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.

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

<table>
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<th>CMU + Raisbin (s)</th>
<th>CMU + Raspex (s)</th>
<th>Google Speech Recognizer (s)</th>
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Discussion

Adaptation

• Every coxswain 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 ARM® 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.

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.