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B1: Aware-ables

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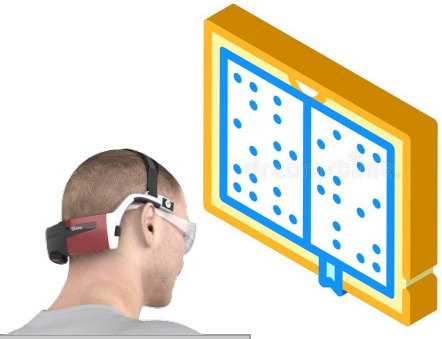
Presented by Chester Glenn

Use Case and Requirements



"A new device for auditory accessibility and assistance"

Wearable braille detection for increased awareness of surroundings and braille literacy

Requirement	Target (units)	Justification
Text-to-Speech latency	2s	Common usability standard for loading wait times
Words per Frame	>10	~300wpm to match braille reading speed *NOTE: 150wpm is a comfortable speaking speed
Character Error Rate	10%	Matches error rate of traditional OCR
Word Error Rate	<10%	Errors should be corrected from spellcheck

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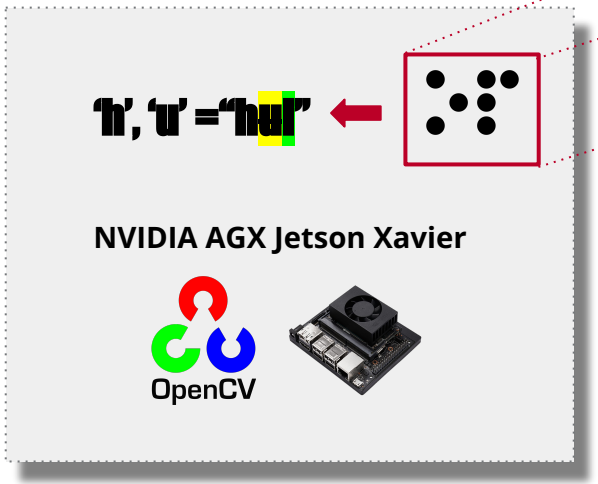
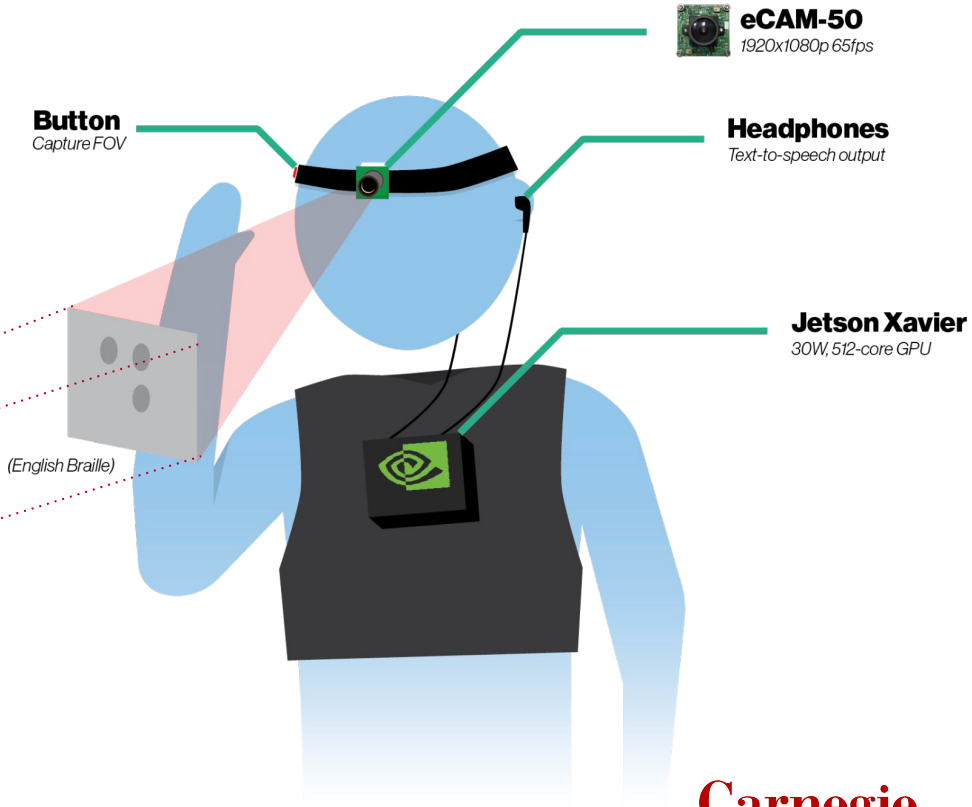
Initial Solution Approach

- Head-level camera for pointing at Braille writing
- Button for easily triggering Braille capture
- Jetson AGX Xavier vs. Jetson Nano





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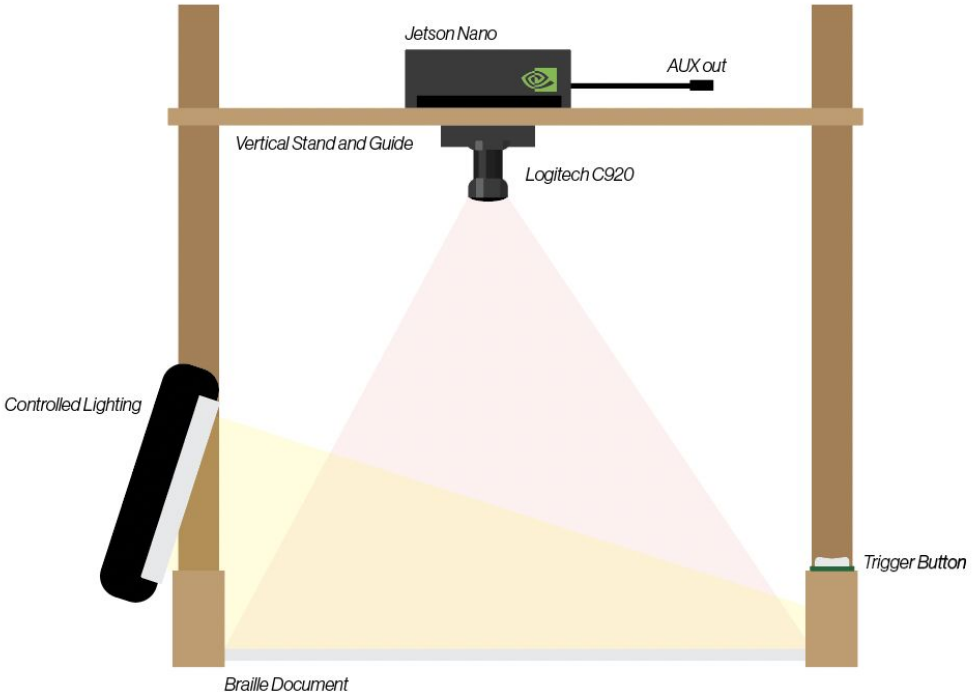

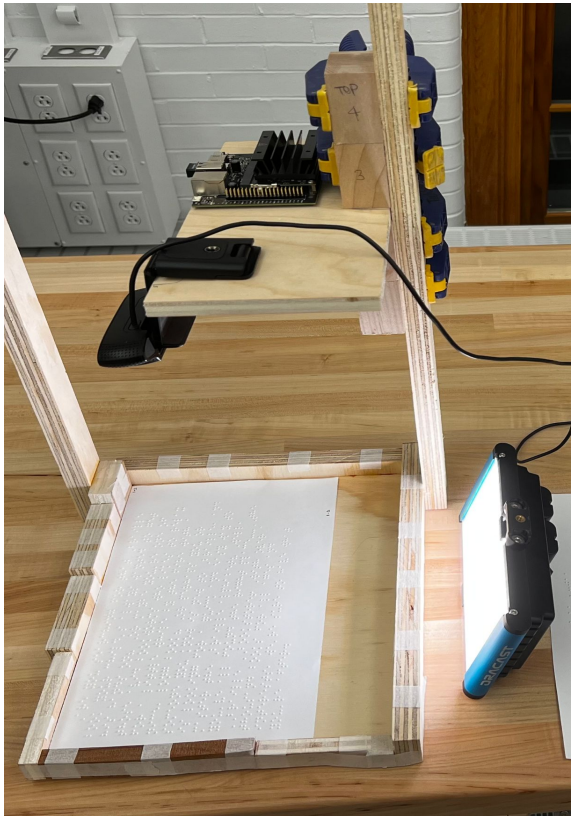

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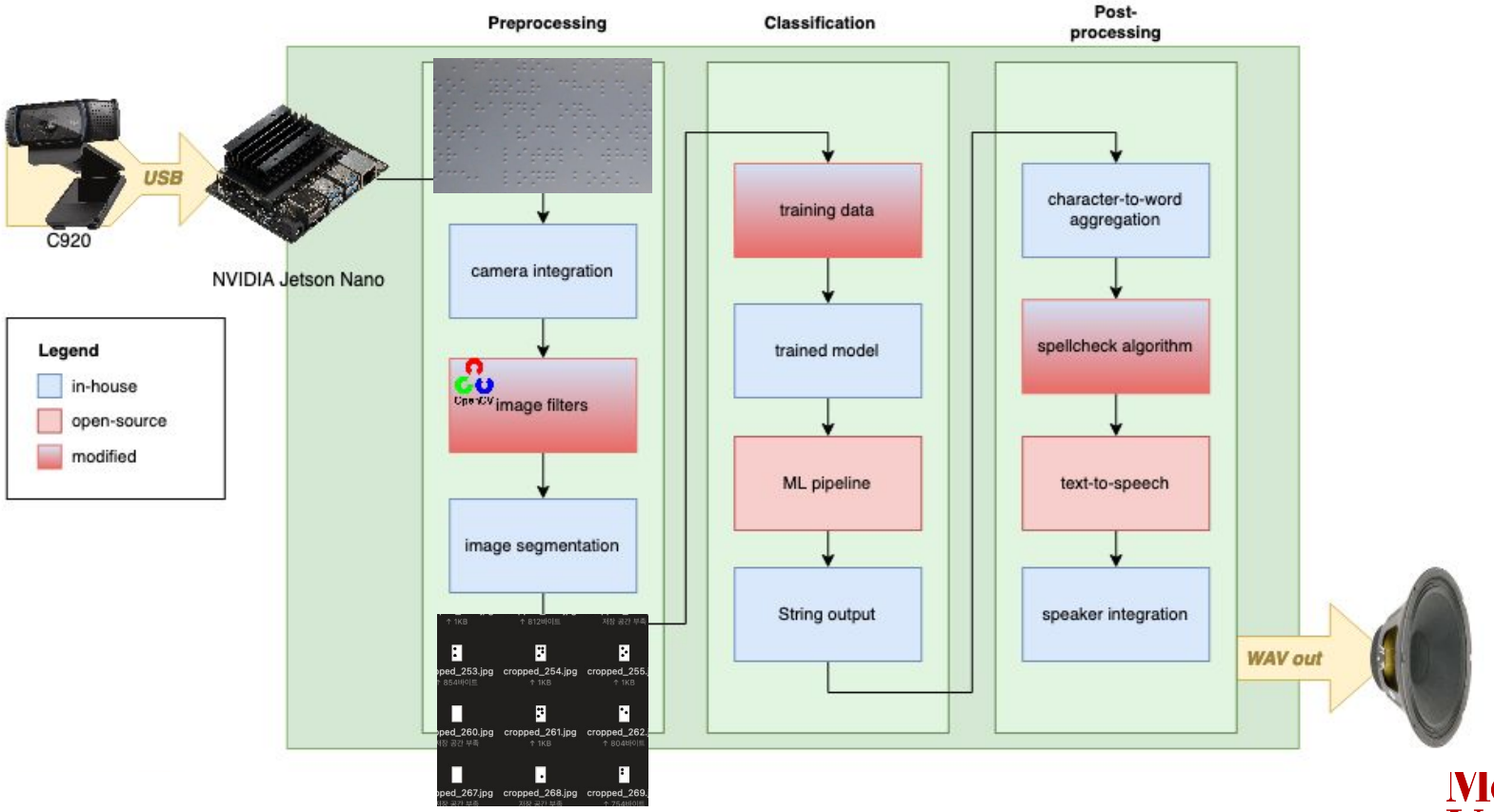
Block Diagram



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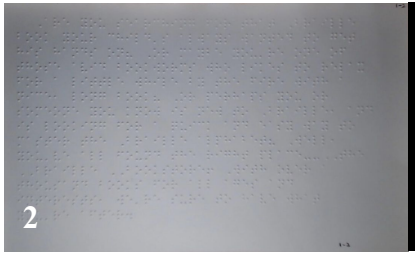
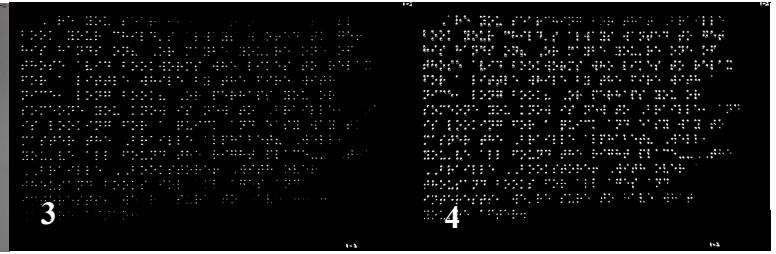
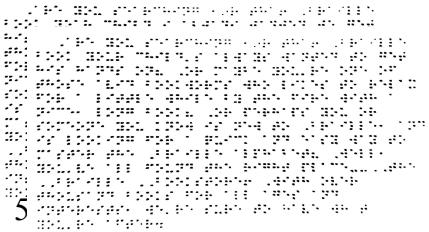
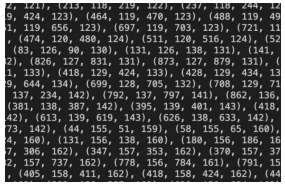
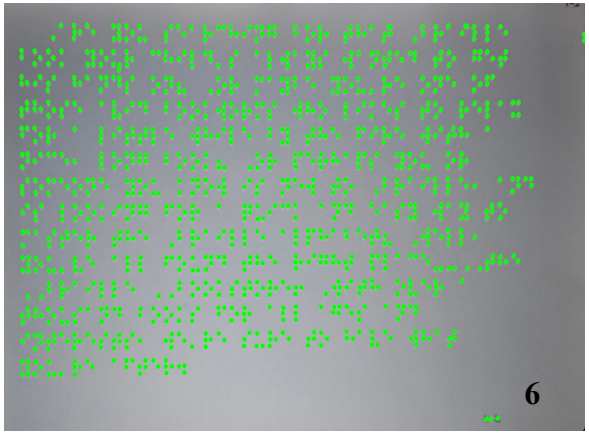
Testing: Pre-Processing

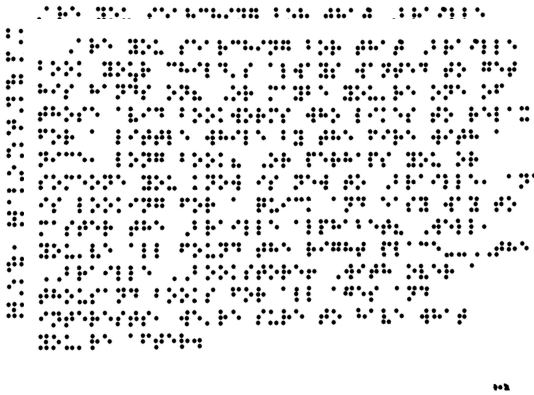












Model	Performance (Character recognition accuracy)	Latency
original capture w/o ml crop	89%	< 0.5 s
nms w/o ml cropp	98 %	< 0.5 s
nms w/ ml crop	98%	~ 5s

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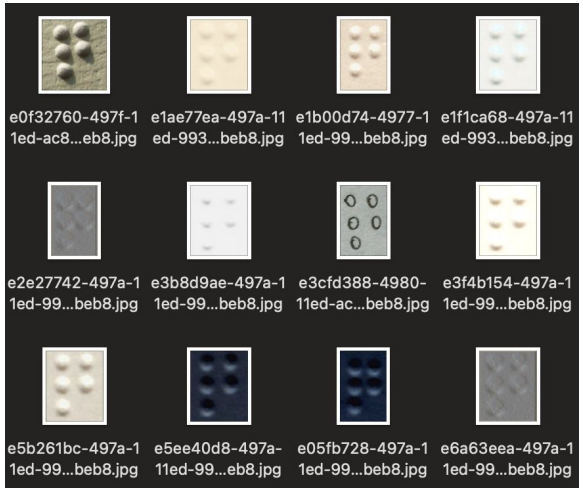
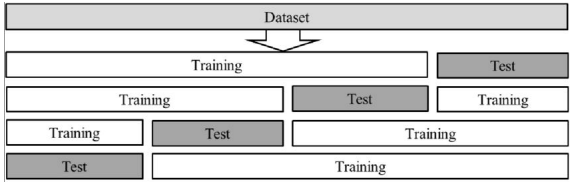
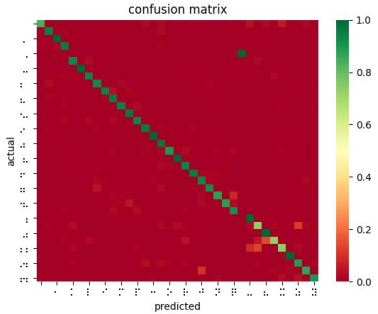
Testing: Character Classification



20,000 image dataset (src)

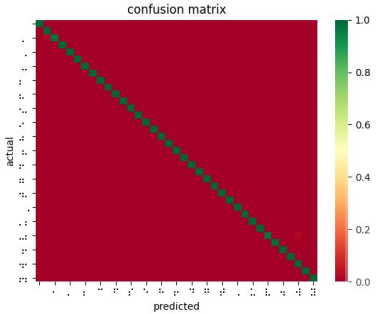


4-fold cross-validation technique (src)

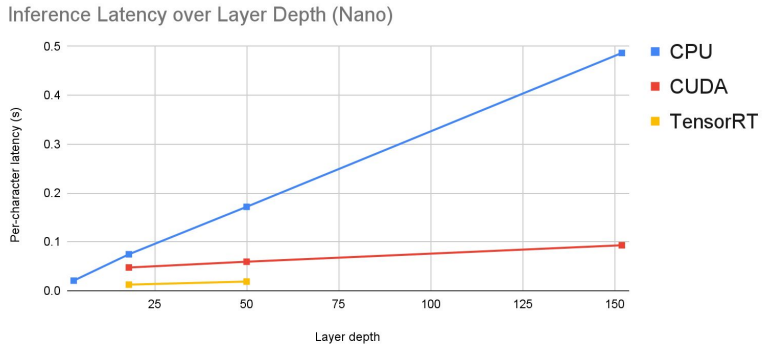


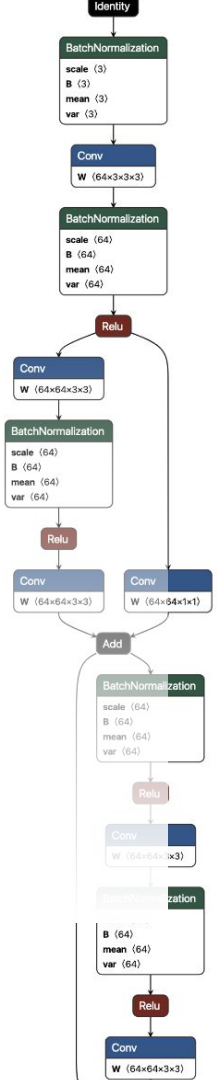
pre-trained model - 89%

vs.



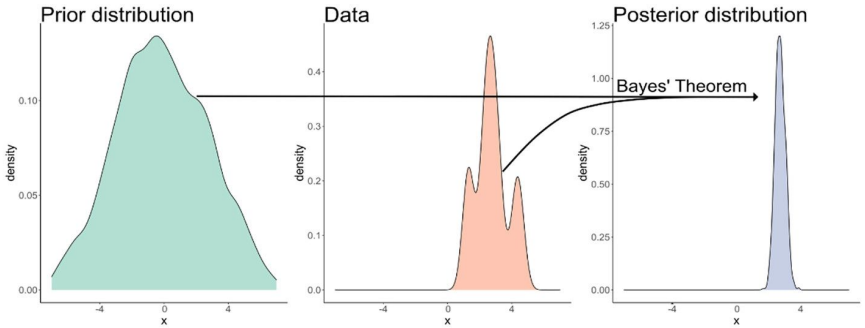
in-house ResNet-18 - 99%

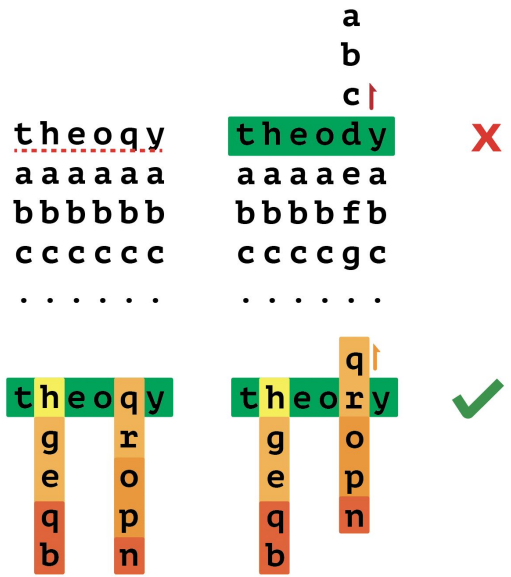




Testing: Post-Processing

Model	Word Error Rate	Latency
Static Dictionary	15%	1s
Bayesian Model	8%	0.02s
Bayesian + Dictionary	5%	1s
Confidence Matrix	3%	0.5s





Ex: Normal Bayesian model vs. Added confidence matrix

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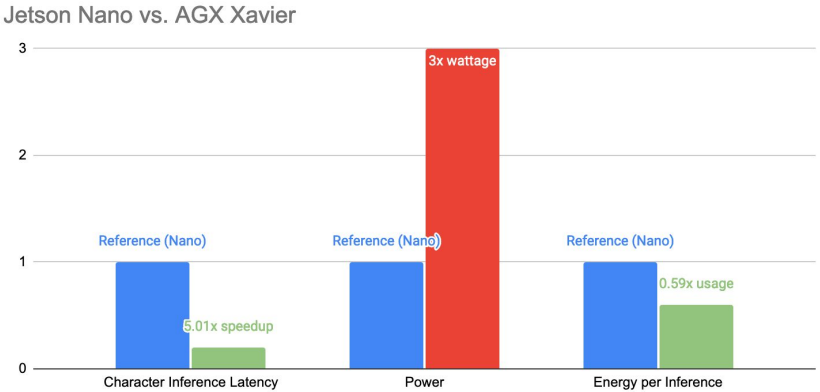
Integrated System: Validation & Verification

Requirement	Target	Actual (Nano)	Actual (Xavier)
Text-to-Speech latency	2s	**	~2.3s **
Words per Frame	>10	~8 (based on 0.5 second classification latency ceiling)	~40
Character Error Rate	10%	0.14%	0.14%
Word Error Rate	<10%	<1%	<1%

3x lower wattage



5x faster inference

***: rough measurem*
yet to be complet

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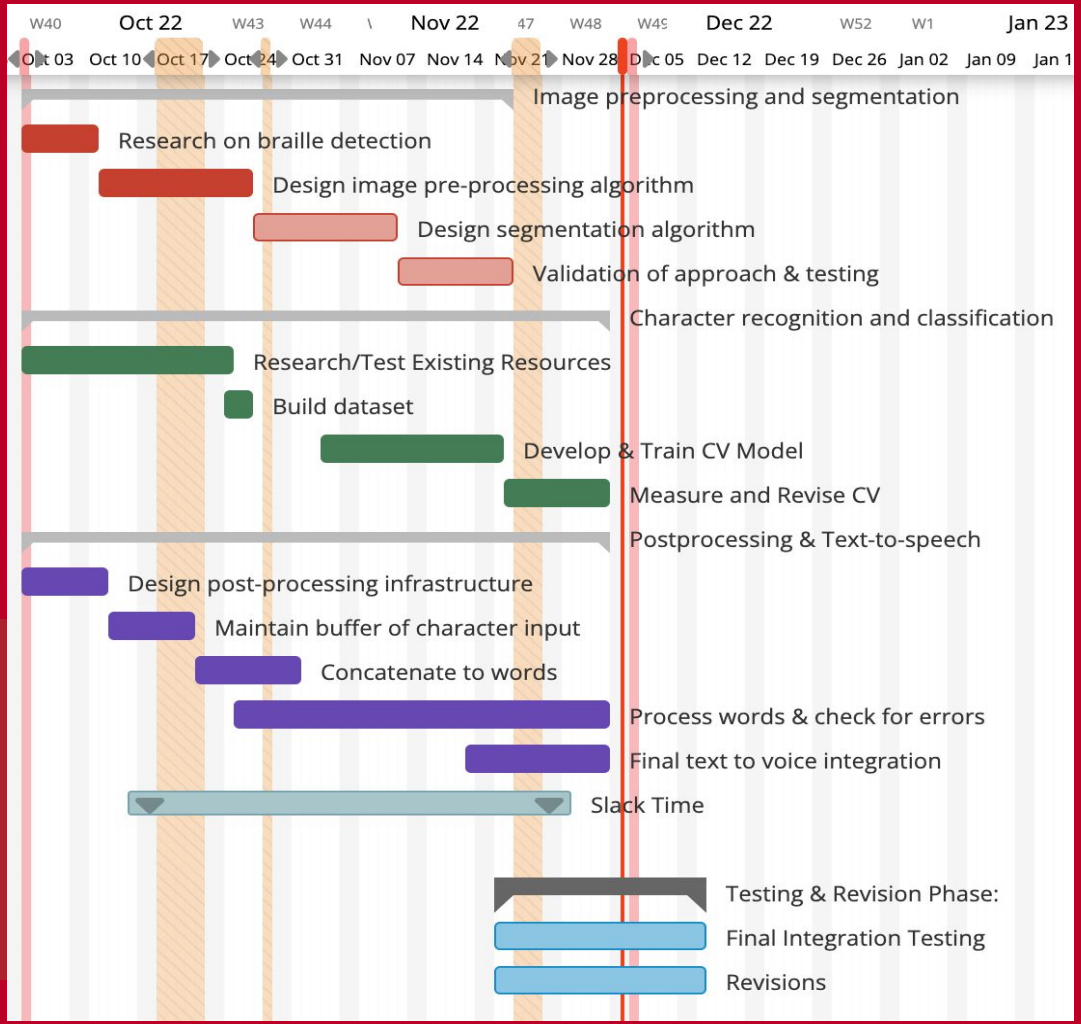
Schedule



LOOKING AHEAD...

- Further Integration Testing and Measurement
- Xavier vs. Nano final results
- Improve aesthetics

Lessons Learned...

- Focus on the **hardware** as soon as possible.
- **Collaboration** with others is not illegal, but helpful.
- Listen to advice.
- **Testing** and **record keeping** are both important not only for tracking your product's improvement but also teaching you how to improve further.
- **Communicate** with your group to make sure everyone is on the same page.

Thank you for listening!

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