VoiceEvo: Facilitating Ski Airbag Deployment via a Hands-Free Trigger

Alex Alexiev, Harry Chin, Hamza Dugmag, Willis Guo, Daniel Zhuang

https://backcountrymagazine.com/stories/arcteryx-proclirbag-reviewed/

Ski airbags are effective at protecting skiers and snowboarders from an avalanche. That is, when they are successfully activated by manually pulling a handle on the strap of the backpack...

01. The Opportunity

60% of ski airbag failures are due to **user activation failure** [1].

During an avalanche, skiers have **limited motor control** and need to use their arms for balance instead of manually pulling the trigger [2]. On top of that, ski poles are obstructive when trying to grip onto pulling handles in current designs.

02. Critical Metrics

High **detection accuracy [%]** improves reliability

Low **power consumption [W]** reduces anxiety
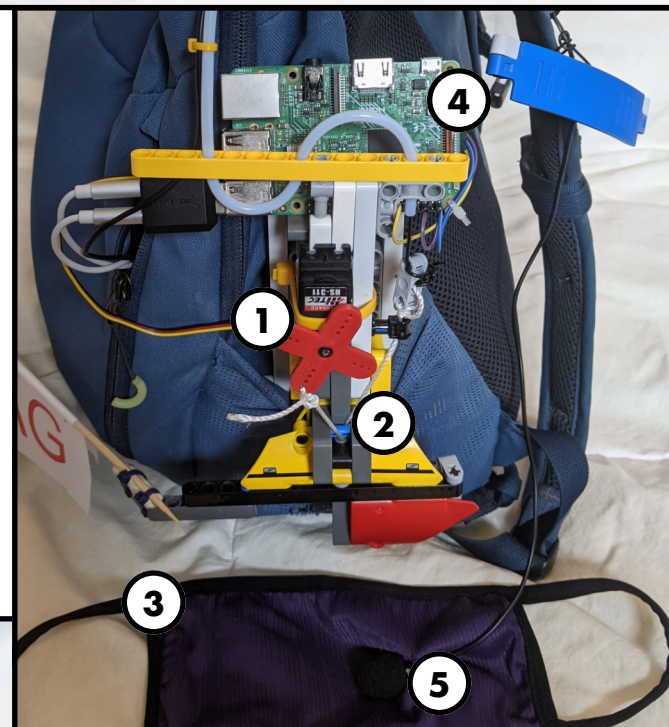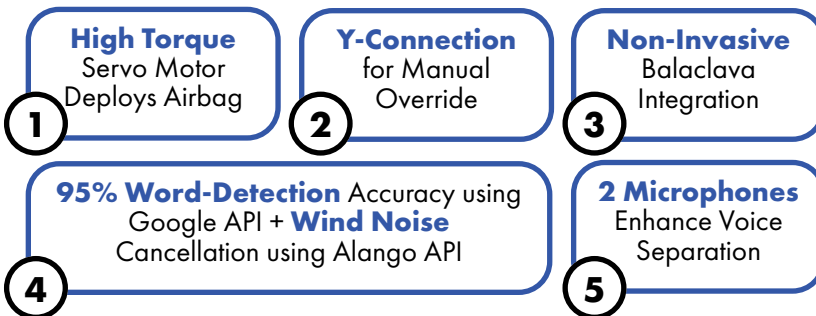
Fewer **points of failure [#]** improves durability

Low **movement restriction** increases activation rate

Short **deployment time [s]** maintains integrity

03. The Design

We have designed **VoiceEvo,** a **hands-free, voice-activated** airbag triggering system. Skiers can deploy the airbag by simply saying a hotword into the microphones that are securely embedded into their balaclavas. Our design facilitates activation without sacrificing reliability.

High Torque Servo Motor Deploys Airbag — 1

Y-Connection for Manual Override — 2

Non-Invasive Balaclava Integration — 3

95% Word-Detection Accuracy using Google API + **Wind Noise** Cancellation using Alango API — 4

2 Microphones Enhance Voice Separation — 5

04. Testing and Evaluation

1.8W power usage • 2s deployment time • 3 points of failure

This design streamlines ski airbag activation with high reliability by eliminating the use of arms, which was an impediment to user safety. In tandem with high time and power efficiency, we recommend this design in response to the opportunity. A critical assumption is that most users will be comfortable with shouting in high stress situations, which is supported by the fight-or-flight response [3]. Also, the manual override provides a fallback in case of electronics failure to give users a peace of mind.

05. Next Steps

We will integrate researched technologies such as the Alango API and waterproof the electronics with reference to the Ingress Protection test [4]. Since users can react to avalanches differently, we will implement personalized voice profiles where users can specify and evaluate their hotwords. After verifying our design refinements, we plan to validate the solution with stakeholders through on-site testing.

[1] Haegeli, et al. 2014. "The Effectiveness of Avalanche Airbags." Resuscitation 85 (9): 1197–1203. [2] https://www.healthline.com/health/stress/amygdala-hijack. [3] Arnal, Luc H. et al. Current Biology, Volume 25, Issue 15, 2051 - 2056. [4] ISO 20653:2013.