Carnegie Mellon University

B1: Aware-ables

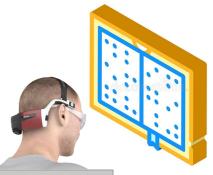
Team B1: Chester Glenn, Jong Woo Ha, Kevin Xie Presented by Chester Glenn



Use Case and Requirements

"A new device for auditory accessibility and assistance"

Wearable braille detection for increased awareness of surroundings and braille literacy

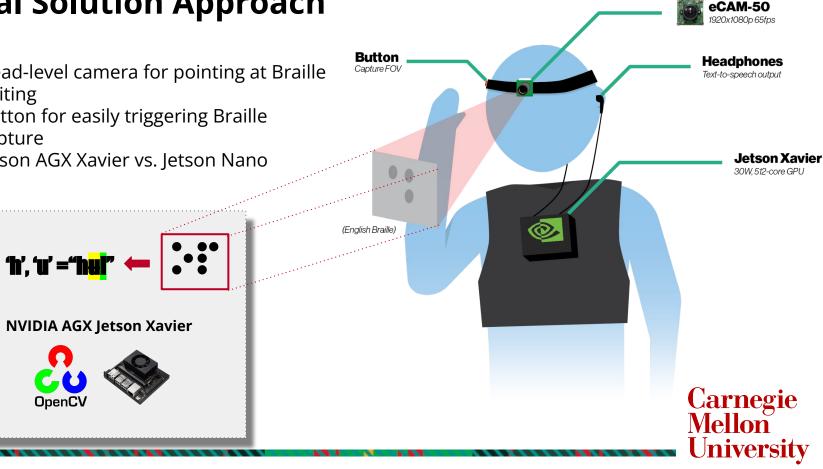


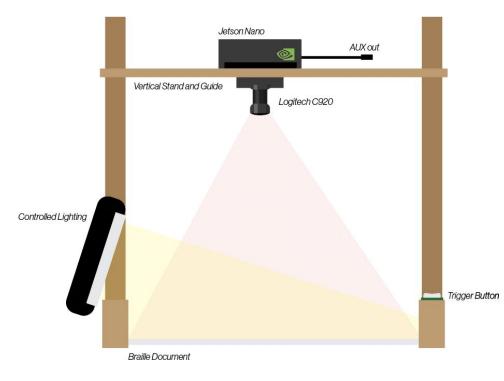
University

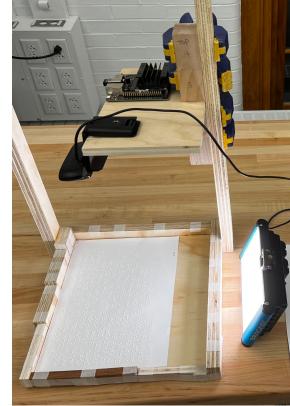
Requirement	Target (units)	Justification
Text-to-Speech latency	2s	Common usability standard for loading wait times
Words per Frame	>10	~300wpm to match braille reading speed *NOTE: 150wpm is a comfortable speaking speed
Character Error Rate	10%	Matches error rate of traditional OCR
Word Error Rate	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

Initial Solution Approach

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

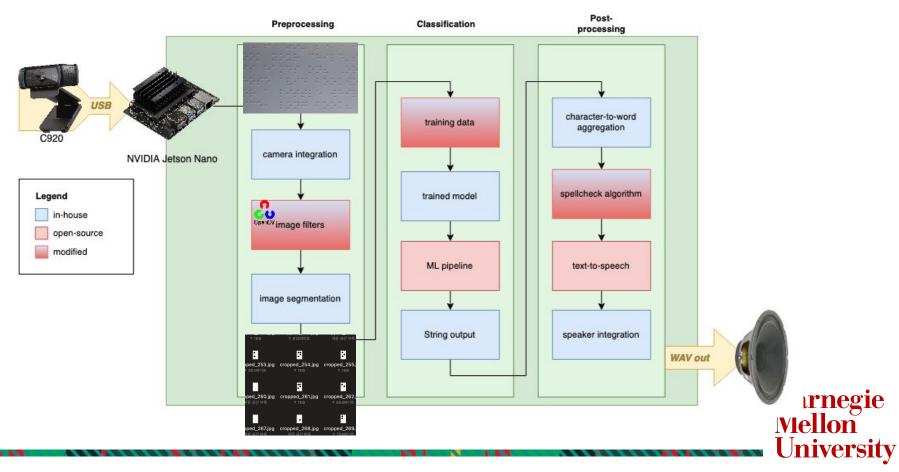






Carnegie Mellon University

Block Diagram



Testing: Pre-Processing

3 2

VEN BRUINNERS SOM AND COMPANY weeland of the status and ave usé marin assuer par se TERRIFERENCE AND EXCHANGE ANALIS . Exhiir deviz el fer cobr doire perme loge roots the meaning and be exchapt and table of and an instance 124 1123 413 41 ereden ban soorten soorten soorten soorte 14

2185-360 and ensure that and a constant root gota maxim a rearma arease as ana

🔮 алтны враж хороць цэр бланалог ары эр i faran in tan kara a a a a a a a a a 22 An approximate and a provide a set as a se gryana and dan sin sin sin shak tan is goings in approximate and a straight date

The second s

: :::4

32. 62

**2

University

• All of the state of the st

6 Carnegie Mellon

321.LY

::

•••

;::

::

:..

...

:.

÷.

...

33

٠

.::

...

3:

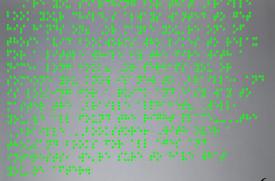
.

**: 3*:*

way waying

656, 123), (697, 119, 703, 123), (721, (474, 120, 480, 124), (511, 120, 516, 124), (52, (83, 126, 90, 130), (131, 126, 138, 131), (141,), (826, 127, 831, 131), (873, 127, 879, 131), 133), (418, 129, 424, 133), (428, 129, 434, 644, 134), (699, 128, 705, 132), (708, 129, 137, 234, 142), (792, 137, 797, 141), (862, 136 381, 138, 387, 142), (395, 139, 401, 143), (418 (613, 139, 619, 143), (626, 138, 633, 142) 142), (44, 155, 51, 159), (58, 155, 65, 160) (131, 156, 138, 160), (180, 156, 186, 160). 162), (347, 157, 353, 162), (370, 157, 306. 162), (778, 156, 784, 161), (791 158, 411, 162), (418, 158, 424, 162)

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

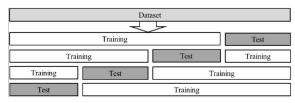




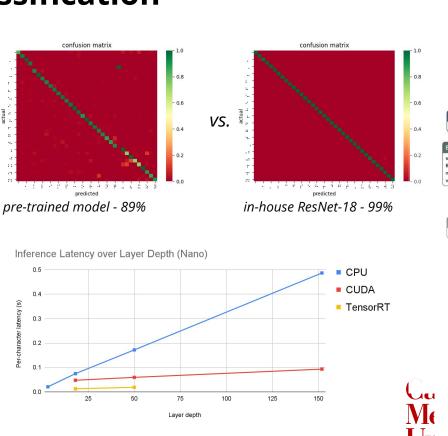
Testing: Character Classification

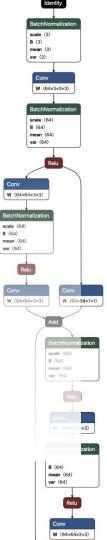


20,000 image dataset (<u>src</u>)



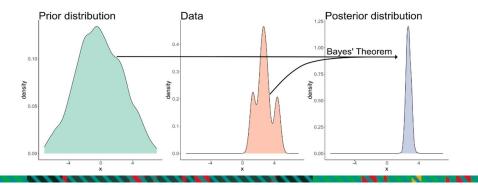
4-fold cross-validation technique (<u>src</u>)

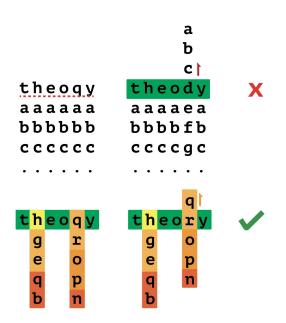




Testing: Post-Processing

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





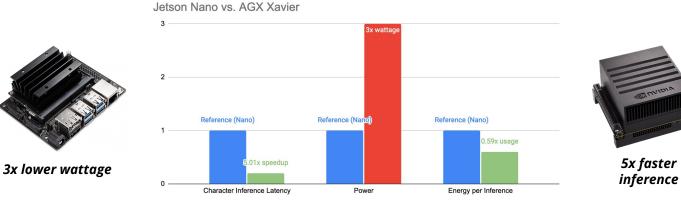
Ex: Normal Bayesian model vs. Added confidence matrix

> Carnegie Mellon

University

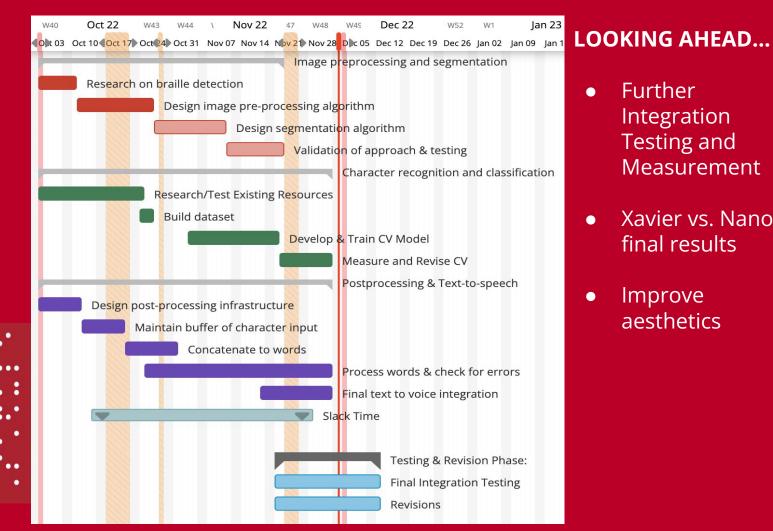
Integrated System: Validation & Verification

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%



**: rough measurem yet to be complet





- 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.



