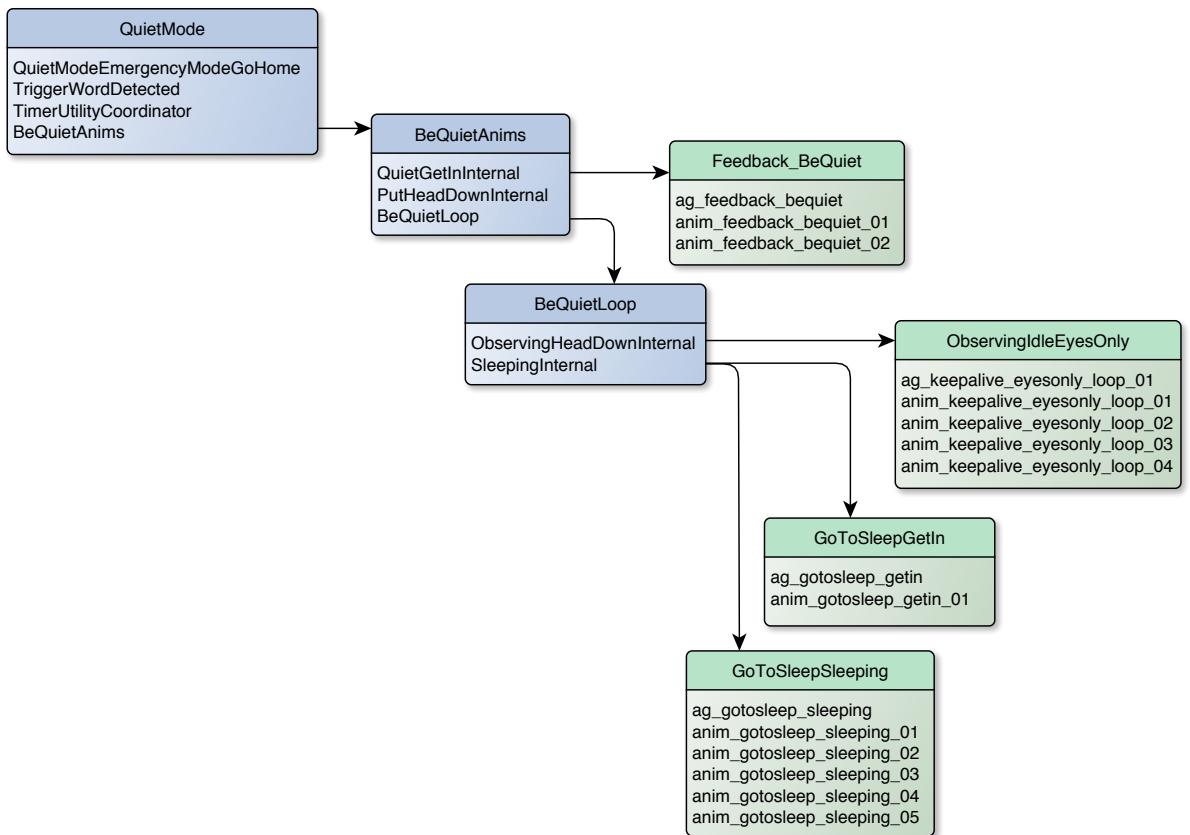


Figure: Quiet mode behavior tree

It *QuietModeEmergencyModeGoHome* see [power management](#) for a description of emergency mode.

The *BeQuietAnims* behavior is used to trigger the *Feedback_BeQuiet* animation, and lowers the Vector's drowsy head, using the *PutHeadDownInternal* behavior.

Thereafter the *BeQuietLoop* is used play one of three animations:

- The *ObservingIdleEyesOnly* animation is played while Vector sits quietly and looks around.
- The *GoToSleepGetIn* animation is played when Vector goes to sleep,
- The *GoToSleepSleeping* animation is played while Vector sleeps.

9.13.2 ShutUp mode

The *ShutUpMode* behavior is variation of quiet mode, used when Vector's has been asked to "shut up" (the `imperative_shutup` user intent).

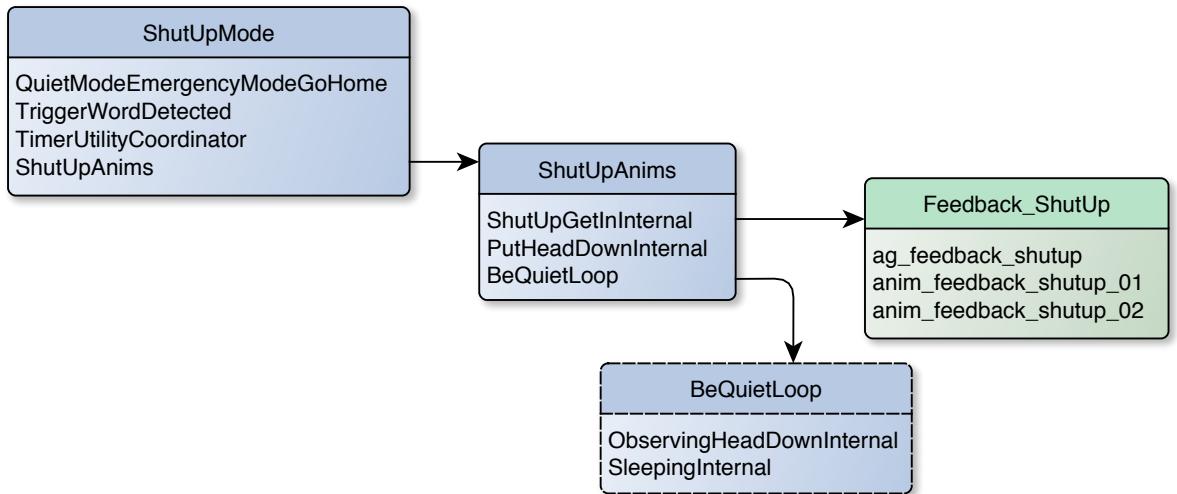


Figure: Shut up mode behavior tree

The main difference is the intent that triggers is, and the animation response. Thereafter, this mode reused the same *BeQuietLoop* used by the quiet mode.

9.13.3 Change history synopsis

Date	Change
2020-12-1	Created

9.14 Start up behavior

Summary: The initial startup behavior that kicks off normal operation. (These are self-maintenance behaviors)

When Vector's application starts, it looks up a top level state to kick off the initial behavior -- has the robot been tested at the factory? Has the owner gone thru on boarding? And so on.

This behavior is the root of the behavior tree that Vector will use. There are 7 of these broad, top level states:

- PR demo
- Factory test (e.g. the playpen tests)
- Acoustic testing
- On-boarding
- Post on-boarding
- Normal
- Developer

Note: when Vector exits the Customer Care screens, it resumes operation by re-running the top level behavior.

9.14.1 Mapping to the initial behavior

These top-level states are mapped to initial behavior using `victor_behavior_config.json`

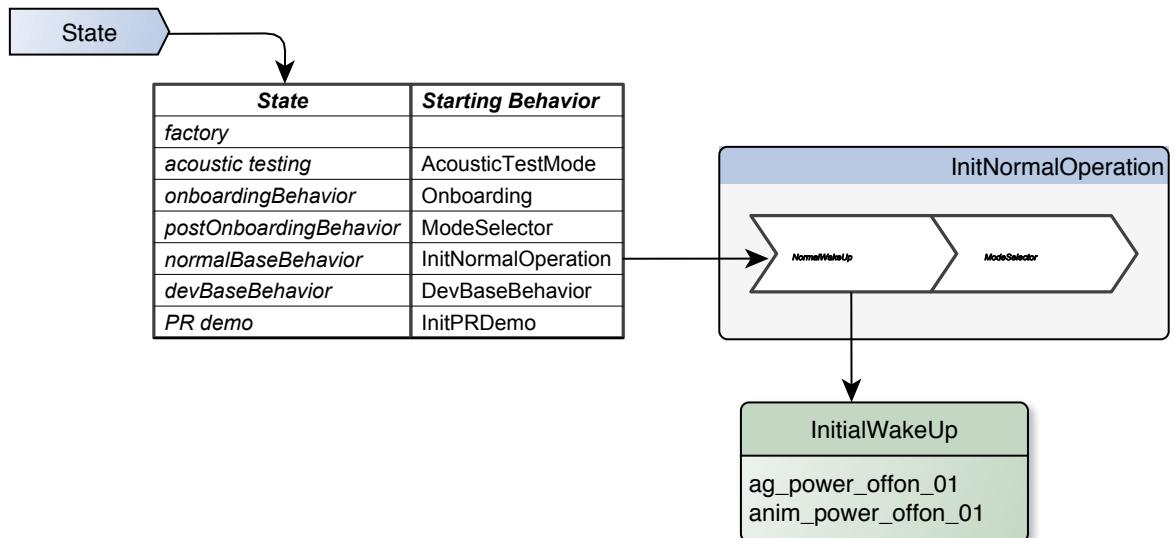


Figure: The start-up behavior tree

(In a few cases the mapping is hardcoded in the software.)

In normal operation, this is the *InitNormalOperation* behavior. The behavior file is located at:

```
behaviors/victorBehaviorTree/initNormalOperation.json
```

9.14.2 Walk thru of the InitNormalOperation behavior

When the *InitNormalOperation* (class *DispatcherStrictPriorityWithCooldown*) behavior first starts, it does a one-off run of a *NormalWakeUp* behavior. This behavior is not run when *InitNormalOperation* is started again later. (For instance, it is run again when the Customer Care screens are exited.) This one-shot execution is achieved by using settings its cooldown timer to a period that is infinitely long.

The *NormalWakeUp* (class *AnimSequence*) behavior checks to see that it is not night time, and not a maintenance reboot. If isn't, then it triggers the *InitialWakeUp* animation group. The animation affect Vectors eyes, head angle, backpack lights, and sounds. (There are not any other movements). This behavior file is located at:

```
behaviors/victorBehaviorTree/normalWakeUp.json
```

After this it defers to *ModeSelector* behavior for the top level, prioritized behavior dispatch.

9.14.3 Other variations

There are three other animation variations on Vector that are currently not used:

- anim_power_offon_02
- anim_power_offon_03
- anim_power_offon_04

9.14.4 Change history synopsis

Date	Change
2020-11-29	Created, setup format
2020-11-30	Added file references
2020-12-1	Moved some intro material to behavior tree

10. Tools

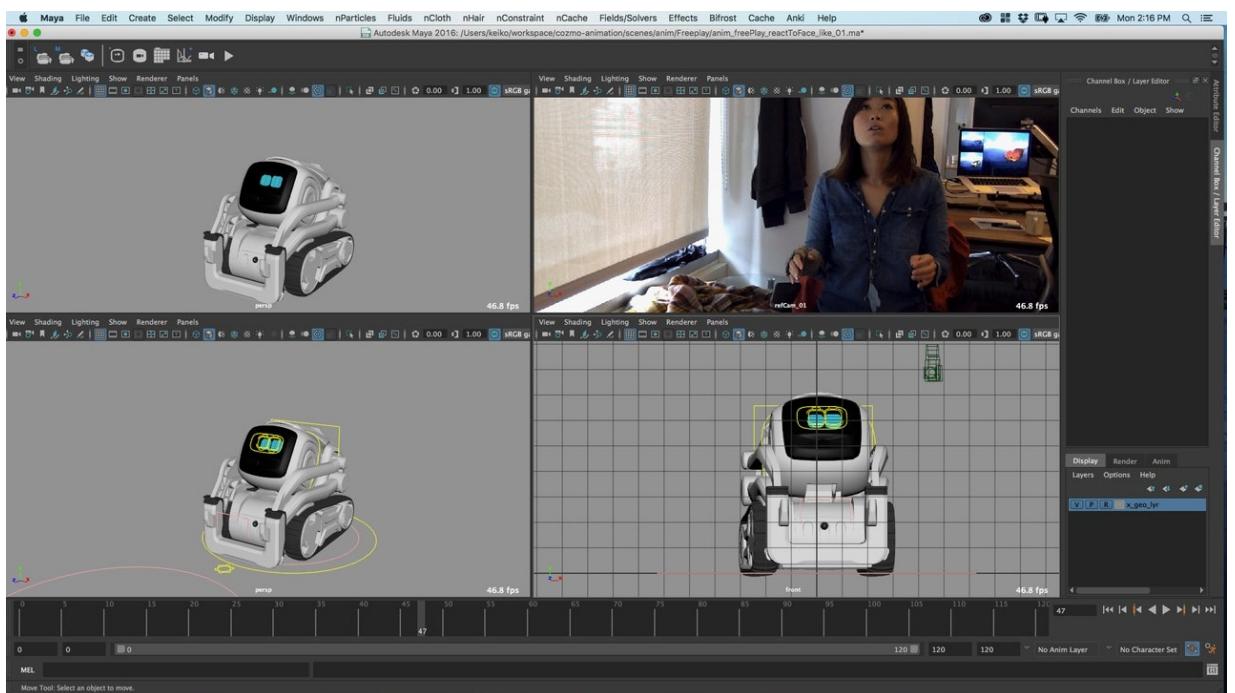
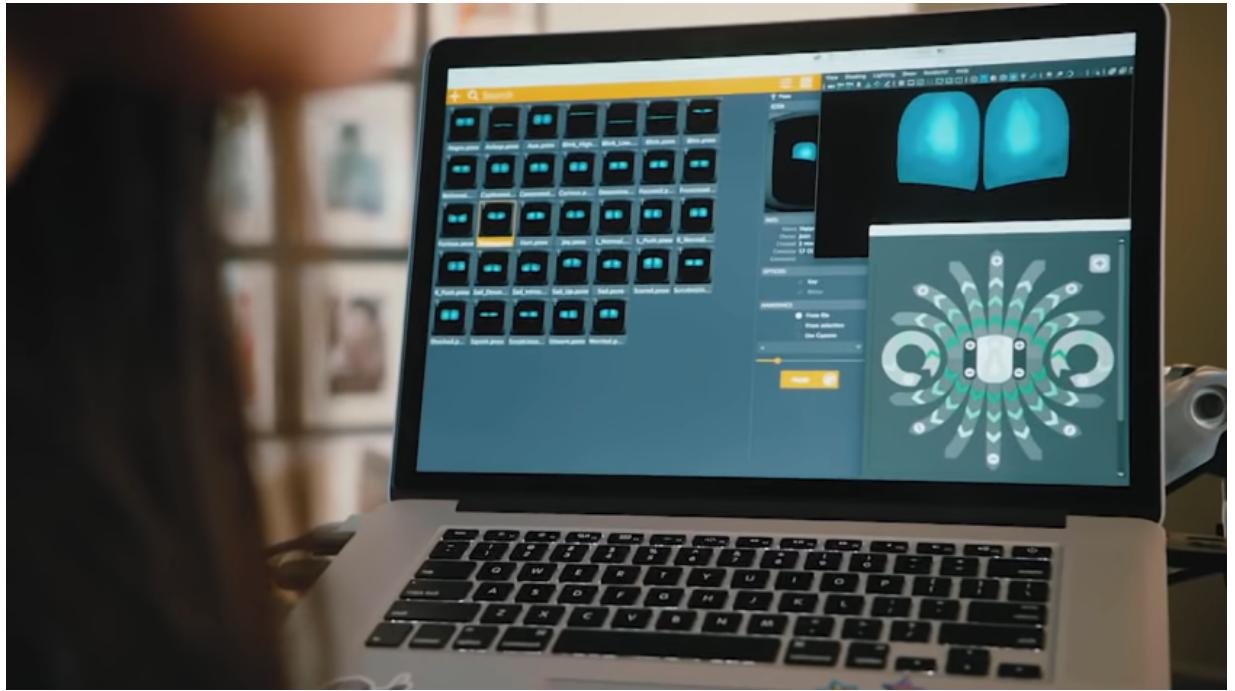
10.1 Animation tool

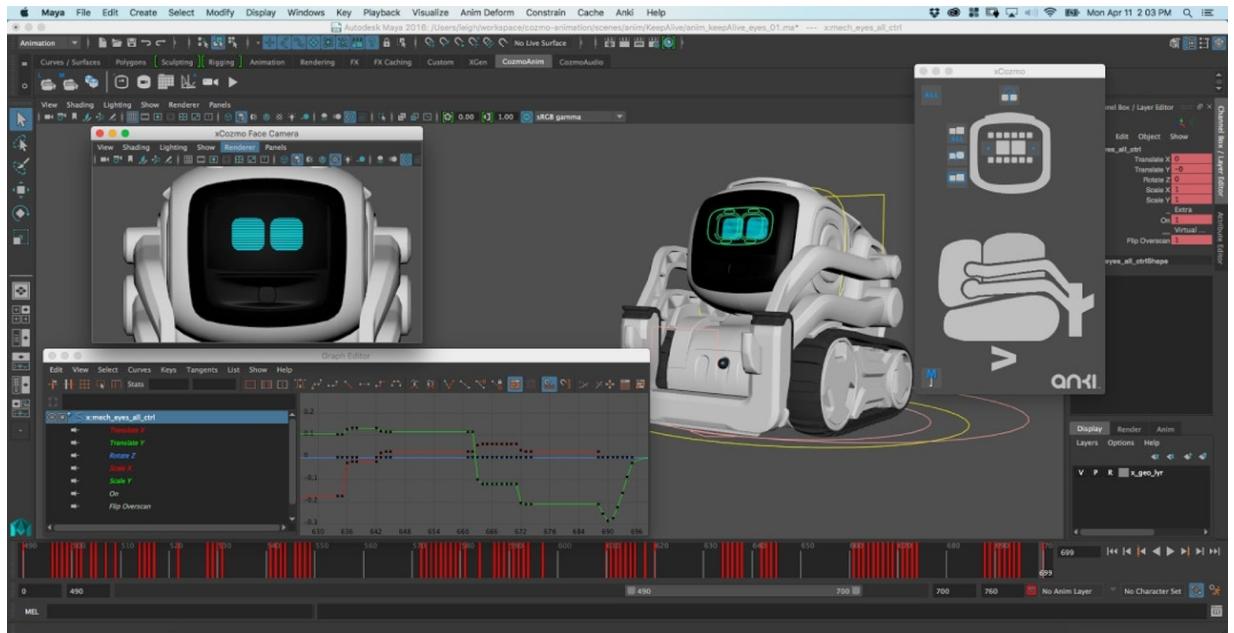
10.1.1 Maya

Anki used Maya to animate Cozmo and Vector. The tool used a plugin to emit the movements, as JSON using a format that the animation engine could read with the flatbuffers library. (See [How to convert animation bin files to JSON](#) for a bit more on converting between JSON text and the binary format.)

The animations tools had UIs with at least the following two screens:







VIRTUAL VECTOR IN MAYA PERFORMING AN ANIMATION



REAL WORLD VECTOR PERFORMING THE SAME ANIMATION

More Info

- [Maya Tutorial \(Beginner Video 2016\)](#)
- [AutoDesk Maya Tutorial Links](#)

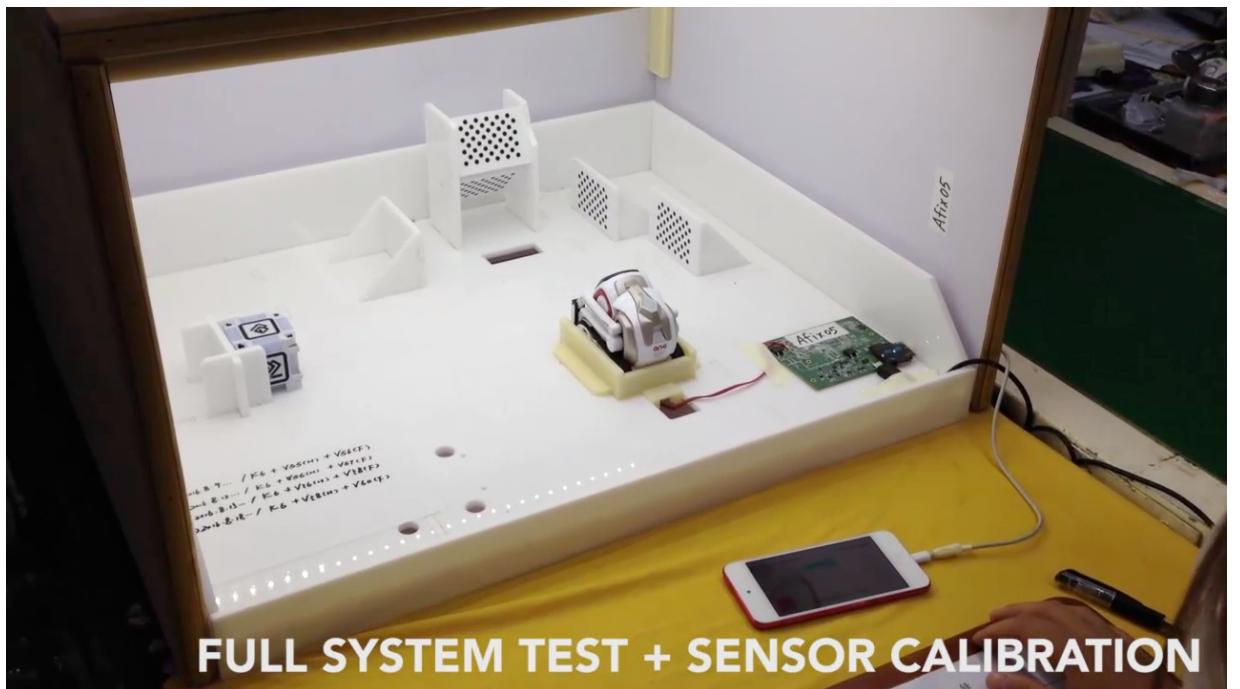
10.2 Playpen

Playpen is a test station used calibration Vector and Cozmo's camera, and perhaps other sensors.

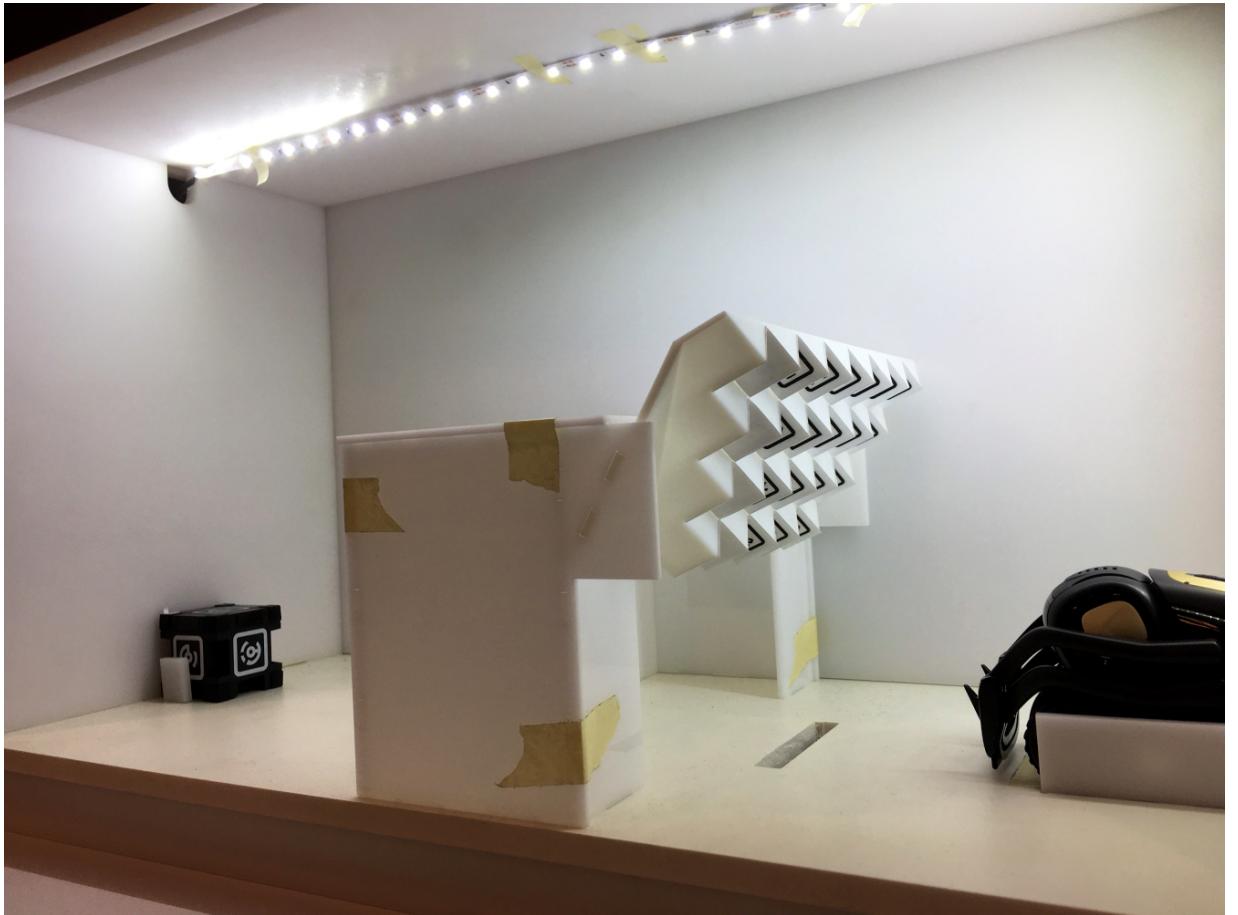
Once Cozmo is fully assembled, he's placed in the Playpen to take his "final test". He does a lot of things in there, but one thing he does is an eye test. He drives around from target to target, making sure he can count all the dots, they're all in focus, and they're all where he expects them to be (literally, his head is on straight!).[discord](#)

10.2.1 Cozmo's playpen

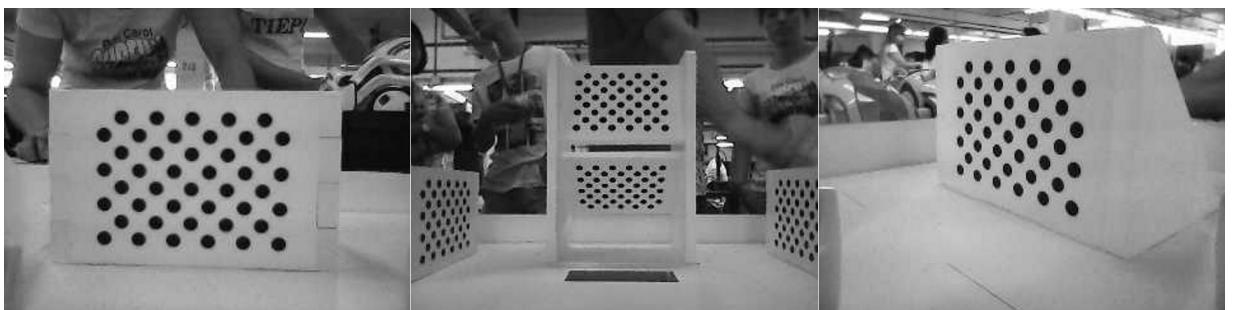
This is what one looks like for Cozmo:



And for Vector



And this is what Cozmo sees:



A direct shot of a calibration image that Vector sees:



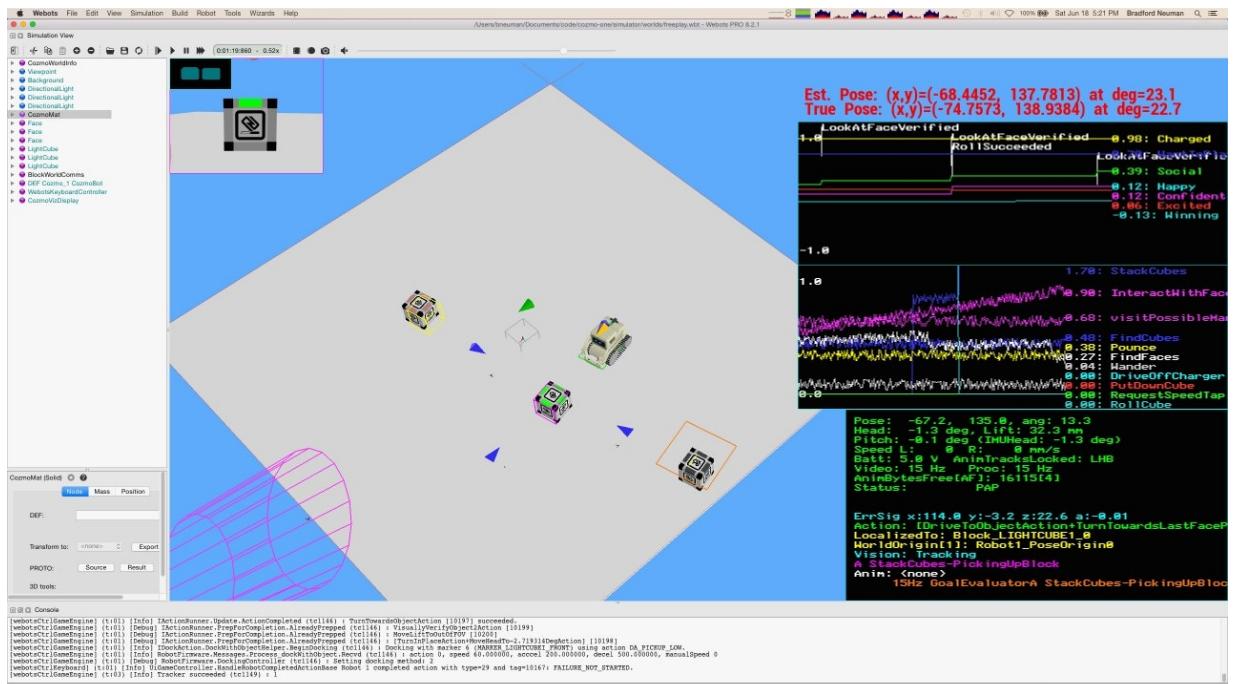
10.2.2 Creating a new one for Vector?

TODO / TBD: We don't know how to make a replacement one yet. Or all the steps in issuing commands to Vector.

10.3 Webots

Anki used Webots to test Cozmo and Vector's emotion model on the desktop before downloading. And perhaps the behavior tree.

Cozmo's Mood Manager can be visualized in Webots, a software program designed for the development and simulation of robots. Labeled by the small, multi-color words (top right-hand corner of the photo), data points change over time based on Cozmo's mood.([Interview with Sr Sound Designer Ben Gabaldon](#))



11. Troubleshooting

11.1 Backpack Lights

VECTOR LED SUMMARY

LEDs	Animation	What it means
●	The small circular light glows a steady green.	Vector is on.
	The rectangular lights glow green and climb up his Back button.	Charging: Vector is getting more energy. When he's done, his rectangular lights will stop glowing.
	The rectangular lights glow light blue and climb up his Back button 1 then 2 then 3.	Booting: Vector is starting up. When he's done, these rectangular lights will stop glowing light blue.
	The rectangular lights glow solid blue.	Speaking to Vector: After you've said "Hey Vector", Vector is ready to hear what you have to say.
	The rectangular lights will pulse orange continuously.	Connection. Vector can't connect to Wi-Fi. Connect with the Vector app to figure out what's happening.
	The rectangular red light on the bottom of his backpack will pulse..	Low battery: Place Vector on his charger.

Things that this could do:

- Diagram of the backpack lights
- Show the FAC lights
- Changes to the backpack lights in the custom software

See also DDL.

11.2 Purple circle light

- For the first few seconds at boot, this is normal and should get fixed later on in the body board boot process. However, if your Vector is stuck on it and he shows an error code (801, 898, 899), there could be an issue. First try to reboot by holding the button for 5-6 seconds. If that doesn't work, leave him and let the battery die. This will probably take a few hours. After the battery dies, turn him back on. If he still shows a purple light after being turned back on, then there is a hardware issue on the bodyboard.

11.3 FAC (Factory) Mode

Vector has a "FAC" mode, used in the factory to test and calibrate the robot. When in FAC mode, the display has a red background, with either the letters "FAC" displayed:



Or one to two digits displayed. These appear to be calibration errors (makes sense since we don't have a playpen to calibrate them with).



And his backpack lights have an unusual color pattern – red, green, and blue:



This mode is never intended to be seen outside of the factory, so little is known. Only a couple of units have been found in this mode; one after it had been intentionally damaged, and its calibration & EMR data were corrupted or inaccessible. In all likelihood, the software checks its EMR to see if it has been released; if not, it enters the FAC mode at whatever the "next" stage is according to the EMR. At that point Vector expects to be placed into manufacturing test fixtures, such as the playpen.

If you see a normal Vector in this mode on a place like eBay, it is recommended you don't buy him. The software he is running is still 0.9.0 recovery just in a different mode and there aren't any dev things open.

11.4 Hardware error codes

If something has gone wrong, an error will appear on Vector's face. These errors happen if Vector's hardware is bad, but some of them could also be software.

801

- Rampost was unable to communicate with the body board at boot. This will show up before an 898 or 899 error. If the board shows just a purple light and won't turn off, you need to wait for his battery to die. After that, turn him back on. If there is still a purple light, there could be a hardware issue with the body board.

870-895

- Body board has a specific hardware fault. For all of these, try a reboot. If that doesn't work, your Vector probably needs some fixin'.

870

- The front right microphone is not working correctly.

871

- The front left microphone is not working correctly.

872

- The back right microphone is not working correctly.

873

- The back left microphone is not working correctly.

// I'm not sure if 870-873 actually show up as I have seen boards get through rampost without the backpack board connected.

890

- The front right cliff sensor is not working correctly.

891

- The front left cliff sensor is not working correctly.

892

- The back right cliff sensor is not working correctly.

893

- The back left cliff sensor is not working correctly.

894

- The front ToF sensor is not working correctly.

895

- The touch sensor is not working correctly.

896(?)**-897**

- Seems to be Whiskey specific. It seems to only show in their dev recovery and they work fine in normal firmware, so this doesn't seem to be a worry.

898

- There was an error when trying to communicate with the body board. If the board shows just a purple light and won't turn off, you need to wait for his battery to die. After that, turn him back on. If there is still a purple light, there could be a hardware issue with the body board.

899

- The firmware was unable to find the body. If the board shows just a purple light and won't turn off, you need to wait for his battery to die. After that, turn him back on. If there is still a purple light, there could be a hardware issue with the body board.

950

- This error will only occur on a Whiskey. The software is unable to open the extra ToF sensors. It is possible that one or both of the sensors are broken.
- This can be fixed with an EMR/OEM swap. Instructions soon

960

- IMU hardware failed.

970

- The Wi-Fi hardware failed.

980-981

- An error occurred when trying to communicate with the camera. If he is stuck on this error, go to recovery and clear user data. If he is still stuck, the camera may not be soldered on well or it could be broken.

990

- Vic-anim is unable to open the display for writing. This is something you will probably never see.

11.5 Software error codes

If something has gone wrong, an error will appear on Vector's face. The ones on this page are (usually) software.

914-915

- There was an issue with vic-engine. Vector should restart to normal operation on his own.

913

- There was an issue with vic-switchboard. This could happen if there was an error in BLE communication or if you entered too long of a string into the SDK. He should restart fine.

916-917

- There was an issue with vic-robot. He should restart just fine.

800

- There was an issue with vic-anim. He should restart just fine. If he doesn't, restart into recovery and clear user data.

850-852

- There was an issue with the cloud and/or serial number. A clear user data may help.

920-921

- There was an issue with vic-gateway or vic-gateway-cert. If he is stuck on this, you may need to clear user data.

923

- Vic-cloud has crashed. He should restart fine. If you got an 801-899 error before, this may be the server's fault.

12. Vector enhancement proposals

12.1 Vector Enhancement Proposals

Memos, cheekily named for Python's memo system. At the moment, I see these as proposals for changes to the software and files on a Vector. (Proposals for changes to the site or documentation, or build tools, etc should go elsewhere.)

This would be relevant for changes, esp substantial changes, that you might like many people to adopt.

File Format:

- I'm going to try to use markdown most often, but
- PDF/HTML export for normal human readers

Common elements, to make it easier to read and management them:

The first part is the markdown front matter: it begins and ends with --- and the lines inside contain YAML. This lets other tools extract the basics.

```
---
title: VEP123 - The name of the VEP (only a few words)
summary: An optional description of the proposal, if the title is too short
authors:
  - Author Name
date: 2022-07-10
---
```

The title starts with "VEP" and a unique (serial) number. It is followed by a brief description or topic of the proposal. The other fields are self explanatory, and helps track the info

Other outline, organization:

- Description of the changes
- Some Design decisions
- Documentation
- Cavaets
- Status
- References
- Change history synopsis (this is for people)

12.2 VEP1 - Update-engine changes

Summary: Update-engine changes to make for unsigned, incremental updates; and to reduce the number of partitions modified.

Authors: Randall Maas

12.2.1 Description of the changes

Motivation: Building a new, experimental development release is not possible with an stock update-engine:

1. We can't create an OTA file for unmodified production, development and OSKR bots, as it needs to be signed in order for the update-engine to apply it.
2. The OTA update is very "heavy weight" -- it needs to update the boot and system files systems (with a 200+MB file!) just to change a couple of files.

This enhancement changes the following to the update engine:

- remove signing check of the manifest, update files
- Allows replacing individual partitions, esp just the system file system; usually it replaces several at a time
- Allows using tar to update the contents of the system file system
- This is not recommended since it doesn't get the permissions right

12.2.2 Documentation

- none at this time

12.2.3 Cavaets

- the tar based updating of the system file system doesn't always work as expected, since the busybox tar doesn't preserve permissions
- it is tricky to create a tar file
- there is no undo for a partial update
- this probably doesn't disable delta updates properly, so if a delta update were to be issued, we'd need a way to make sure it doesn't mess up the FS.

12.2.4 Status

- it works well (except the system fs file-only changes), I believe that Wire has used this or a modified version
- I am considering other changes to support package-based updates to the file system, to better address the above issues.

12.2.5 References

12.2.6 Change history synopsis

12.3 VEP2 - Package management for modules on Vector

Summary: Supports installing and uninstalling packages/modules on Vector

Authors: Randall Maas

12.3.1 Description of the changes

Motivation: We needed a way to package changes to a few files on an already deployed system, to ensure that the permissions are correct on the files (usually executable), and some restrictions/protections from screwing up system files. (Ie, don't force it to be unbootable)

This is a package manager that does those, and adds in a few extras:

- It allows modifying parts of a file, usually the version identifier of the system, so we know what we're working with.
- Lists the installed packages
- Can uninstall packages
- Can set the permissions for the files.

12.3.2 Some Design decisions:

- The tool had to be small, and not hard to deploy
- The tool can't be compiled (we don't know how)
- It had to be based on tools already on Vector: python 2.7, and busybox based utils. Busybox supplies the shell, and tar... except tar doesn't support preserving permissions.
- It is preferred to separate out the package manager from the update-engine as much as possible, to make it more understandable and support testing.

It just installs the packages

This tool doesn't do everything that the other managers do:

- It doesn't check dependencies
- It doesn't download files
- It has minimal the pre-flight, post-flight scripts that are run.

The package download is handled by either the update-engine (and its line of control), or by scp command. The lack of dependency check is a benefit, as it's hard to maintain, and it is rarely used correctly: maintainers tend to choose a dependency of "the latest version" (as of when the package was), negating its use.

12.3.3 Documentation

The documentation of the tool is included as part of its tgz. This is a quick overview.

When a package is installed it creates another package taking a snapshot of those files already there. When the package is uninstalled this 2nd package is used to replace the newer files with the older ones. It doesn't delete any files that were added since or by the first package, so some extra stuff can accumulate, but that is far safer.

Creating a package. To create a package, lets call it demo, requires setting up the files system with the files, and the package manifest. The manifest says, among other things:

1. The package name, version, and other helpful paperwork info.
2. where to get the files from locally, and where they should be placed into filesystem deployed when deployed on a Vector.
3. The path to any files that should be modified, and how. This is used to change the reported version string.
4. The permissions to set the files to

I've attached a really simple demo to demonstrate. To create a package unzip them, and then:

```
./vector-pkg.py create -pkg=demo
```

That will create .vpkg file — a gzip'd tar file with a specific layout. From here everything has to be on a Vector.

Installation. To install the vpkd:

```
./vector-pkg.py install -pkg=demo-1.vpkg
```

Uninstall. To uninstall the vpkd later

```
./vector-pkg.py uninstall -pkg=demo-1
```

Adding a restart step after installation

There are four different ways to restart after applying the package. To simply restart Vector's application:

```
[post_deploy]
0=systemctl stop anki-robot.target
1=sleep
2=systemctl start anki-robot.target
```

To restart Vector's application, but silently -- that is, not play the *InitialWakeUp* animation:

```
[post_deploy]
0=systemctl stop anki-robot.target
1=sleep
2=echo 1 > /data/maintenance_reboot
3=systemctl start anki-robot.target
```

If `vector-pkg` is by called the modified `update-engine` it can tell it to reboot the operating system after the package has installed, using the key `reboot_after_install` in the `META` section. For example:

```
[META]
reboot_after_install=1
```

The following will reboot the operating system using a "maintenance reboot" so that the *InitialWakeUp* animation is not played:

```
[post_deploy]
0=/anki/bin/vic-log-event update-engine robot.maintenance_reboot success
1=echo 1 > /data/maintenance_reboot
```

12.3.4 Cavaets

12.3.5 Status

Not tested by others yet. Once the bugs are shaken out, the update-engine can be tweaked. When the update-engine gets a URL with ".vpkg" (such as from the BLE app) at the end, it downloads it, and then pass it to the package manager.

12.3.6 References

The files are on github <https://github.com/randym32/Anki.Vector.PackageInstaller>

12.3.7 Change history synopsis

Date	Change
2020-8-30	Created

12.4 VEP3 - Developer configurations for robot

Summary: Change robot configurations for

This is a stub proposal for a VPKG with many common configuration settings for a Developer-tinkering bots.

- configure many servers to use main production server
- configure servers to use local servers (logging)
- Customize: CPU, Heat, Display settings

Not sure if these can be downloaded via Bluetooth LE

- server configuration
- local preferences

12.4.1 References

12.4.2 Change history synopsis

12.5 VEP4 - Logging

Summary: Changes to the logging scripts, configuration to local servers. This is to modify the servers to use for the logging, crash dumps, and similar. Events/logs will no longer be sent to AWS, or backtrace.io.

Authors: Randall Maas

This a draft proposal (to be filled in) on how to modify Vector config files and scripts to send logging and crash dumps to a server of our choosing.

- Logging
- Trace information
- Server
- Settings
- DAS optin/optout

Replace /anki/bin/vic-log-upload - moving aside, /anki/bin/vic-log-upload since it just does AWS, S3:// - put in something that can contact our local server

Files:

- server_config.json
- log uploader

12.5.1 References

12.5.2 Change history synopsis
