P.E.G.A.S.U.S.

Pilot Enhanced Guidance and Augmented Sight Utility System

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Ch 2: Project Description

2.1 Project Background

Situational awareness is the primary factor that ensures the safe operation of millions of vehicles around the world each day. In aviation, it is often the case that pilots must make quick decisions during flight based on readings from a complex suite of flight parameter instruments as well as navigational data. This is in addition to understanding their operational environment via visual observation. However, pilots have to increasingly rely on their instrumentation readings as meteorological conditions around them deteriorate and visibility is diminished. It is imperative that these readings are easily visible and clearly displayed, within context, in a cockpit environment.

Currently, there are a variety of ways that pilots are able to stay situationally aware when operating in the sky. These various technologies and systems provide aid in understanding an aircraft's position in the surrounding airspace as well as relative to other aircraft, what the potential nearby hazards could be, and the current and predicted weather conditions for the operational environment. Global Navigation Satellite Systems (or GNSS) provide navigational data and information to pilots and aircraft via satellite communication. These systems allow for an enhanced understanding of the aircraft's position in space as well as its position relative to the desired flight path (Canal Geomatics, 2024). Aircraft flight data monitoring of basic instruments such as airspeed indicators, attitude indicators, angle of attack indicators, manifold pressure, RPM, and G-indicators all provide vital feedback to pilots that helps them understand and properly manipulate the mechanics of the aircraft to ensure a successful flight (FAA, 2025). Often, these instruments are spread out across the cockpit on multiple digital as well as analog displays. It is typical to have a GPS display configured to the center of the cockpit, while analog instrument readings are spread out panoramically under an airplane's dashboard. The people using these devices often have to divert their attention from the surrounding airspace or wherever they are trying to fly to in order to look around in the cockpit and properly monitor and understand their instrument readings and GPS data.

A Heads-Up-Display (hereon referred to as a HUD) is a technology that solves this issue of diverted attention by being able to project relevant flight information to a pilot in the line of their external forward vision. The data from this display is projected onto a semitransparent display panel, allowing for visualization of flight parameters in the pilot's direct field of view (Skybrary, 2025). With this new capability of enhanced flight parameter view, a pilot does not have to divert their attention multiple times to a flight instrument panel and GPS display. By being able to read flight data in the same perceived plane, the pilot can focus on the surrounding airspace and have visual input in flying the plane while also ready access to this critical and on-demand information.

2.2 Precedent

HUDs are a popular means of projecting information in various types of vehicles and in recent years, the automotive industry has become one of the chief market segments for this kind of technology. As far as past projects are concerned, a UCF team has done a variation of a heads-up display called the "Huddy Buddy". This project aimed to solve a popular issue within driving automobiles, in that smart phone applications are often built to have the smartphone displaying navigational or speed data but are meant to be physically mounted in front of the driver causing complications. The solution to this was for the group to build their own HUD that was integrated with a smartphone to project that data into the same visual plane as the rest of the road (from the driver's perspective) (Glowth, et al. 2025). This project helped our team to gain insights regarding what worked for their HUD as well as what the challenges were. These insights helped us to more well-define our portability requirements as well as things like visibility and computing requirements for the system.

In the commercial aviation industry, HUDs are a popular accessory but often come with some limitations. Namely, most HUDs integrated into commercial aircraft come directly from the aircraft manufacturer and directly integrated into the airplane itself. If this is not the case, it is typical that commercial HUDs for aviation are very expensive and require some complex installation work to be successfully integrated into the flight experience. For example, the *SkyDisplay* from MyGoFlight is a HUD that integrates into an aircraft's existing instrument infrastructure (with technologies from companies such as Garmin or HoneyWell). This is a phenomenal piece of equipment but can run at a pretty hefty price tag for the consumer. Installing this system with a common digital Primary Flight Display can cost around $30,000 and installing it with a system from Aspen Avionics, a much cheaper option, can still cost upwards of $15,500. It is for this reason that we aim to develop a lower-cost and more portable unit that fits the needs of a private aviator as opposed to midsized commercial or private aircraft (MYGOFLIGHT, 2025).

Existing and Past Projects

There are many different heads up displays that are already in use, especially in cars, but there is a lack of them in planes, particularly in cheaper private planes like the Cessna 172. This is one of the most used planes and it lacks some of the special features large airliners and military level aircraft have. While it does show the altitude and speed that this project will display it presents it through dials spread all across the pilot's cockpit. If all of the most used measures can be displayed into one central spot so the pilot does not need to scan multiple gauges this can improve safety and the pilot's overall ability to focus on flying. While there are some after-market options that are offered, they are very expensive. While a more affordable option is preferred, the reliability of a plane's HUD must be accurate and constantly updated in real time to avoid any safety concerns and is one of the main reasons for its hefty price tag.

Heads up displays (HUDs) are becoming increasingly popular for displaying data due to their low profile and ability to relay important data. Because of this many production cars come with already built in HUDs. While they are able to give important information, they don't take away from the driver's field of view or make the vehicle more unsafe to drive. It really does the opposite by putting all of the data that the driver would look down on the dash for directly in front of their vision of the road, so there is no shift in focus to check speed or other data on the dash like the RPMs.

The newer cars having these features are a good safety feature, but most of the cars on the road do not have this capability, and it really can be added through an aftermarket product. Amazon sells multiple different options that offer the same features. The only requirement is a compatible car outlet for the product. This will give older cars the same features as the newly manufactured ones and provide a good alternative as opposed to buying a new car. The amazon products have multiple options and are small, compact products with no difficult install. They stick onto somewhere on the dash and either have a flip up glass pane or have a screen saver that goes onto the window that shows a projection.

MOMAN - Heads Up Display for Cars

This is one of the middle-priced HUD for a car. It cost $49.95 pre-taxes and it is manufactured by MOMAN, a photo, video and audio company. They make many different aftermarket electrical products for automobiles. This specific HUD is mounted to the dash of a vehicle and uses a vertical piece of glass attached to a base to present its data. It is connected using a 5V usb cable or connects to a cigarette lighter. The features are extensive with speed, time, driving distance, date, altitude, compass, driving direction, speeding alarm, and fatigue driving.

MOMAN claims to have no delays and functions built in to prevent glare and night and day settings for clear visibility no matter what time of day. MOMAN provides a good example of a product that is an affordable and reliable option with many different features and a good display, which are all of the desired traits of a good HUD (MOMAN Amazon, 2025).

KUOWEIHUD - Heads Up Display for Cars

This is one of the cheapest options found on amazon for HUD. It costs $13.99 before taxes and fees and is manufactured by KUOWEIHUD. They specifically specialize in making cheap HUDs for cars. This product in specific is only able to connect using a USB cable and it utilizes the windshield to project its image. It does not use a glass panel like the last product and rather just shines the data up onto the glass. With the cheaper price tag comes much fewer features. The only bit of data that this device displays is speed with a maximum speed at 115mph. It uses a GPS to track speed and claims a max of 1.8mph of error. While speed is a good bit of data to display it is the only piece of data and is the reason the HUD is so cheap. If speed is the only thing that is needed, then it would be a good choice (KUOWEIHUD Amazon, 2025).

HUDWAY - Drive

This HUD is on the higher end of the price range for cars, costing $329 before taxes and fees. It is manufactured by HUDWAY, which is another company that specializes in making HUDs for cars. With this being the most expensive out of the three car options it does have the most features. While the other displays have a set of data that is displayed, the HUDWAY Drive has the capability to customize the data shown. The screen has a high resolution and has the capability of displaying navigation, phone calls, music, notifications, and OBD-2 data. OBD-2 Data is required for special installation, but it makes the HUD capable of displaying data coming directly from the car and makes it very reliable due to its use of the car's instruments and not other outside devices. It can display speed, RPM, temperature, time, fuel capacity, battery level, and really any other data received from the OBD-2. While this HUD costs multiple times more than any of the other HUDS it could be worth the price for the extra features it offers. It allows the user to display the data they want and with high reliability with the use of the OBD-2 data. The only other downside besides the price is the extra installation time to plug into the OBD-2 (Hudway, 2020).

GARMIN - GHD 2100 Head-Up Display

This HUD is designed for planes and is an optional addition when purchasing an aircraft. It is manufactured by GARMIN, and it is only purchasable through a dealer and according to an article on AIN written by Matt Thurber the option to include this is $668,700. This makes it a serious financial purchase and could be too expensive an option for some buyers. This display is installed from the top of the cockpit instead of the dash and hangs in the pilot's field of view. It can show flight path markers, flight director, acceleration error, speed error, and other quantitative measures such as elevation and pitch. This is one of the only real options for plane HUD s and its expensive price tag could make it unaffordable. The price isn't unjustified, with the installation being part of the plane and using expensive instruments for very high reliability the price reflects a reliable product. There is little room for errors in flight HUDs with little differences meaning there could be a crash or rough landing. While GARMINS HUD is expensive there is no need to worry about the information being wrong. With this in mind it is a good product with an expensive but fair price tag (Thurber, 2024).

Military Heads-Up Display

The F-18 is one of many military planes that has been utilizing HUDS for the last 50 years. They were manufactured by multiple different companies going all the way back to the 70s with two of the most notable manufacturers being L-3 and Rockwell. The public has never really gotten access to products from these companies, with most of the technology being contracted out by the government. This is why commercial planes did not catch up and started using their own HUDS until the 80s. All the military technology remains ahead, with the newer HUDs being built directly into the headset instead of having it on a glass panel on the dash. The headset for the F-35 still displays all the same flight data important to the pilot, but now when the pilot can be scanning the skies and not looking forward, the data will still be visible with the use of the headset. Some of the features of the headset are airspeed, altitude, heading, weapon status, and target designation, as well as real-time infrared imagery from the aircraft's Distributed Aperture System (DAS) to give the pilot a 360-degree, "see-through" view of their surroundings. This is by far one of the most advanced HUDs ever made but it is not a realistic option for residential use.

Lessons From These Products / Projects

Upon reviewing the existing products, we have determined that the typical heads-up display for the aviation industry is an expensive one with proprietary software as well as hardware integration into the airplane. These systems often project flight parameters. Our solution would allow for a portable and accessible HUD module that not only enables enhanced visibility of key flight parameters, but also additional visibility in terms of an increased field of view for the pilot. Because of this, we are paying close attention to the increased visibility in meeting parameters such as brightness, screen resolution, and contrast.

2.3 Project Goals & Objectives

The overall goal for this project is to develop a self-contained and portable heads-up display for aircrafts. Currently, there are no affordable options for any aircraft in the residential sector, and we plan to change that. Our product will have a box that houses all sensors and other electrical components as well as lenses for the optical display. There will be a piece of glass that will stick out of the box or be attached at the end that will be used to display the GUI. The idea behind this project is to create a portable, affordable, and self-contained heads-up display to fill a gap in the personal aviation industry.

Listed below are the P.E.G.A.S.U.S. goals and objectives as determined by the engineering team. The goals are used to define the intended outcomes this project aims to achieve, while objectives specify concrete deliverables. There are also advanced goals and objectives which are feasible if time permits. Alongside advanced goals and objectives, stretch goals and objectives are listed as items that are beyond the scope of our implementation but would be very beneficial to this project if added.

Goals

Basic Goals:

- Develop a portable standalone Heads-Up-Display (HUD) for aircraft.
- System will display essential flight parameters in a rapid and concise manner.
- System will incorporate a Graphical User Interface (GUI).
- System will have debugging capabilities for the engineering team.

Basic Optics Goals:

- Good HUD visibility in variable lighting conditions / polarizations.
- LCD clarity maintained throughout system.
- Portable optical components.

Advanced Goals:

- Live system will increase the pilot's peripheral field of view.

Optics Advanced Goals:

- Incorporate an adaptive lighting system so that HUD can be viewed comfortably in any visibility conditions.
- Optimized eye-box virtual image

Stretch Goals:

- Read, calculate, and display ground and air speed data.
- Implement a GUI navigation feature.
- Overlay pilot's flight path on to their FOV from navigation software.

Optics Stretch Goals:

- Head / Eye tracking for dynamic eye box.
- Variable Focus of system optics.

Objectives

Basic Objectives:

- The P.E.G.A.S.U.S. must be roughly the size of a briefcase.
- House all optical components and sensors in a single housing.
- The device will be fully powered by a 12V outlet inside the plane.
- P.E.G.A.S.U.S. will read and compute sensor data in real time.
- Implement an Inertial Measurement Unit (IMU) to calculate three-dimensional attitude data and compass heading data.
- Implement an altimeter for altitude data reading.
- Incorporate one microcontroller unit (MCU) designated to real-time sensor reading.
- Implement a dedicated MCU to read calculated data and format in a GUI.
- The GUI will display attitude (orientation in space) data, altitude, and compass heading.
- The MCU will periodically log flight data onto a local storage device for debugging purposes.

Basic Optics Objectives:

- HUD Visibility Above Threshold through polarized and unpolarized lenses.
- LCD resolution still clear at virtual image plane because of optical component optimization.
- Optical Components within physical constraints of package (package dimensions: 304mm x 127mm x 254mm).

Advanced Objectives:

- Cameras will have their own dedicated housing stuck to the pilot's side windows.
- System displays data for >80% of total flight time with restart technology if an unexpected shut off occurs.
- Increase blind-side FOV with use of lateral cameras bringing up FOV to full 210° of human eyesight.

Optics Advanced Objectives:

- Adaptive Visibility of System based on ambient lighting.
- Correct for system aberrations and distortion specifically localized within target eye box area.

Stretch Objectives:

- The P.E.G.A.S.U.S. parses GPS data for accurate route-planning through a routing algorithm to allow for a general flight direction for the pilot.
- Display two kinds of route overlays in the form of a full navigation overlay and a minimal navigation overlay to give the pilot more versatility in their routing display options.
- Integrate cameras with a computer-vision model to allow for runway detection and overlay for increased landing safety in poor conditions.

Optics Stretch Goals:

- Mechanically adjust optics to shift virtual image plane based on user tracking.
- Add tunability to collimating optics for varying user focus conditions.

2.4 Features and Functionalities

Project Capabilities
There are four different devices for peripherals used for data acquisition for the display. There will be a camera, altimeter, gyroscope, and GPS. With these four devices an array of different data can be displayed to a pilot in real time to help navigate an aircraft in a safe manner. Each of these four different peripherals serves a different purpose and is important to the design. All of the data will be displayed onto a glass screen and none of the parts will need to be bolted or screwed down. None of the pieces are made to fit a specific type of plane and will be universal for any plane that has the necessary power required. The glass window is located on the dash in front of the pilot.

The screen is meant to be minimalistic and will require two different settings, one where the screen is being used to display the feed from the camera and another where it will display the numbers measured from the other devices. The screen is small and these two different settings will make it so the screen is able to properly convey information without the pilot straining to see the display. The camera is more ideally used while on the ground for parking or for maneuvering through tighter spaces similar to the functionality of a backup camera. The other setting for the screen is meant for while the plane is in the takeoff, flight and landing stages.

The other peripherals are the more important flight data measures, and they will all be displayed on the flight setting. The hardware will have enough power to be able to rapidly get all measured data and display and update values quickly. The values displayed will be the speed, location, altitude, and the pitch. These are all of the important measures that could be helpful during the flight.

2.5 List of Requirements and Specifications

Listing clear qualitative and quantitative requirements for this project is crucial to its success. By mapping out what system requirements are, designing will be simpler due to understanding what range certain components need to be in for use as a viable option. By defining these measures, we also ensure that the project meets certain practical benchmarks as a useful tool for pilots. Below are the two tables for system and component specifications for use across this project.

2.5.1 Seven Key Engineering Specifications with Quantitative Measures:

Table 2.5.1: Key Engineering Specifications [13]

Parameter	Specification	Description	Priority
Cost	<$750	Ensures we stay within the budget	High
Total System Power Consumption	<21W	Critical for aircraft electrical load margin	High
Display Brightness	>999 nits	Ensures HUD visibility in cockpit daylight	High
System Boot Time	< 1 minute	Pilot needs minimal delay at startup	Med
Altitude Measurement, Processing and Display Time	<200ms	Ensures prompt reading to ensure accurate display of data	Med
IMU Polling Rate	>9.9 Hz	Smooth sensor readings	Med
GUI Refresh Rate	> 30 FPS	Ensures a responsive GUI	Med
Total System Weight (including housing)	<11 lbs	Keeps system portable and minimizes aircraft load	Low
Horizontal Field of View Overlay*	>39°	Provides useful HUD coverage	Low

* - Indicates an advanced goal

2.5.2 Key Component Specifications

Table 2.5.2: Key Component Specifications [13]

Component	Specification	Quantitative Target	Notes
ESP32-S3 MCU	Max I²C/SPI bus rate	I²C @ 400 kHz, SPI @ 10 MHz	Handles multiple sensors without bottleneck.
ICM-20948	IMU data accuracy	±2000 °/s, 16-bit	Detects fast aircraft IMU changes.
BMP388	Altitude resolution	±0.1 m (24-bit oversampling)	Needed for flight altitude awareness.
GPS (PA1616S)*	Position accuracy	< 3 m CEP, update rate 10 Hz	Sufficient for navigation overlay.
Raspberry Pi 4	Processing power	Quad-core 1.5 GHz, ≥4 GB RAM	Ensures GUI rendering + camera feed overlay.
Pi Camera (160° FOV)	Resolution & FPS	8 MP @ 30 FPS	Provides wide visual for HUD overlay.
LCD	Brightness & Resolution	1000 nits, 1024×600	Sunlight-readable, adequate HUD resolution.

* - Indicates an advanced goal

Table 2.5.3: Optical Component Specifications [6]

Optical Component	Parameter / Specification / Units
Liquid Crystal Display	Size: (76.2mm x 76.2mm) (3''x 3'') Resolution: Full HD (1920 x 1080) Brightness: (>1000 nits) Contrast Ratio (1000:1)
λ/4 Waveplate	Type: Achromatic Wavelengths: 380-700nm Polarization: Linear to Circular Conversion
Collimating Lens	Lens Diameter: 80-100mm Focal Length: 50-100mm Material: Optical Grade Glass (BK7, Silica) or Acrylic
Flat Mirror	Size: 5.6'' Diagonal Thickness: 2-3mm

	Material: Optical Reflective Coating (Silver, Aluminum)
Aspherical Mirror	Diameter: 100-150mm Thickness: 10-20mm Focal Length: 50-100mm
Magnifying Lens	Lens Diameter: 100-120mm Focal Length: 30-50mm Magnification Factor: 2.17 Material: Optical Grade Glass (BK7, Silica) or Acrylic (anti-reflective)
Photodiode	Wavelength Sensitivity Range: 380-770nm Material: Silicon Dark Current: 1-10nA Room Temp. Responsivity: 0.3-0.6 A/W
Electrochromic Glass Element	Size: 6.5’’ x 6’’ Thickness: >5mm Transparency: Variable based on voltage Power Consumption: 3-6 W/m^2
Optical Combiner Film	Size: 6.5’’ x 6’’ Thickness: 0.1-0.5mm Transparency: 40-60% Reflectivity: 40-70% Material: Holographic Optical Film or Dielectric Coated Film

2.6 Project Hardware Block Diagram

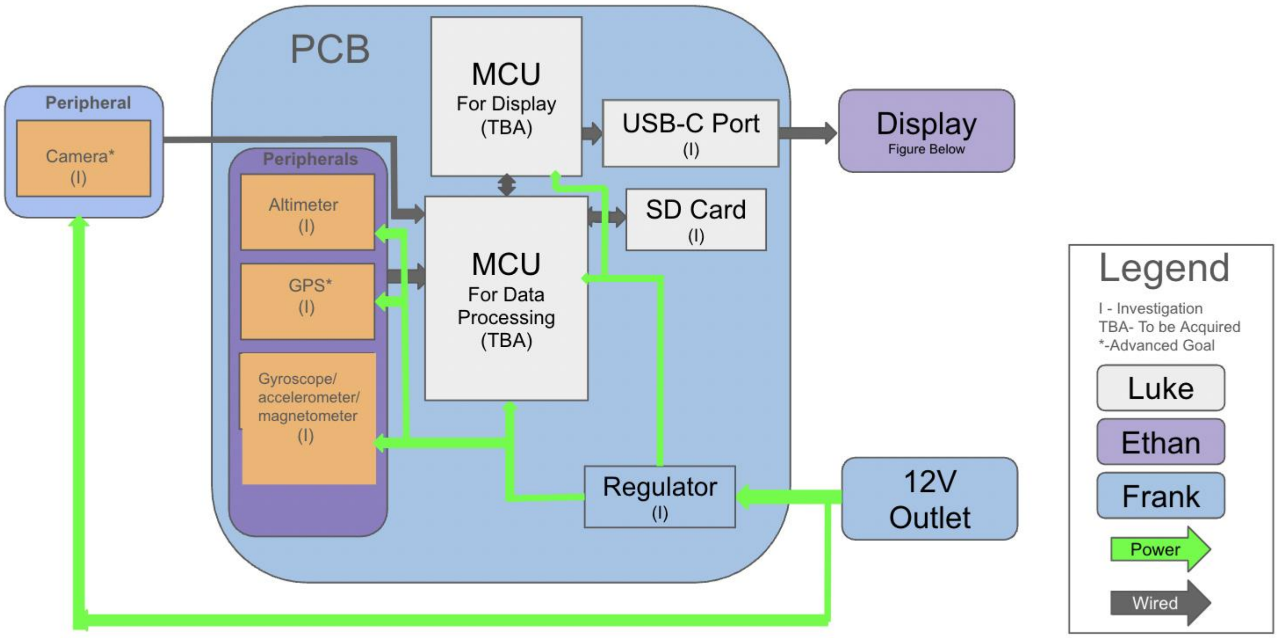

Figure 2.6.1: Hardware Block Diagram

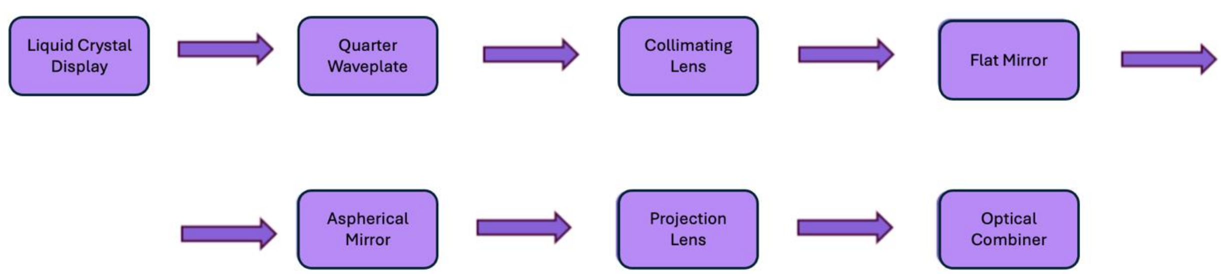

Figure 2.6.2: Display Optics Hardware Block Diagram

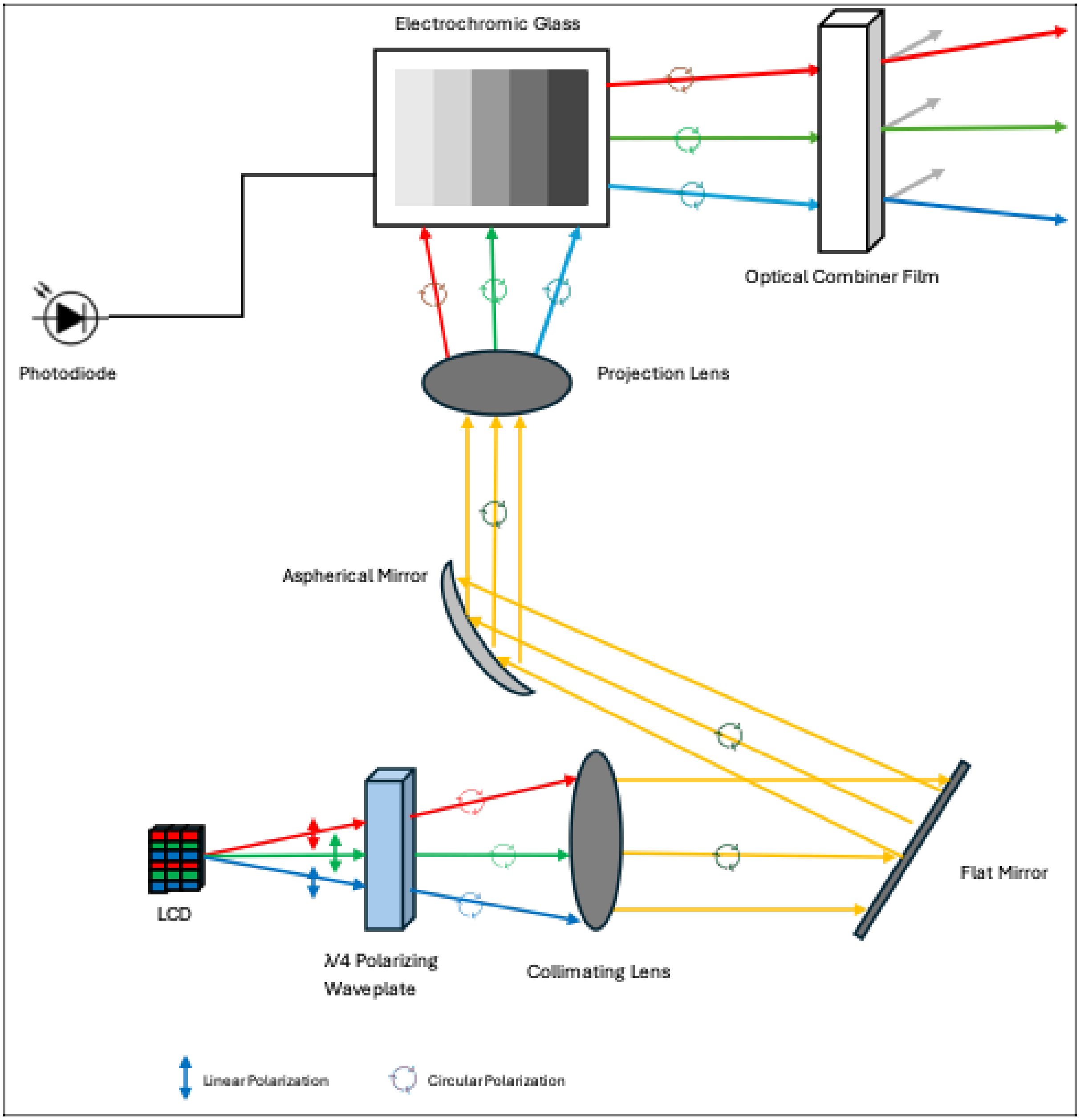

Figure 2.6.3: Optical Design Schematic

2.7 Project Software Diagram / Flowchart

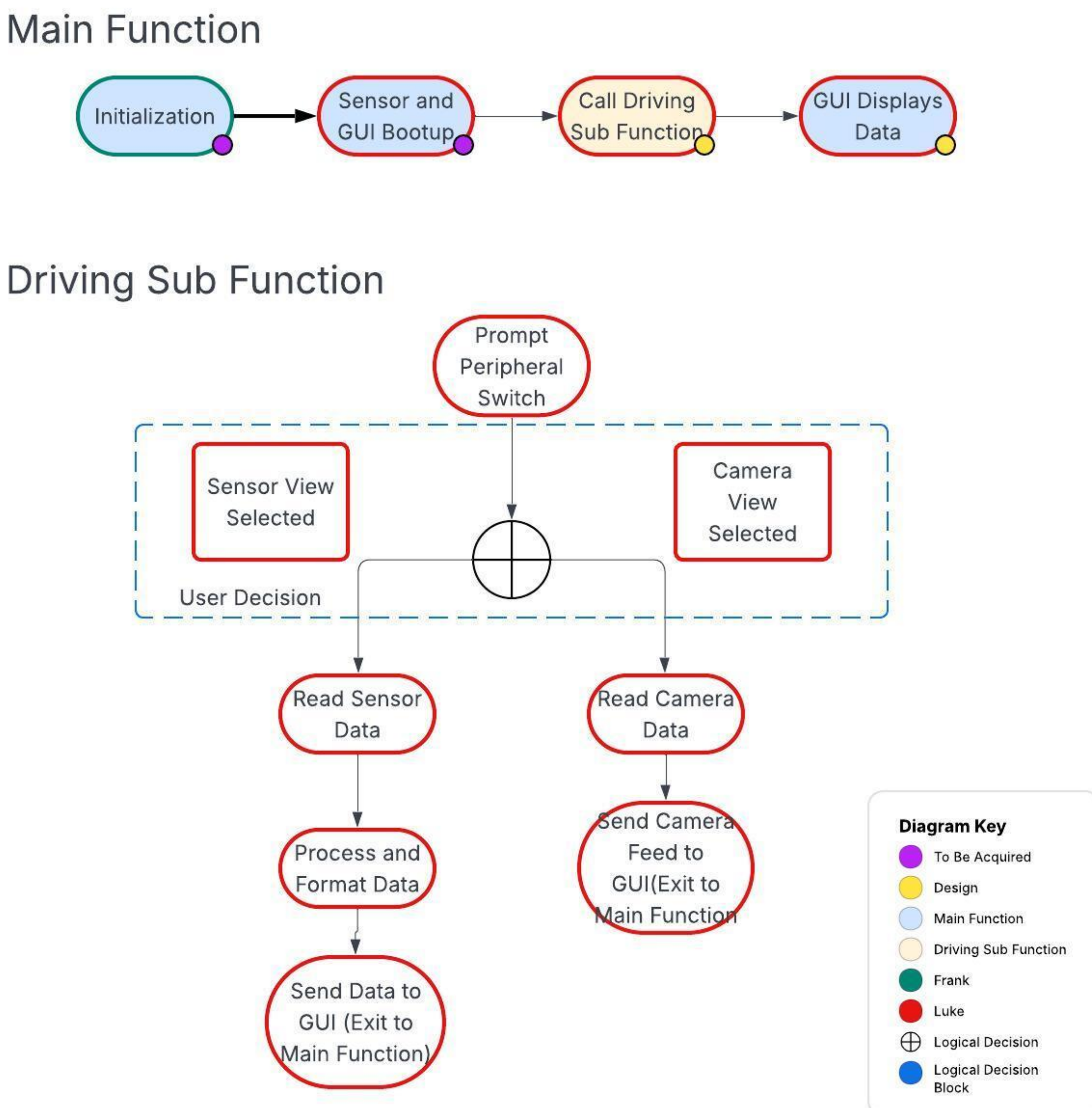

Figure 2.7: Software Diagram

2.8 Prototype Illustration & GUI

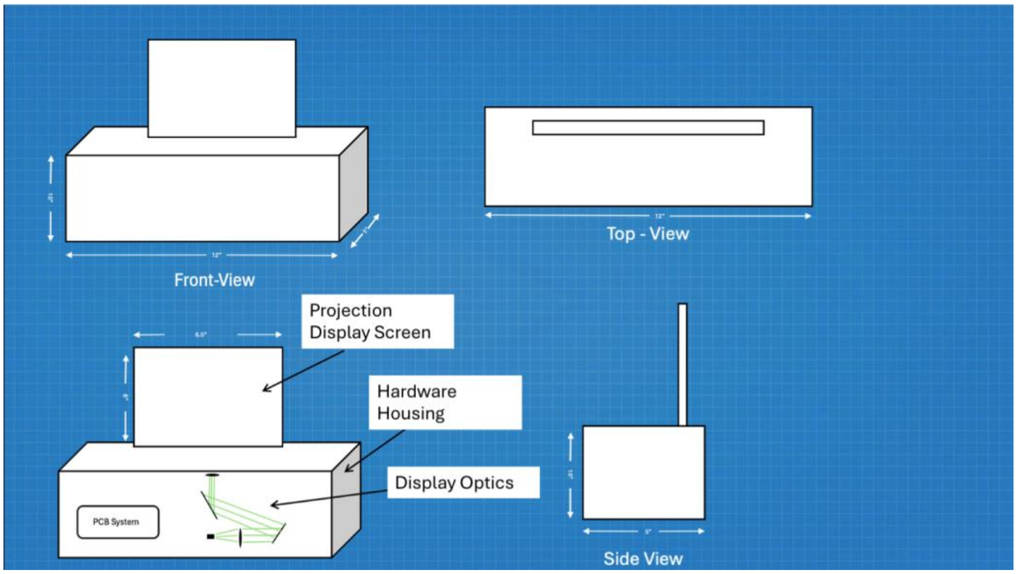

Figure 2.8.1: Blueprint / Prototype Illustration

Figure 2.8.2: Graphical User Interface [12]

2.9 House of Quality

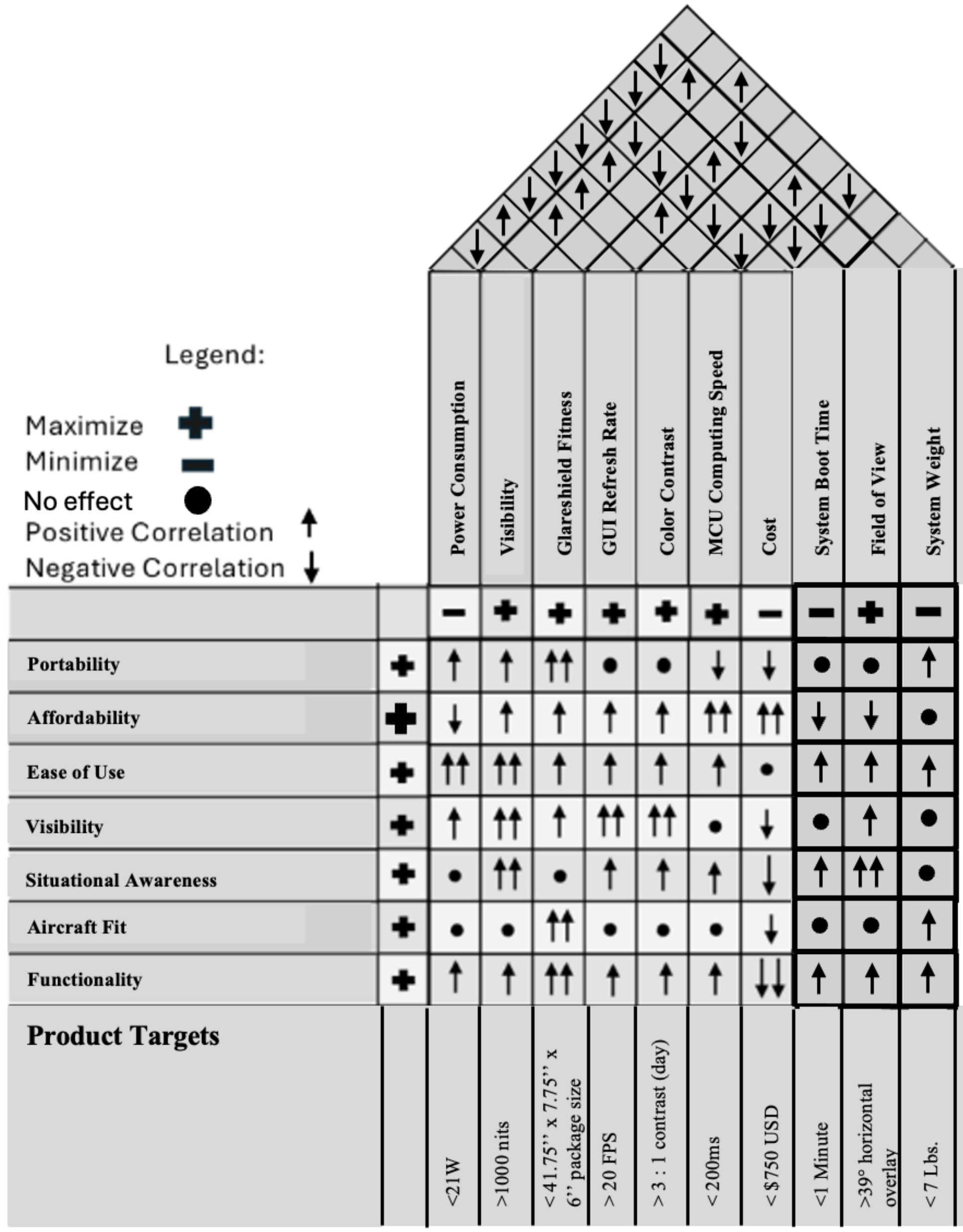

Figure 2.9: House of Quality

2.10 Test Plan & Live Demonstration

2.10.1 Test Plan

The testing of a heads-up display for an airplane requires the use of an airplane for some data pieces, but many pieces can be tested on the ground or in a car. Our group plans to test the ground speed, compass heading, pitch heading, and camera view on the ground. We plan to test ground speed by driving in a car down the road and comparing it with the speedometer in our vehicle. The compass heading is also easy to test simply by comparing the display to a compass. Pitch heading will also be easy to test by comparing it to a level and rotating the device around the respective axis. Camera view does not require being in an aircraft; we simply ensure the camera feed is sent to the HUD through the data lines. For altimeter testing, we plan to use a Cessna 172 if available and if not available, we will find small hills and go to the top and bottom of these hills for altitude readings if needed. Altitude readings could also be done by going to the roof of a parking garage and comparing them to ground readings or more accurate altimeters [16].

2.10.2 Live Demonstration

For our basic goals of three-dimensional orientation data, as mentioned in the test plan we are able to pick the HUD up and rotate it around each axis to demonstrate the changes. We can even bring a level to compare accuracy. For the goal of HUD visibility in all weather conditions, we can open and close the blinds in our demo room or go from inside to outside to display that the HUD is bright enough. The live camera feed is very demonstratable, simply select that view and it will appear on the HUD. The advanced goals may require a field trip by walking around the building or outside or up and down an elevator. For altitude, we can go up and down an elevator to the top and bottom floors of buildings to demonstrate that feature. For ground speed, we can walk around the building or if noise interferes with that, we can walk around outside the building to demo that. While we cannot bring our reviewers into an airplane, we can demonstrate working components and software to them by doing these basic tests.

Ch 10: Administrative Content

10.1 Project Milestones

Due to the large scale of this project, it is important to stay organized and have a clear table of all due dates across the timeframe of this project. Our team is utilizing Jira to stay organized by planning sprints and epics around assignment due dates to allow everyone to stay on task. Jira allows for full team visibility of who is working on what part of the project and what their progress is. Below is the table of assignment due dates that help us organize our Jira board.

Table 10.1: Project Milestones [13]

Task	Duration	Status
Senior Design 1 and Documentation		
Finalize Project Idea	8/18/25 - 8/26/25	Complete
Finalize Design Objectives and Goals	8/26/25 - 9/2/25	Complete
Committee Formation	8/26/25-9/5/25	In Progress
Divide and Conquer 10 Page Document	8/26/25 - 9/5/25	In Progress
Divide and Conquer 10 Page Document - Revision	9/5/25 - 9/12/25	Not Started
Midterm Report	9/12/25 - 10/31/25	In Progress
Midterm Report - Revision	11/3/25 - 11/7/25	Not Started
Final Report	11/7/25 - 11/25/25	In Progress
Prototype	10/1/25 - 11/25/25	Not Started
Senior Design 2		
PCB Assembly	TBD SD2	NA
PCB Testing	TBD SD2	NA
Optical Design and Casing Assembly	TBD SD2	NA
Optical Testing	TBD SD2	NA
Final Presentation	TBD SD2	NA

10.2 Budget and Funding

The budget for this project was set at $750 in total. Material use and the project have worked around this constraint to build the following bill of materials:

Table 10.2: Bill of Materials [13]

#	Item / Part No.	Qty	Unit Price (USD)	Line Total (USD)
1	Raspberry Pi 4 Model B (4 GB)	1	$55.00	$55.00
2	Adafruit Feather ESP32-S3 (STEMMA QT)	1	$19.95	$19.95
3	BMP388 Altimeter breakout (STEMMA QT)	1	$13.95	$13.95
4	ICM-20948 9-DoF IMU (STEMMA QT/Qwiic)	1	$14.95	$14.95

5	Ultimate GPS Breakout (PA1616S)	1	$39.95	$39.95
6	Active GPS antenna (SMA)	1	$19.95	$19.95
7	u.FL to SMA adapter cable	1	$1.95	$1.95
8	Arducam Wide-FOV Pi Camera (IMX219, 160°)	1	$12.90	$12.90
9	Pi camera FFC 300 mm	1	$1.95	$1.95
10	7” HDMI LCD (1000 nits, 1024×600)	1	$98.36	$98.36
11	Samsung EVO Select microSD 64 GB	1	$14.99	$14.99
12	Adalogger FeatherWing (RTC + microSD)	1	$8.95	$8.95
13	5 V / 5 A buck regulator (Pololu D24V50F5)	1	$29.95	$29.95
14	3.3 V / 2.5 A buck regulator (Pololu D24V22F3)	1	$14.95	$14.95
15	Panel-mount DC barrel jack (2.1 mm)	1	$2.95	$2.95
16	Resettable polyfuse 2 A (MF-R200)	2	$0.69	$1.38
17	TVS diode SMBJ24A	1	$0.34	$0.34
18	STEMMA QT cable 100 mm	2	$0.95	$1.90
19	STEMMA QT to male header cable	1	$1.95	$1.95
20	JST-PH 2-pin pigtail 100 mm	2	$0.75	$1.50
21	Two-way mirror acrylic sheet (8x10, 1/8”)	1	$40.00	$40.00
22	0.1 µF 0603 X7R decoupling capacitors	20	$0.02	$0.40
23	10 µF 0805 X5R capacitors	10	$0.10	$1.00
24	100 µF electrolytic ≥10 V	2	$0.64	$1.28
25	4.7 kΩ 0603 resistors	4	$0.02	$0.08
26	10 kΩ 0603 resistors	10	$0.10	$1.00
			Total:	$401.53

10.3 Work Distribution

Below is how the project workload will be split up by area. The four areas of the project are Optical Engineering, Electrical Engineering, Computer Engineering, and Project Management.

Computer Engineering	**Responsibilities**
Luke Anderson	Software Design and Implementation
	MCU Selection and Implementation
	Website Design and Management
	Project Lead
Electrical Engineer	**Responsibilities**
Frank Murphy	PCB/PSU Design
	Hardware Component Selection
Optics Engineer	**Responsibilities**

Ethan Dill	Optical Design
	Component Alignment
	Optical Component Integration

Table 10.3 Distribution of Workload

Executive Summary

The P.E.G.A.S.U.S [11] project is a student-led senior design project with the goal of creating a portable alternative to current aircraft heads-up displays (HUDs). In most aircrafts, they either come with a HUD or they do not, and aftermarket ones are few and far between. The goal of this project is to create a HUD that provides basic data such as heading, speed, altitude, and an increased FOV to the pilot. The P.E.G.A.S.U.S. project is portable enough to easily transfer between aircrafts and helpful enough to make it worth putting in an aircraft. This project not only fills a gap in current aviation technology but also demonstrates the feasibility of making HUDs accessible to all the aviation community.

Not only does this project fill a gap in the aviation community, but it will also serve as the senior capstone project for our group. Through this project, Ethan will gain hands-on experience with designing, prototyping, testing, and building industry-ready optical devices. Frank will learn how PCBs are designed from the ground up, which is a highly desirable industry skill. Luke will learn how to read flight data and create a GUI on a microcontroller as well as other embedded software skills. All these skills will culminate in a working product that will hopefully help pilots and provide a cheaper alternative for the few products that do exist today.

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