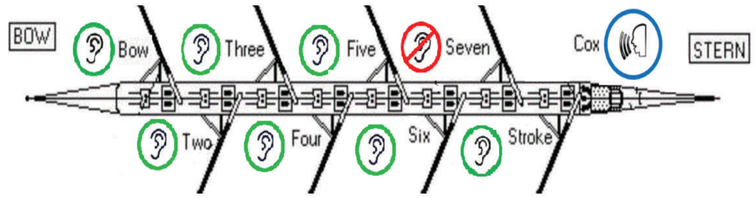
Real-Time Speech Recognition for Deaf and Hard of Hearing (DHH) in Competitive Rowing

Introduction

"Ready all, Row!"

These are the words every rower knows. In a 8 man racing boat or shell, timing is critical as all 8 must row at the same time to gain the maximum power during each stroke. For a deaf rower however, audible cues have no effect and thus must rely on the movements of their peers instead of joining the other 7 in sync. Our goal is to create a method to provide the same access to deaf/hard-of-hearing (DHH) rowers that is given to their hearing counterparts.



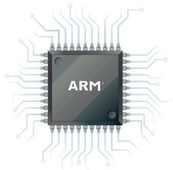
Discussion

Adaptation

- Every coxswain[3] is different. The way they speak, the way they choose to word a command.
- The speech recognizer engine allows for adapting the current acoustic model so the Pi is tailored for each individual coxswain that trains the machine.

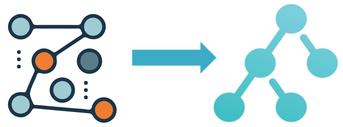
Computer Architecture

- The default ARM6[4] computer architecture was too slow for our needs.
- We upgraded to ARM7 and noticed an upgrade in speed and efficiency.



Language Model versus Context Free Grammar (CFG)

- Language model has common grammar mistakes that can confuse a rower.
- We switched to a CFG to preserve the natural flow of word syntax in coxswain commands and improve readability.



Weatherproof/Design Aspects

- The device must survive all training and race conditions.
- Weather can range from cold rainy conditions to hot humid sunny weather and the device must work in all possible scenarios.

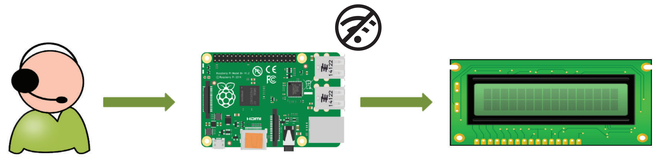
Method

In order to solve the problem of a DHH rower with no assistive devices, visual methods had to be employed.

- A Raspberry Pi was used for its computing capabilities as well as its size and weight.

The Pi is completely **offline** in order to take advantage of race conditions and the fact that it can be used anywhere.

- A limited dictionary is used to minimize the computation power needed since all processing is done onboard instead of the cloud.



Results

Timing Results across 3 different analyzers

CMU + Raspbian[1] (s)	CMU + Raspex[1] (s)	Google Speech Recognizer (s)
2:10	0.84	0.23
2:67	0.87	0.24
1:47	0.84	0.24
1:04	0.78	0.26
1:54	0.87	0.21
1:10	0.88	0.22
1.63	0.74	0.22
1.58	0.64	0.23
1.34	0.54	0.24
1.67	0.85	0.23
DNF[2]	0.74	0.23
2.11	0.70	0.23

Future Work

- Improving reaction time
- Finding the best placement on the racing shell
- Including an easy to use interface so the coxswains and coaches can use it
- Field testing on the water and in race conditions

Acknowledgements

I'd like to thank Professor Joe Stanislow & Professor Gary Behm for all their hard work and continued support during this project.

Footnotes

[1] Raspbian is the default operating system (OS) for the Raspberry Pi. Raspex is a different type of OS that is currently used in this project.

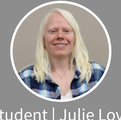
[2] Did Not Finish. During testing, the recognizer was not able to recognize that phrase consistently.

[3] A person who sits in either the stern or the bow of a boat and provides steering and motivation to the crew.

[4] Advanced RISC (Reduced Instruction Set Computing) Machine is a type of computer architecture that is widely used in smartphones and portable smart devices.

R·I·T
National Technical Institute for the Deaf


Student | Andre Webster


Student | Julie Love


Professor | Joe Stanislow


Professor | Gary Behm