Smart Home

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Outline

- Background
- Problem
- Progress
- Tech Stack
- Plans for Thesis B and C

My experience

- Developed smart homes for myself and my partner’s family
- Gaps in the market
- Room for growth
- Desire to push the industry forward

What is a smart home?

History of the Smart Home

- 1900's - Inception
- 1966 - ECHO VI
- 1975 - X10 Protocol
- 2000's - The beginnings of wireless
- Now

Problems with Smart Homes

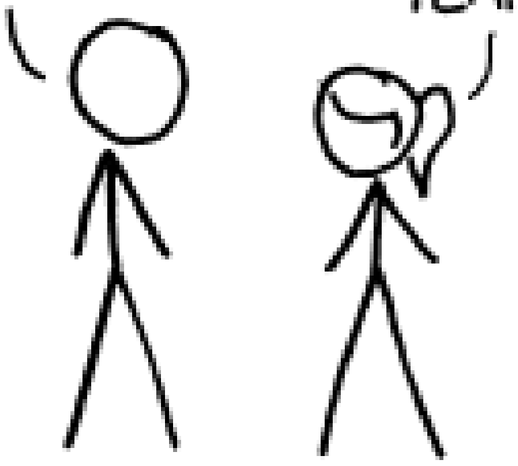
- Interoperability
- Lack of true “intelligence”
- Requirement for internet access

HOW STANDARDS PROLIFERATE:

(SEE: A/C CHARGERS, CHARACTER ENCODINGS, INSTANT MESSAGING, ETC)

SITUATION: THERE ARE 14 COMPETING STANDARDS.

14?! RIDICULOUS! WE NEED TO DEVELOP ONE UNIVERSAL STANDARD THAT COVERS EVERYONE'S USE CASES.



SOON:

SITUATION: THERE ARE 15 COMPETING STANDARDS.

Problems with Smart Homes

- Interoperability
- Lack of true “intelligence”
- Requirement for internet access

Aim

Create an intelligent environment where a user’s movements can accurately predict how to control devices within the home locally to increase convenience, safety and security

Convenience

- Automation
- Ease of access
- Save energy and money

Safety and Security

- Falls
- Medical Emergencies
- Break-in alerts

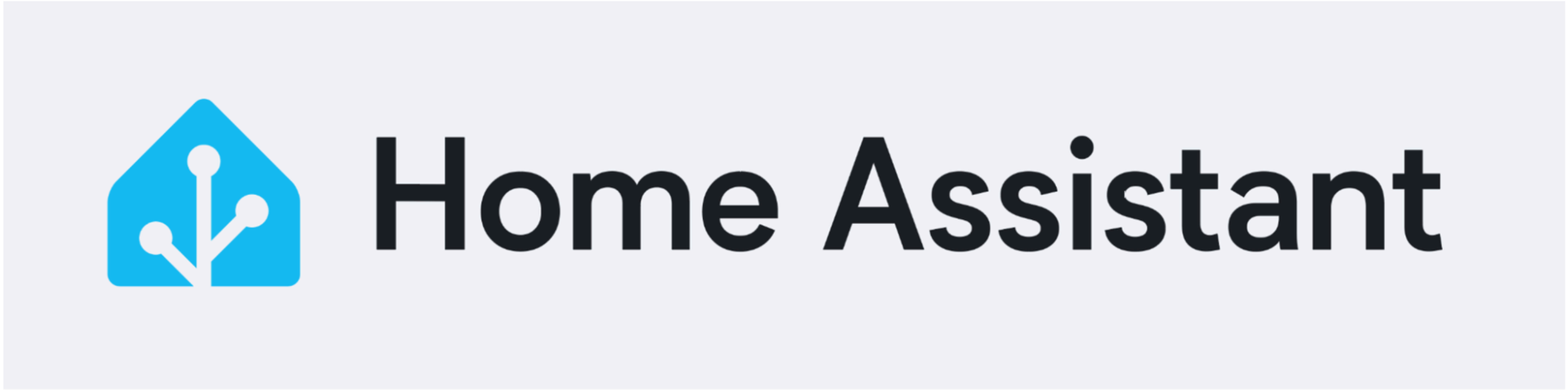
Existing Smart Home Platforms

The Big 3

Google Home

Amazon Alexa

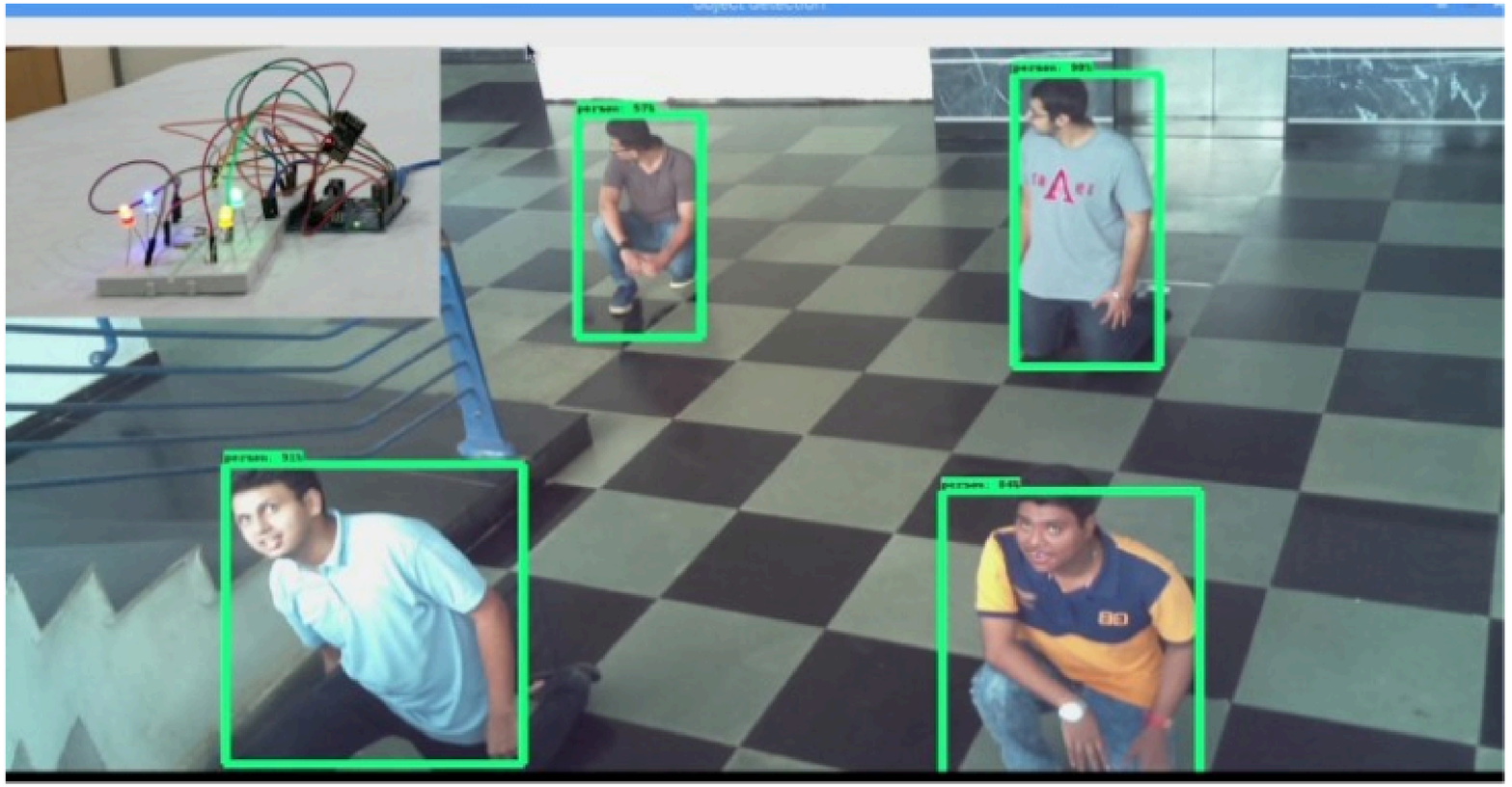
Apple HomeKit



The leading open source home automation software

Existing Implementations

Smart Home Automation using Computer Vision and Segmented Image Processing [1]

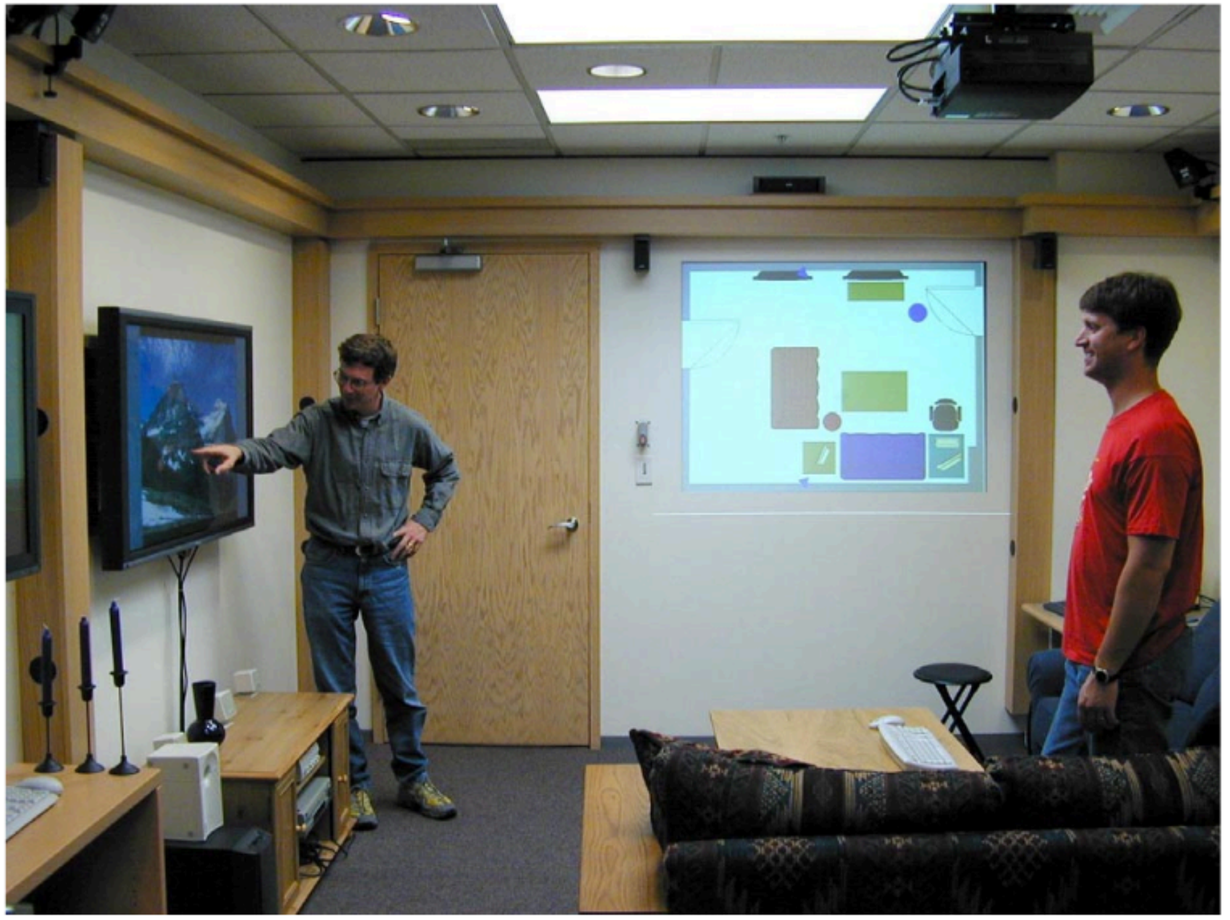


A Vision System for Intelligent Monitoring of Activities of Daily Living at Home [2]

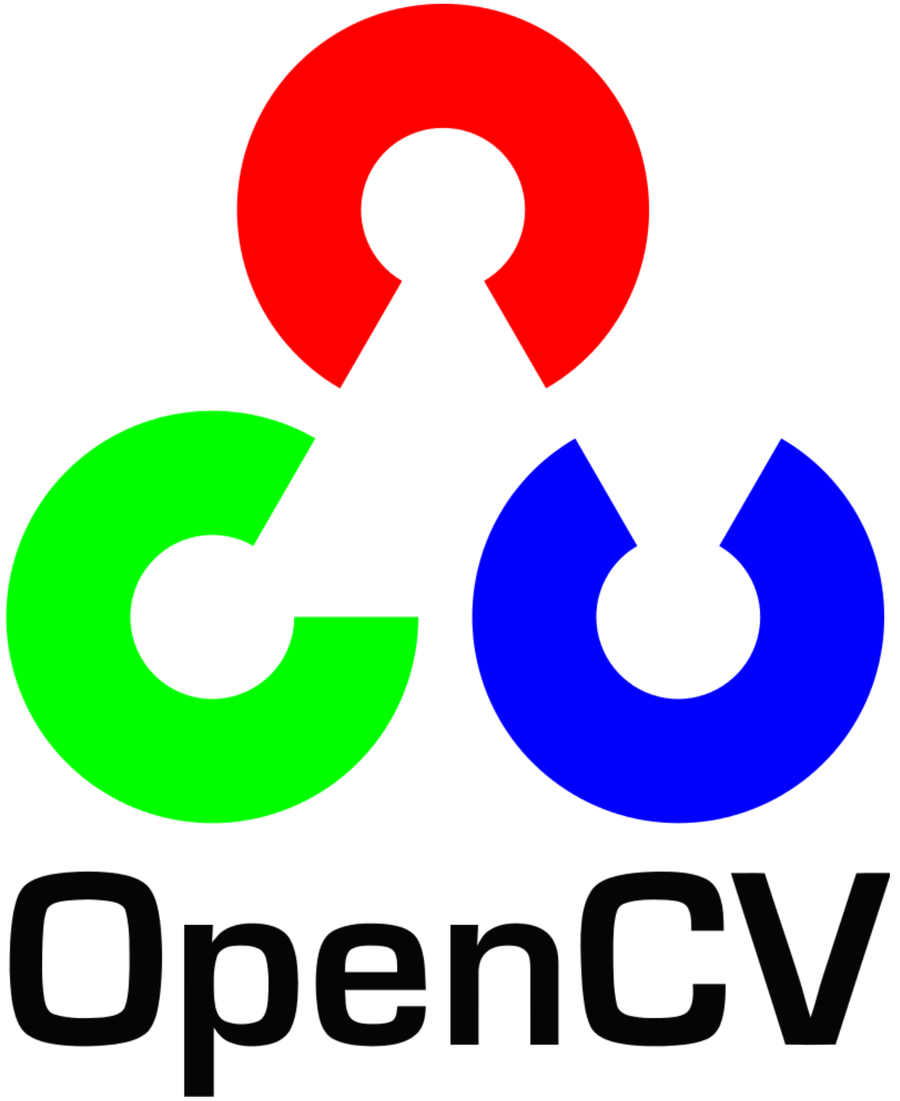
Multi-Camera Multi-Person Tracking for EasyLiving [3]

A Behaviour Monitoring System (BMS) for Ambient Assisted Living [4]

Human Computer Interaction Through Hand Gestures for Home Automation Using Microsoft Kinect [5]



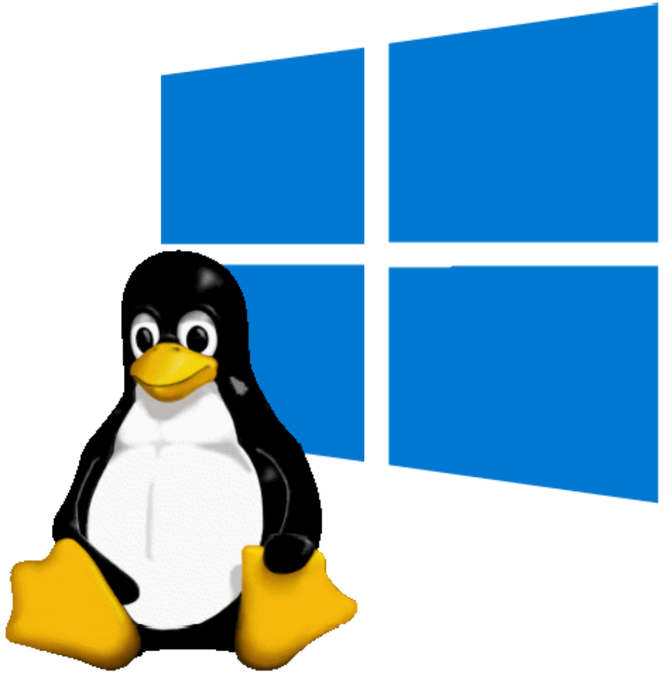
Computer Vision for Home Automation



Progress and Roadblocks

- ROS on Virtual Machine
- Kinect on Virtual Machine
- ROS1 to ROS2 Bridge
- ROS Humble vs ROS Foxy
- Ubuntu 20.04 vs Ubuntu 22.04
- ROS Noetic
- Kinect Bridge

Progress and Roadblocks



Progress and Roadblocks

Progress and Roadblocks

Progress and Roadblocks

Artificial
Intelligence

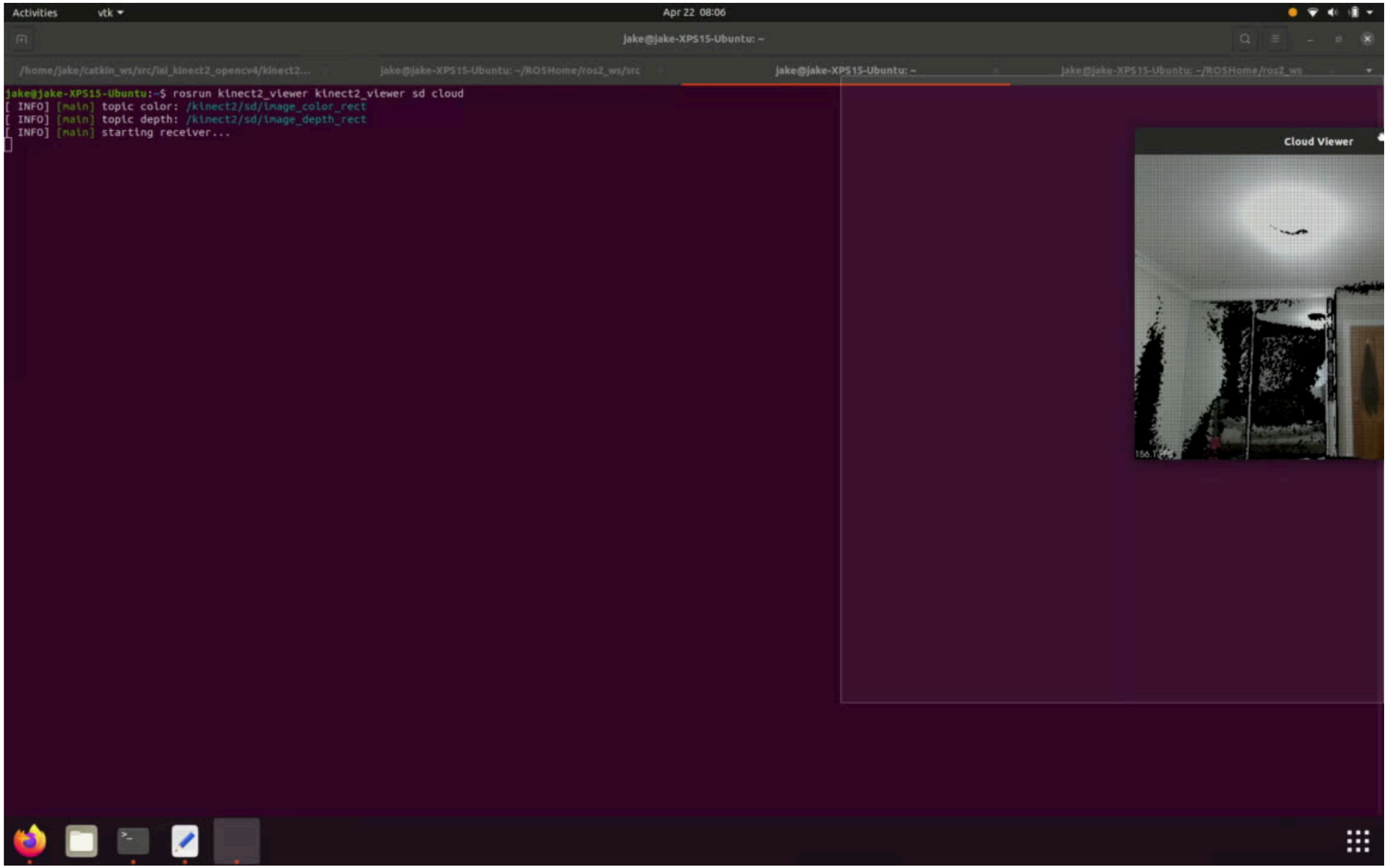
Progress and Roadblocks

Progress and Roadblocks

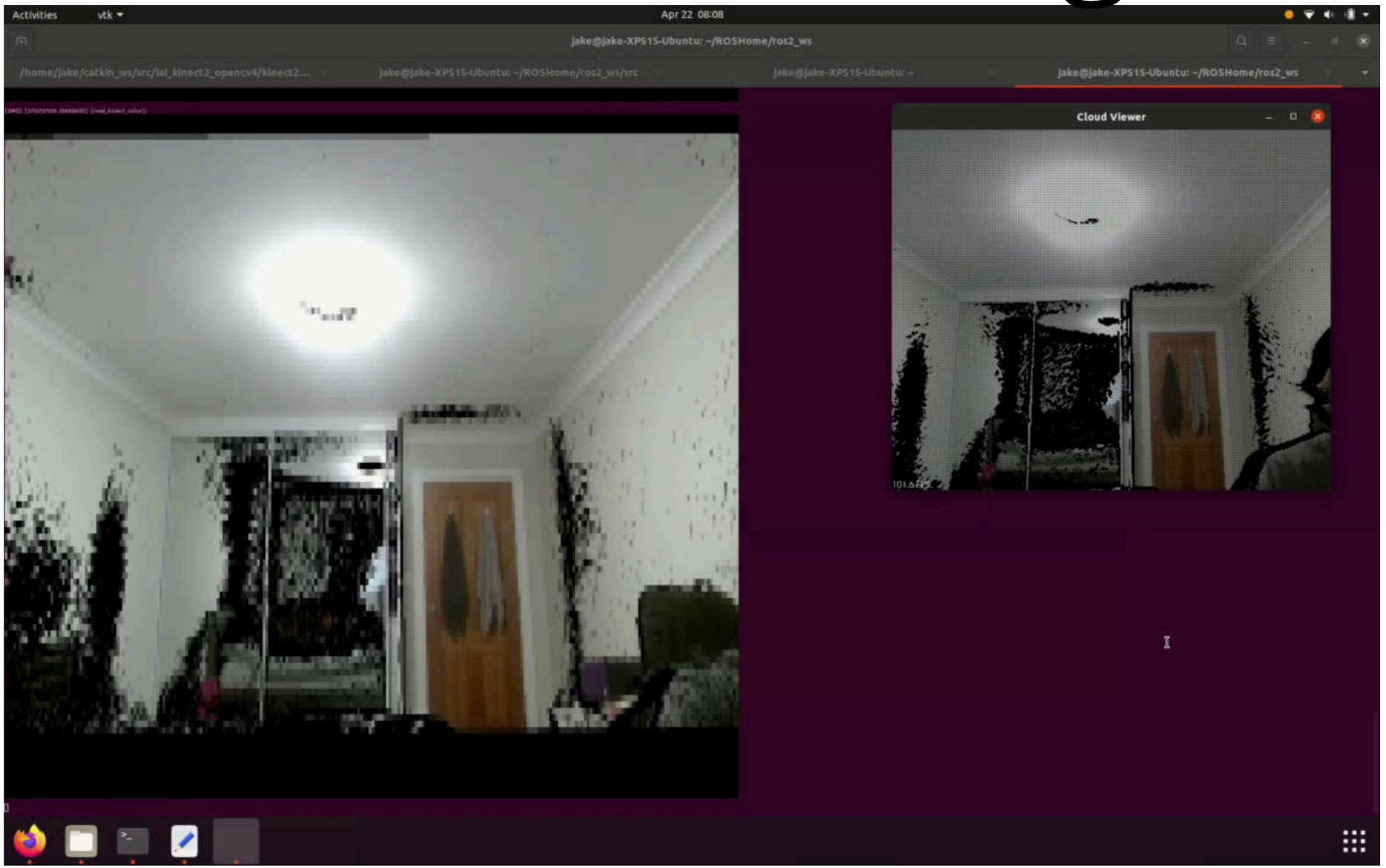
Progress and Roadblocks

- Successful environment setup of the Kinect and ROS2

Kinect to Ascii Art



Kinect to Console Image



Controlling devices

- Kinect hand gestures
- Turtle sim

Demo

Activities vtk Apr 22 08:39

jake@jake-XPS15-Ubuntu: ~/ROSHome/ros2_ws

TurtleSim

/ho ntu: ~/ROSHome/ro... jake@jake-XPS15-Ubuntu: ~ jake@jake-XPS15-Ubuntu: ~/ROSHome/ro... jake@jake-XPS15-Ubuntu: ~/ROSHome/ro...

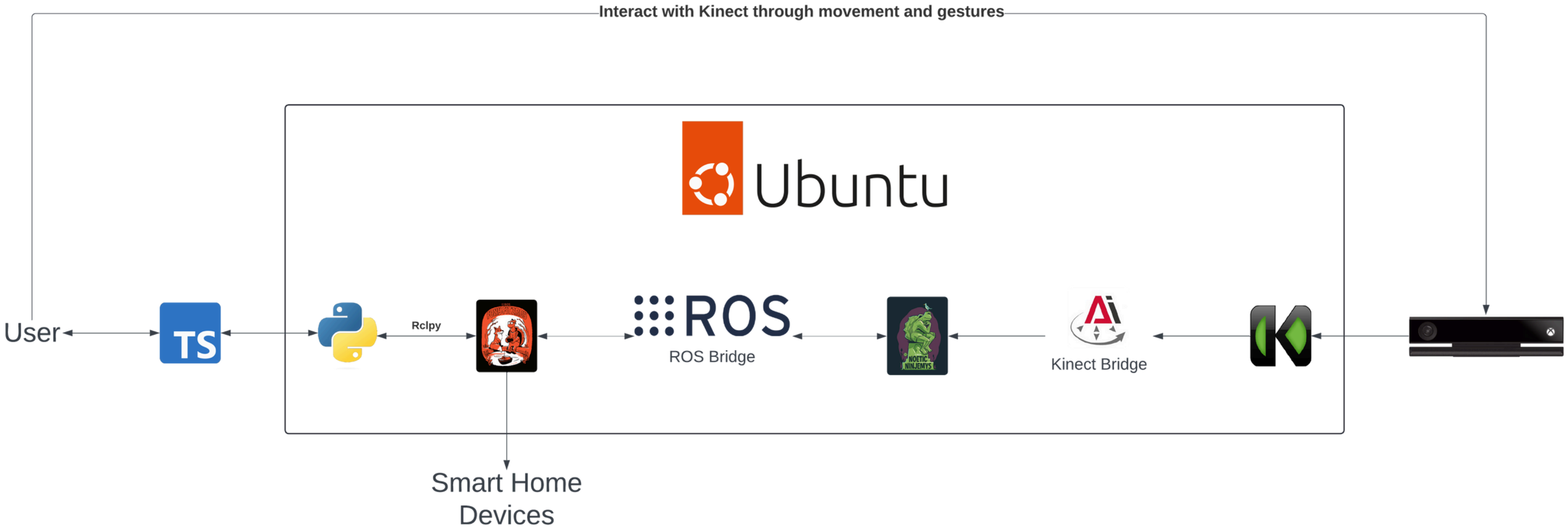
```
jake@
[INFO
[INFO
```

```
turtlesim_node
 with node name /turtlesim
urtle1] at x=[5.544445], y=[5.544445], theta=[0.000000]
```

Cloud Viewer

Plan moving forward

Tech Stack


Interact with Kinect through movement and gestures
Ubuntu
User
TS
Rclpy
ROS
ROS Bridge
Kinect Bridge
Smart Home
Devices

Timeline

Implement Yolo v8

Skeletonisation for gesture recognition

Train AI model

To recognise common actions in the home

Create a web interface

To allow users to control devices and add gestures

Evaluate performance

Test the models accuracy and reliability

Evaluating Success

- Rate of true positives
- Rate of false positives
- Rate of false negatives
- Speed of execution
- Perceived increase in convenience

Jake Palandri

Thank you!

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References

[1] Hasnain, M. R., S, R., P, M., & G, S. (2019). Smart Home Automation using Computer Vision and Segmented Image Processing. 2019 International Conference on Communication and Signal Processing (ICCSP), 429–433. https://doi.org/10.1109/ICCSP.2019.8697997

[2] Chaaraoui, A., Padilla-López, J., Ferrandez, J., García-Chamizo, J., Nieto-Hidalgo, M., Romacho-Agud, V., & Flórez-Revuelta, F. (2013). A Vision System for Intelligent Monitoring of Activities of Daily Living at Home (Vol. 8277). https://doi.org/10.1007/978-3-319-03092-0_14

[3] Krumm, J., Harris, S., Meyers, B., Brumitt, B., Hale, M., & Shafer, S. (2000). Multi-camera multi-person tracking for EasyLiving. Proceedings Third IEEE International Workshop on Visual Surveillance, 3–10. https://doi.org/10.1109/VS.2000.856852

[4] Eisa, S., & Moreira, A. (2017). A Behaviour Monitoring System (BMS) for Ambient Assisted Living. Sensors, 17(9). https://doi.org/10.3390/s17091946

[5] Desai, S., & Desai, A. (2017). Human Computer Interaction Through Hand Gestures for Home Automation Using Microsoft Kinect. In N. Modi, P. Verma, & B. Trivedi (Eds.), Proceedings of International Conference on Communication and Networks (pp. 19–29). Springer Singapore.