The Best Snowboarding Buddy: Snowpes System

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The Best Snowboarding Buddy: Snowpes System

BY

Peiwen He

A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Fine Arts in Visual Communication Design

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Abstract

The mountain ski resorts are huge places, while the maps are difficult to read and remember. Due to the difference of languages and map signs across countries, it's difficult for people to locate themselves on a map. In addition, it can be difficult for a snowboarder to keep contact with their crew. It also makes asking for rescue take longer. For the snowboarders whose ears are occupied, it's dangerous when there's someone behind them closely. For novice snowboarders who snowboard alone, it is not easy for them to learn new tricks so that they may give up. The Snowpes system includes XR (Mixed Reality) snowboarding goggles and a camera drone. With Augmented Reality Head-Up Display (AR HUD) Technology, the Snowpes goggles can help snowboarders navigate through the big resorts safely and connect with their crew easily. The Snowpes goggles’ VR (Virtual Reality) mode can help users feel more engaged in the snowboarding community. The Snowpes camera drone can follow the users automatically and it can be controlled by goggles with computer vision and spatial computing technology. Project Implementation includes developing digital 3D model design, Camera Drone HUD Design, Goggles HUD Design, HUD prototype, and a Promotion Video.

Keywords  Augmented Reality, Virtual Reality, Head-Up Display, Drone, Snowboard Goggles
**Problem and Solution Statement**

Mountain ski resorts are a huge place. Paper trail maps snowboarders carry around are difficult to read and remember. And the important information, such as navigation, heartbeat, speed, and vertical drop, is not easy to access on the move. When snowboards are doing the sports in a new place, especially overseas, it’s hard for them to understand their surroundings intuitively through just a paper trail map. The different languages might also makes asking for rescue late. And they can’t know where their snowboarding crew members are, so that they are more likely to lose contact with each others. When snowboarders are on the run, it is important to be aware of other skiers and snowboarders. But it’s not possible for snowboarders to hear or focus on everyone. How might we design a system to help snowboards understand themselves and their surroundings and create a safe and pleasant snowboarding experience for them? The Snowpes system includes snowboarding goggles, and a camera drone. Users can create a custom route easily by tapping the start and endpoint on a 3D trail map showed on the HUD. Moreover, users can choose a buddy to follow along with. They can also track their buddies and vehicles. The video gallery of Snowpes system collects the videos captured by the goggles camera and the camera drone, and there are also the VR tutorial videos and live snowboarding videos. Therefore, users can use the goggles’ VR (Virtual Reality) mode to enjoy snowboarding anywhere. With Augmented Reality Head-Up Display (AR HUD) Technology, snowboarders will see the stats on their goggles’ HUD and navigate themselves intuitively by switching to the goggles’ AR mode. For safety reasons, there will be a visual warning when someone is trying to cut them off. Plus, there's also an emergency call button on the goggles. Project Implementation includes developing digital 3D model design, Camera Drone HUD Design, Goggles HUD Design, App prototype, and a Promotion Video.

**Main Body**

It is important to be aware of other skiers and snowboarders, especially if they are behind you. But it’s not possible for snowboarders to hear or focus on everyone. Over 5% – or 430 million people – of the world’s population have disabling hearing loss (World Health Organization, 2020). In addition, most of the snowboarders who I interviewed says that they prefer to listen to music while doing the sports. It’s dangerous for them if there’s someone close behind them when snowboarding. To address this safety issue, Snowpes goggles apply a special orange AR visual warning to the HUD to tell them which side they need to watch out for. The reason that I choose safety orange to be the accent color for the goggles HUD because the ski resorts use safety orange color on their warning flags. The vivid reddish-orange is used to set objects apart from their surroundings, and there is a very strong complementary contrast between the vivid reddish and the color of the sky (Color Matters, 2021). North America uses about five symbols to grade the trails, while Europe or Japan uses slightly different symbols to mark theirs (Fig.1), which might cause misunderstanding when snowboarders do the sports overseas. Moreover, Europe and Japan only use colors to mark the difficulty of a trail, which is not user-friendly to the color-blind snowboarders.
Worldwide, approximately “8% of men and 0.5% of women suffer from color blindness” (color vision deficiency, or CVD), which means that there are about 300 million color-blind people all over the world, almost the same as the entire population of America (Color Blind Awareness, 2020). By using bigger and animated shapes and colors, Snowpes HUD can not only inform users which levels the trails they are heading to but also help the color-blind users understand the European and Japanese trail signs. Our eyes follow a certain pattern when browsing a page. According to Figure 2, the Gutenberg Diagram divides the page into four quadrants. When it comes to design a HUD, it would be better if the secondary information is not placed on the primary optical area. Snowpes HUD puts the primary data on the primary optical area as well as the strong follow area, and tries to decrease distractions on the snow slopes. To test the balance, authentic and legibility of the HUD, I sketched the HUD designs on the Mylar sheets, and saw the ski resorts through the sheets. In this case, Snowpes can provide a more well-organized and efficient HUD for users with minimized distractions.

**Conclusion**

Given the fact that ski mountain resorts are huge places, it’s easy to get lost and lose contact with other crew members. Besides, there are about 300 million color-blind people and 430 million deaf people all over the world. Goggles with AR HUD technology can help snowboarders navigate through the big resorts with more understanding of their surroundings and also help snowboard crews connect with each others. The 3D trail maps are designed for users to easily plan their route with simply tapping the start and end points. By using the safety orange visual warning, it would be safer for the ear-occupied snowboarders to know there’s someone behind them. Snowboarders, especially color-blind snowboarders can be well informed with bigger and animated shapes when snowboarding overseas. The system also provides users a more immersive experience anywhere with the technology of VR, camera drone and streaming. This system is aimed to give users a safe and pleasant snowboarding experience.
Appendix A - Defence Slides

1.

Get Lost or Lose Contact

Mountain ski resorts are huge places, while the maps are difficult to read and remember, it’s difficult for snowboarders to locate themselves on a map. It can also be difficult for a snowboarder to keep contact with their crew.
2.

North America uses about five symbols to grade the trails, while Europe or Japan uses slightly different symbols to mark theirs. The signs in Europe and Japan are not user-friendly to the color-blind snowboarders. While approximately “8% of men and 0.5% of women - 300 million people - suffer from color blindness”.

![Figure 1. The trail signs ratio. Image downloaded from https://signsfromthemountains.com/ in April 2021.]

3.

Hearing Loss

Over 5% - or 430 million people - of the world's population have disabling hearing loss.
4. Private lesson can be expensive

It’s expensive to learn snowboarding by **hiring a personal coach**. Private lesson can cost more than **$100 a hour**.

<table>
<thead>
<tr>
<th>Private Lesson (Ski or Snowboard)*</th>
<th>One Person</th>
<th>Each Additional Person</th>
</tr>
</thead>
<tbody>
<tr>
<td>One Hour</td>
<td>$115</td>
<td>$75</td>
</tr>
<tr>
<td>2 Hours</td>
<td>$230</td>
<td>$140</td>
</tr>
<tr>
<td>3 Hours</td>
<td>$320</td>
<td>$210</td>
</tr>
<tr>
<td>Full Day (6 hours)</td>
<td>$600</td>
<td>$400</td>
</tr>
</tbody>
</table>

[Figure 2. Private Lessons Cost downloaded from https://skibuttermut.com/lessons-packages/lessons/private-lessons in May 2021.]
Auto Tracking Target. Superb Computer Vision. Your Best Snowboarding Buddy.

<table>
<thead>
<tr>
<th>Feature</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
<td>1.5 kg</td>
</tr>
<tr>
<td>Flight Time</td>
<td>30 min</td>
</tr>
<tr>
<td>Video Resolution</td>
<td>4K HDR / 180</td>
</tr>
<tr>
<td>Max Speed</td>
<td>100 mph</td>
</tr>
<tr>
<td>Range</td>
<td>5 mile</td>
</tr>
<tr>
<td>Dimension</td>
<td>20 x 25 x 5 cm</td>
</tr>
</tbody>
</table>
Users

Snowpes focuses on snowboarders. There are 4 Insights according to the interviews and research from snowboarders of various experience levels and countries.

1. Snowboarding Crew
   - Plan their next run with Snowpes goggles 3D virtual reality trail map
   - Know where their crew members are and choose a member to follow along
   - Navigation on Snowpes goggles HUD

2. Overseas Snowboarder
   - Navigation with the trail signs which users can understand even they snowboard overseas
   - Call for help with one button

3. Beginner Snowboarder
   - Learn new tricks immersively with Snowpes goggles VR mode
   - See other snowboarders' first-person POVs live video with their goggles
   - Review their previous run with videos captured by goggles and camera drone

4. Ears-dominated Snowboarder
   - Give visual warnings when there's someone trying to cut off the users
User Flow 1

Navigation on HUD

- **Put on Goggles**
- **Switch to AR Mode**
  - **Tap the Buddy Tracking Button**
  - **Swipe to Open Controller**
  - **Tap the End Point**
  - **Tap the Start Point**
- **Choose a buddy to follow**

User Flow 2

Safety Guard For Users

- **Put on Goggles**
- **Switch to AR Mode**
  - **You are Hurt**
  - **Someone is overtaking you**
  - **Left Side**
  - **Right Side**
  - **Right Visual Warning Shows on HUD**
- **Left Visual Warning Shows on HUD**
- **Feel Safe**
  - **Press the SOS Button on the Goggles**
  - **You are Rescued**

Peiwen He

⚠️ SNOWPES
User Flow 3

Camera Drone Control

1. Put on Goggles
2. Switch to AR Mode
3. Swipe to Open Controller
4. Tap the Camera Drone Button
5. Control the Drone Back to the Dock
6. Finish your Run
7. Control the Distance between You and the Drone

User Flow 4

Immersive Experience with Goggles

1. Put on Goggles
2. Switch to VR Mode
3. Tap the Local Video Gallery Button
4. Tap the video you just recorded
5. Tap the Live Video Channel button
6. Tap on the video you want to watch
7. Enjoy Videos
1. **Snowboarding Crew**

"The trail maps are difficult to read and remember. It's easy to get lost and lose contact with my crew frequently."
2. **Overseas Snowboarder**

"When I snowboard overseas, the different languages and map signs are a real pain. Especially when I need to call for help."
Beginner Snowboarder

"It’s really expensive to take personal snowboarding lessons, and hard to teach myself with online videos. I wish I can be involved into snowboarding community quickly."
4.

**Ears-occupied Snowboarder**

"Listening to music helps me enjoy the sports more, but sometimes it can be dangerous when there’s someone close behind me."
Research

1.

Color Selection - Safety Orange

The vivid reddish-orange is used to set objects apart from their surroundings, and there is a very strong complementary contrast between the vivid reddish and the color of the sky.

Research

2.

Reading Gravity

Our eyes follow a certain pattern when browsing. The Gutenberg Diagram divides the page into four quadrants. When it comes to design a HUD, it would be better if the secondary information is not placed on the primary optical area.

(Figure 3. The trail signs rate how our eyes track down a page according to the Gutenberg diagram. Image downloaded from https://www.tales.co.nz in April 2021.)
HUD Testing

Use Mylar Sheet to test and adjust the balance and legibility of the HUD.

1.

Product Design Iterations - Snowpes Goggles

- High Cost to Buy
- Long Learning Curve
- Some Snowboarders Only wear goggles

- Might Push the Wrong Button
- 360 Camera is too big
- Consider Computer Vision

- Final Version
- Move the Emergency Button to the Left Side
1. **Product Design Iterations - Snowpes Camera Drone**

- It might **blend into the snow** too much.
- Matte black is reading too flat as a texture.
- The location of the **LIDAR sensor** is missing.
- **Final Version**
  - The **receiver** and **lidar sensor** are designed to seem like the **eyes of the drone**.

2. **Goggles HUD Iterations**

- **Try to decrease the distraction** on the snow slopes.
- **Hierarchy is not enough** for the data.
- **Avoid** using safety orange everywhere.
- **Try exaggerate** the trail’s symbol.
- **Final Version**
  - Use **Shapes and Colors** to mark the trails.
  - Put **Primary Data** to the main area.
3. Map Iterations

- Tap on a mobile phone can be hard when users are on a lift
- It's not convenient to explore a map on mobile phones
- Can't find out where users park their car

- Final Version
- 3D Trail Map

4. Controller Iterations

- Final Version
- Use Gesture to Open controller

- It's too cold to use mobile phones
Conclusion.

"In the beginning, I just planned to design a cool HUD for me to not have to worry about the navigation or wait for my friends who are slower than me in mountain resorts. After thinking about accessibility and doing the research, I figured out that the people who need this is more than I expected. SnowPees system is user-friendly to the deaf and the color-blind users. This system can help users navigate through the big resorts safely, connect with their crews easily, and feel more engaged in the snowboarding community."

Reference


Appendix B - Bibliography

https://www.colourblindawareness.org/colour-blindness/.


Appendix C

https://designed.cad.rit.edu/vcdthesis/project/peiwen-he-snowpes
Introducing SNOWPES Goggles and Drone!

SNOWPES™ SYSTEM
Your Best Snowboarding Buddy

Designed for snowboarders

Users

Snowpex focuses on snowboarders. Here are 4 insights according to the interviews and research from snowboarders of various experience levels and continue.

1. Snowboarding Crew

   - Plan the route with Snowpex goggles and 3D trail map
   - Know where the snowboarders are and create a meeting point
   - Navigate with Snowpex goggles

2. Overseas Snowboarder

   - Navigating with the trail map, which features visible snowboarders' routes
   - Call for help with one click

3. Beginner Snowboarder

   - Learn new tricks by making a video with Snowpex goggles' VR mode
   - See other snowboarders' first-person VR live video with their goggles
   - Remember their previous run with videos recorded by goggles and camera drone

4. Eco-conscious Snowboarder

   - Use virtual snowboards when there's someone trying to cut off the board

1.

Snowboarding Crew

"The trail maps are difficult to read and remember. It's easy to get lost and lose contact with my crew frequently."

Snowpex Goggles

Features a 3D camera to track the location of the goggles, which offers

27
Switch Goggles Modes

Skiing goggles have 3 modes: A, B, and E.

1. Upper case change modes by simply toggling the switch on the right side. Lower case also reacts to the switch.

Call out Goggles Controller

In this game, goggles allow users to control the camera. When users press the right side, the camera moves and controls. Users can also scroll through the menu by using the computer vision technology.

Beep Tracking

With goggles, we can direct a user marker to follow any in the field of view without planning their own routes.
2. Overseas Snowboarder

"When I snowboard overseas, the different languages and map signs are a real pain. Especially when I need to call for help."

3D Trail Map

Plan Your Next Run

HUD Navigation - Green Path

HUD Navigation - Blue Path
Emergency Call

When users are snowboarding overseas, the language barrier might cause issues in communication. With the breast goggle, users can be prompted in time to ensure proper use of the lift passes or other goggle features.

3. Beginner Snowboarder

“It’s really expensive to take personal snowboarding lessons, and hard to teach myself with online videos. I wish I can be involved into snowboarding community quickly.”

Sarong Sangkana Sugar

Sarong Sangkana Sugar has followed the sport automatically with enjoined lessons. The teachings provided are particularly useful to those who are entering the exciting world of snowboarding activities.
Ears-occupied Snowboarder

"Listening to music helps me enjoy the sports more, but sometimes it can be dangerous when there's someone close behind me."

Visual Warning - Left Side

A snowboarder in close proximity is shown to indicate safety

Visual Warning - Right Side

Another snowboarder in close proximity is shown to indicate safety

Physical Interface Design

- Goggles

1. Emergency button
2. AR/VR off switch
3. 360 camera
Physical Interface Design

- Camera Drone

3D Model
Research

1.

Color Selection - Safety Orange

The old reddish-orange is used to set objects apart from their surroundings, and there is a very strong complementary contrast between the warm reddish and the color of the sky.

2.

North America uses about five symbols to grade the trails, while Europe or Japan uses slightly different symbols to mark theirs. The signs in Europe and Japan are not user-friendly to the color-blind snowboarders. While approximately 8% of men and 0.3% of women - 300 million people - suffer from color blindness.

3.

Hearing Loss

Over 5% or 430 million people of the world's population have disabling hearing loss.

4.

Reading Gravity

Our eyes follow a certain pattern when browsing. The Gutenberg Diagram divides the page into four quadrants. When it comes to designing a HUD, it would be better if the secondary information is not placed on the primary optical area.

5.
Private lesson can be expensive

It's expensive to learn snowboarding by hiring a personal coach. Private lesson can cost more than $200 per hour.

HUD Testing

Use Mylar sheet to test and adjust the balance and legibility of the HUD.

Userflows

[Diagram showing userflows]
1. Product Design Iterations - Snowpes Goggles

- High Cost to Buy
- Long Learning Curve
- Some Satisfaction: Only wear goggles

- Might Push the Wrong Button
- Too Narrow to see things
- Consider Computer Vision

- Final Version
- Move the Emergency Button to the Left Side
1. Product Design Iterations - Snowpes Camera Drone

- It might blend into the snow too much.
- Make black to reading box that as a texture. The location of the LiDAR sensor is inactive.
- Main Version
  - The speaker and sensor are designed to seem like the eyes of the drone.

2. Goggles HUD Iterations

- Try to decrease the distraction on the snow dates.
- If necessary, zoom in on the data.
- Avoid using safety glasses everywhere.
- Try exaggerate the trail’s symbol.
- Final Version
  - Use shapes and colors to mark the trails.
  - Pull Primary Data to the main area.

3. Map Iterations

- It’s not convenient to explore a map on mobile phones.
- Can’t find out where users park their car.
**Conclusion.**

In the beginning, I just planned to design a cool HUD for me to not have to worry about the navigation or wait for my friends who are slower than me in mountain resorts. After thinking about accessibility and doing the research, I figured out that the people who need this is more than I expected. Snowpes system is user-friendly to the deaf and the color-blind users. This system can help users navigate through the big resorts safely, connect with their crews easily, and feel more engaged in the snowboarding community."