



Innov8x

Final Paper

ARC SSG

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Problem

Skiers and snowboarders alike are guilty of using their phone on the slopes for several reasons. Some might want different data about their run. Others might want to respond to a text. And some want to listen to their music. There are many reasons to use a phone while on the slope. However, using a phone can be dangerous for yourself and others. It also increases the risk of losing it or other gear like gloves. If the user is distracted with a phone, the user is more likely to hit another person, or get hit by another person. This is a hazard expressed by both the users and ski patrol. Ski patrol wants to reduce the number of crashes that happen due to phone usage.

The other main issue we are trying to address is viewing real time data without looking at a phone. Skiers and snowboarders want to view data like speed, altitude, weather, trail conditions, or other data. The only way to do this is to pull out a phone while going down a run. This is an inconvenience for the user and, as addressed above, a safety risk for the user and everyone around. Existing wearables, like smart watches, with similar capabilities require the user to look away from the terrain, creating the same problems as a phone. No current product puts data into a skier's line of sight transparently.

Overall, the problem we are trying to solve is viewing live data and important alerts, such as avalanches and extreme weather, as well as creating a safer skiing and snowboarding environment by keeping the users eyes on the terrain and keeping their phone in their pocket.

Solution

The Deliverable

Our solution to this problem is a Heads-Up Display (HUD) system that overlays real time data from the user's phone into the skier's field of view, such as speed, altitude, temperature, text messages, and navigation along with full use of a phone when not skiing. This system would be modular in nature, and be able to be applied to a wide range of snow goggle styles. This way the skier doesn't have to consider buying an entirely new set of goggles to benefit from this solution. There is also a companion mobile app to configure user preferences, record run history, and display various other social features like photos and messages.

Our current prototype is a draft of the HUD system, showing that light can be reflected to the user and display media that is transmitted to the OLED screen. The casing for our prototype is a 3d printed enclosure that fits in a snow goggle while being able to display a Micro-OLED screen to the user using a bird path optic layout. The wiring from the OLED runs back to a connected enclosure holding a Raspberry Pi Zero, IMU sensor, ESP32, BME680 Temperature sensor, and battery supply. The Raspberry Pi runs the display, where the user sees live tracked data from the sensors. The system is completely wireless, but this version is not able to connect to a phone yet. A visualization of the HUD is shown below:



Figure 1 - Prototype Demo

Prototyping and Iteration

The prototype has gone through 4 iterations so far, starting with a proof of concept check with the sensors and serial monitor outputs. This was done to validate the sensor accuracy and compatibility with the rest of the system components being integrated. The second iteration focused on the web-based HUD rendering with live data from the USB serial input. This validated the display format and concept that we were working towards, so that we could better structure our hardware to fit that vision.

In our third iteration, we looked into the wireless BLE data streaming and standalone HTML HUD capabilities of the components we had ordered. From further market research with potential users, we found that people wanted a device that would be able to function like their phones. That's why we pivoted into wireless features with our device, so that a user could connect to their phone and import live data from messages and other apps.

The final iteration resulted from our consideration of how to display the OLED screen from the top of the snow goggles to the visor in front of the user, while being able to fit the display portion of the system in the snow goggles. That is why this version focused on the Micro-OLED screen integration with the beamsplitter to display onto the snow goggle visor through bird path optics.

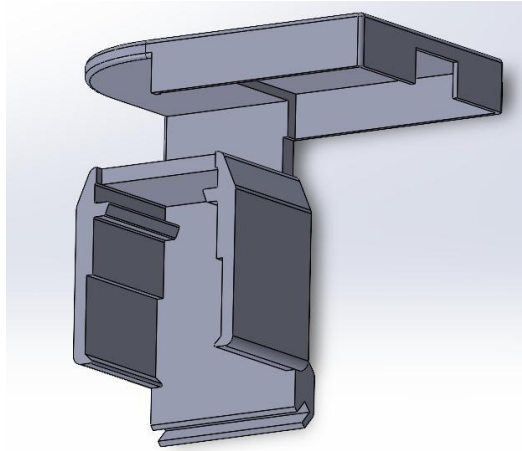


Figure 2 - Optics Housing

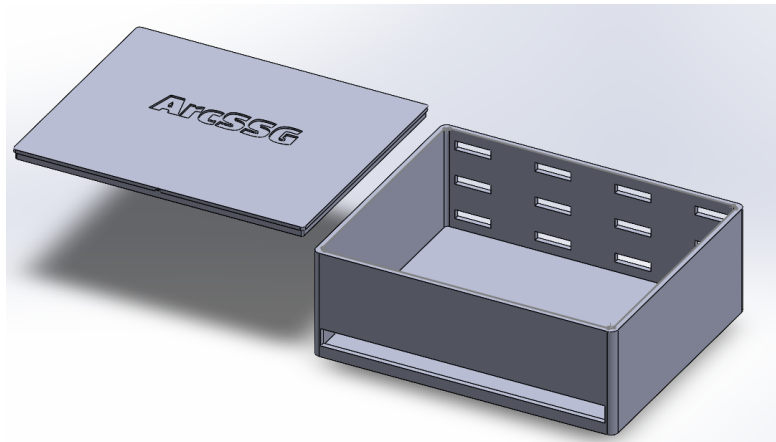


Figure 3 - Electronics Housing



Figure 4 - Current Prototype

Key Benefits

The entire project is based on making snow activities (skiing, snowboarding, etc.) safer for the user and their property, while enhancing their experience to make their day more enjoyable. Specifically, the project has four key benefits that it would provide to customers: Being hands free and keeping user eyes forward, showing real time environmental data for awareness, tracking performance without need to stop or pull out a phone, and preserving the full field of vision for the user with a transparent overlay. All these together can keep people from feeling the need to use their phones on the slopes and drastically reduce the chance of losing them.

Unique Value Proposition

For avid skiers and snowboarders who want real time access to performance and safety data without interrupting their ride, Arc SSG is a heads up display goggle system that overlays live speed, altitude, temperature, and environmental conditions directly into the skier's natural line of sight. Unlike competitors such as Sirius AR and Rekkie, which rely on small peripheral screens that obstruct part of the lens and force the rider to shift focus away from the terrain, Arc SSG uses a transparent optical overlay that keeps the information visible while preserving full field of view. And unlike phone based tracking apps that require stopping, removing gloves, and pulling out a device in freezing conditions, Arc SSG delivers the same data hands free, eyes forward, in real time. Included with all this is the ability to access your phone and all it's features in real time when you aren't skiing down the mountain, solving all the inconveniences of taking out a phone on the mountain.

With this technology, there is a combination of three things no competitor currently offers. This would be a true in line of sight display that does not block natural vision, a wireless sensor architecture that eliminates cables coming out of the goggle frame to the phone, and a companion mobile app that lets riders customize exactly which data appears in their HUD and review their performance after the day is over (phone access included). The result is a system that fits naturally into how skiers already ride with no reason to change their natural habits.

From a market standpoint, Arc SSG sits at the intersection of two rapidly growing categories. Premium snow sport gear and wearable performance technology. Avid skiers, those riding ten or more days per season, already spend \$200 to \$400 on goggles alone and are actively seeking tools to track and improve their performance. Arc SSG meets them where they are, inside the gear they are already wearing, with data they are already trying to access through less convenient means.

Team

Cade serves as project lead and is responsible for optics design, prototyping software, hardware design, 3D printing, and all external facing communication. His background in mechanical engineering and hands on experience with embedded systems, display technologies, and full stack development gives the team a technical lead who can work across every layer of the product. Colin Smith owns hardware assembly, power system validation. Martin Goes handles firmware development, HUD overlay rendering. Li Hong Sweet-Seip contributes to firmware development and hardware validation, and is the most senior member of the team. Pratiksha Satish leads market research and app development.

The team intends to continue development beyond the course. Cade plans to lead the project through the summer, focusing on completing the optical integration and filing a provisional patent. Team members whose schedules allow will continue contributing in their respective roles.

Business Model

Arc SSG operates on a technology licensing model, where the core HUD system and sensor platform are licensed to established goggle manufacturers who integrate the technology into their own product lines. This approach lets Arc SSG focus on what we do best, developing the display technology, wireless sensor architecture, and companion software, while leveraging the manufacturing scale, retail distribution, and brand recognition that companies like Smith, Oakley, and POC already have in place.

Value Chain

The Arc SSG value chain centers on intellectual property rather than finished product manufacturing. We develop and refine the core technology stack: the optical overlay system, the sensor integration platform, and the companion software. Goggle manufacturers license this technology and integrate it into their existing goggle lines using their own frame designs, manufacturing processes, and distribution channels. The end customer purchases goggles from a brand they already trust, with Arc SSG technology built in. On the software side, every pair of goggles ships with our companion app, which handles HUD customization, run tracking, and performance analytics. The app interface can be white labeled or co-branded per licensing partner, but the underlying platform and data infrastructure remain ours, creating a unified ecosystem across all partner brands.

Unit Economics

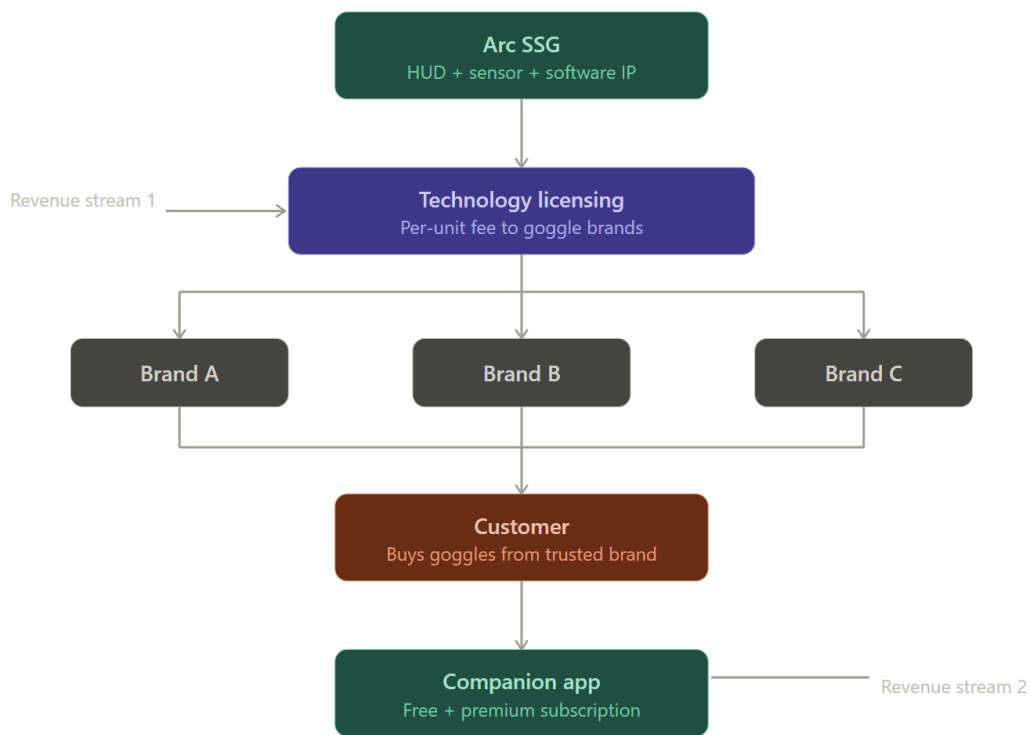
Revenue comes from two streams. The first is a per unit licensing fee paid by each manufacturing partner for every pair of goggles that ships with our technology. The second is recurring software revenue from the companion app. Basic HUD functionality and customization come included with every goggle purchase, while a premium subscription tier unlocks season long analytics, friend tracking, coaching insights, and advanced trail navigation. As the installed base of goggles grows across multiple partner brands, the software subscription revenue scales with it, creating compounding value over time.

Sustainability

Beyond this course, Arc SSG sustains itself through staged funding aligned with development milestones. In the near term, we plan to pursue university venture funds, pitch competitions, and innovation grants to cover patent filing and continued prototyping. These non-dilutive sources allow us to prove the technology and build a strong IP portfolio without giving up equity prematurely.

In the medium term, an initial licensing partnership with a single goggle manufacturer validates the business model and generates first revenue. That proof point becomes the foundation for conversations with additional brands and, if needed, a seed round from angel investors or sport-tech focused venture capital.

In the longer term, the most significant revenue opportunity is the licensing model at scale. Rather than competing head to head with established goggle manufacturers, Arc SSG licenses its HUD overlay system and sensor integration platform to brands who have existing manufacturing infrastructure, retail distribution, and consumer loyalty but lack the AR display technology. A per unit licensing fee on each pair of goggles sold by a partner brand creates high margin revenue without the capital requirements of full scale manufacturing. This is the path from startup to scalable business.



Market

Target Segment

Arc SSG is primarily targeted toward avid skiers and snowboarders who spend 10 or more days per season on the mountain and consistently invest in high-quality gear. These users are typically between the ages of 18 and 45, have moderate to high disposable income, and are already familiar with purchasing premium equipment such as goggles, helmets, and performance-tracking apps. Unlike casual skiers, this group is more engaged in improving their experience and performance, making them more open to adopting new technology that enhances both convenience and safety.

A key user persona for Arc SSG is a performance-focused skier who regularly tracks metrics like speed, vertical drop, and conditions, while also using their phone for music, navigation, or communication throughout the day. As highlighted in our presentation, this creates a “friction chain,” where users must stop, remove their gloves, and interact with their phone in cold conditions, leading to inconvenience and potential safety risks. Arc SSG is designed to eliminate this friction by integrating real-time data directly into the user’s field of view, allowing them to stay focused on the terrain without interrupting their ride. At this stage, the product is not intended for casual or infrequent skiers, as they are less likely to justify the cost or fully utilize its features.

Addressable Market Size

The U.S. ski industry records approximately 60 million skier visits per year, with an estimated 15–20% of participants classified as avid skiers. This results in a target segment of roughly 9 to 12 million high-value users who are more likely to invest in advanced gear and technology. Within this segment, premium goggles already represent a significant category, with average spending typically around \$300 per pair.

Based on these assumptions, the total addressable market for high-end goggles alone falls between \$2.7 billion and \$3.6 billion annually. Arc SSG enters this market through a licensing model rather than direct manufacturing, which allows the company to scale efficiently by integrating its technology into existing brand ecosystems. As a result, even capturing a small percentage of this market through partnerships can generate meaningful revenue. Additionally, the inclusion of a companion app with optional subscription features creates a recurring revenue stream that grows alongside the installed user base.

Trends Driving Growth

Several broader industry trends support the timing and viability of Arc SSG. First, wearable technology has become increasingly common across sports, with users expecting real-time data and seamless integration into their activities. This shift is particularly evident in areas like fitness tracking and cycling, and it is now extending into snow sports. At the same time, advancements in augmented reality and heads-up display technology have significantly reduced costs, making these systems more practical for consumer applications.

In addition, ski resorts are continuing to invest in digital infrastructure and connected experiences, which aligns with the demand for data-driven tools. There is also a noticeable increase in interest around performance analytics among recreational athletes, not just professionals, which further expands the potential user base. Finally, there is a growing expectation for technology to reduce friction rather than add to it, especially in environments like skiing where stopping, removing gloves, and using a phone can be both inconvenient and unsafe. Arc SSG directly aligns with these trends by offering a hands-free, integrated solution.

Recommendation

As of writing, Arc SSG can actively stream live telemetry and communicate with all core subsystems. The functionality of the display and optical pathing have been validated as well. Both the wired and wireless pipelines have been developed, so data can be shared between components along with external Bluetooth devices. A companion app has been developed to store and configure user data. Here, the live telemetry is streamed to Arc SSG where it is displayed inside the goggles. With these core systems in place, market research has been conducted to understand Arc’s competitive position in the market.

In further development, Arc is still missing some core features. GPS data still needs to be integrated for trail navigation and speed tracking. This can be done utilizing the integrated GPS in the phone, or a dedicated GPS module can be installed into the goggles. The optical module also has room for improvement. The current footprint can be shrunk down, and further adjustments are needed to calibrate the best display conditions. From here, extensive user testing is needed to validate the functionality and design of Arc SSG. The beta tests would target avid skiers and snowboarders to gather feedback on various systems. From here, full integration with the companion app would provide a complete experience of Arc SSG for users. The initial app will only include the basic features to test the life cycle of the product as frequent data links will be sent between the devices. These target objectives will be completed over the summer of 2026 into the FA26 semester for project continuation.

To continue this project, Arc SSG needs to expand deeper into the ski/snowboard market to better gauge where the product sits. This will also include work towards licensing the technology for partner companies to integrate into their own products. Further funding will be sought out through the Protofund.