



Abstract

In fast paced sports, especially those where the individual's life is at risk such as skydiving, information about the current environment can be paramount both during and after the event. Skydivers generally use information known only before entering the plane, or that can be seen or felt. Providing them with real-time, consistent information would be invaluable. To understand the importance of such data, it is enough to consider the risk for human lifewhen being under canopy. As the canopy sizes decrease, the risk for the skydiver increases even further. This risk can be alleviated by having real-time updates of ground speed, angle of attack and other relevant states. This project aims to develop an autonomated Heads Up Display (HUD) Goggles system that can provide such information while remaining small and lightweight, robust and accurate. It is highlighted that all these qualities are essential. Inaccurate data can be misleading and may lead to wrong situational awareness. At the same time, the system has to rely on lightweight embedded solutions as it should hinder the user's natural ability to perform the required tasks.

1 Motivation

Such HUD goggles are available on the market, but they have not been able to completely solve the problem and provide high-quality data. The feedback provided by them are typically limited both regarding the states they can estimate as well as the visualization methods they employ. With modern technology advances -especially in miniaturized sensing and processing- this can be improved upon in two parts: display size and style, and available data. Modern advances in LED systems brings us transparent LED screens which would allow for ease of display without compromising the user's vision. At the same, we now have available very low-cost, yet sufficient quality Inertial Measurement Units, GPS receivers while vision can also be part of the loop. The Figure below visualizes the idea.

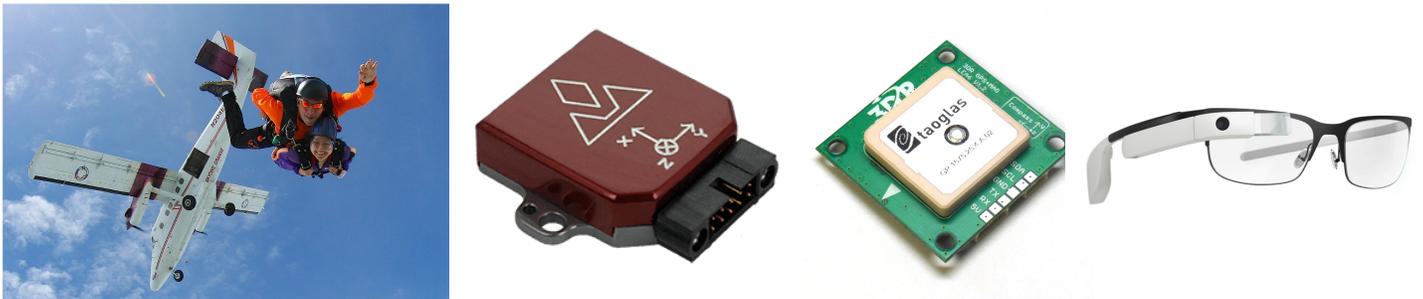


Figure 1: Instance from skydiving activities and indicative solutions for the preliminary sensing suite of the HUD Goggles.

2 Goals

The goals of this project are to bring solutions and advancements to the field of extreme sports so that the individuals involved can incorporate real data into their decision making process. As well the individuals will be able to log such data and review it after the event to progress faster and further within their sport.

The introduction of this kind of technology could not only help users progress within their area of application, but also add a welcomed level of safety to sports normally viewed as highly dangerous.

3 Tasks and Milestones



List of Tasks

- **T1:** Learn and understand the problem - define the states to be estimated online
- **T2:** Interface of the IMU and GPS receiver
- **T3:** Extended Kalman Filter implementation on the Embedded System
- **T4:** Visualization Framework
- **T5:** Demonstration and Evaluation
- **T6:** Documentation

List of Milestones

- **M1:** Integration of IMU and GPS system, *M1*
- **M2:** Inertial Navigation System solution, *M3*
- **M3:** Visualization Framework, *M4*
- **M4:** Validation Results, *M6*

4 Requirements

1. Very independent, but a good team player
2. Experienced C++ programmer
3. Experience with the Robot Operating System is a plus
4. Experience with embedded systems is a plus

5 Supervision

This project is supervised by:

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