Smart Compact Scope for Hunting Rifles

Ahmed Al Busaidi, Collan Dimitri, Jacob Clevenger, Jose Vasquez Dickson
Department of Electrical and Computer Engineering
University of Central Florida
Orlando FL, 32816

***Abstract*—The propose of this project is to explore the idea of creating a rifle scope that would facilitate the user in quickly and accurately hitting a target at distances of 250m to 1500m. Overall the project should help reduce the amount of time it takes to aim at a target and increase the accuracy of the user relative to their accuracy and speed using a typical rifle scope. The group decided on this project as there are members from computer engineering, electrical engineering, and optics, making the group a good fit for this project.**

***Index Terms*—Scope, Display**

I. Introduction

The goal of this project is to create a rifle scope whose utilization is facilitated through the incorporation of technology that would indicate to the user as where to aim in order to hit a target at a specified distance. This is accomplished through the use of an optical system that achieves a variable magnification, with a reticle placed on an OLED display that will change according to an object at different distances. In order to know what accommodation must be made by the user, there will be a laser rangefinder that will measure the distance, and a microcontroller that will translate that distance to the effect that gravity has on a bullet at the point of impact. This will change the reticle on the display so that the user will know where to aim to hit their target.

The main motivation for this project was that it had major components from all of the majors on the team, as it incorporated aspects of optics and electronics. The industry for sporting optics such as our design are traditional and use mechanical components paired with optics to achieve a goal, but new technology would allow for the industry to grow. This design also utilizes the skills that the group have learned individually and tests those skills in a way that allows for growth. Although there are similar products on the market that utilize components that our used in this design, the OLED display sets this design aside and allows us to stay around a financial goal that keeps costs much lower than the similar products.

II. Background

We want to be able to build and design a rifle scope that will make it possible for the user to be more efficient in their aiming and facilitate the work needed to be done out in the field. Such as the work of utilizing a separate rangefinder to determine the distance of a standstill or moving object, then determine how much should the user aim above the target to completely account for the bullet falloff. Our build will completely facilitate these repetitive processes with the simple push of a button.

This product isn't readily available on the market for hunters and soldiers alike. This product will push technology on scopes for better operation and technological advancement of rifle scopes or other types of scopes. In order to satisfy our specifications to build a successful product, we will need to keep the project lightweight, slim design, cost-efficient, easy to use, accurate, and time-efficient when operating.

III. Requirement Specifications

In order to fulfill our goals and objectives to make our project lightweight, slim, inexpensive, easy to use, accurate, and time-efficient, we will examine these characteristics and what they mean for our project below. We have taken each of these characteristics into consideration throughout the progress of our project.

Lightweight - One of our main goals, but with one of the biggest constraints, is to make the scope design as light as possible to prevent fatiguing the user by the weight of all the components. The main constraint is the rangefinder weight as we're not able to get a lighter and smaller rangefinder because of our monetary constraints.

Slim - The scope and the components can't make the entire design oversized in any direction. The components must be strategically placed to provide a clean look and keep the entire design slim with the dimensions of the rifle.

Inexpensive - An important and competitive aspect of our smart scope is that in comparison with other scopes in the market, it will be and must be as inexpensive as possible. It will be more affordable than other scopes in the market.

Easy to use - The user's physical and display interface needs to be user-friendly and intuitive to use. It needs to be simple but display enough information to facilitate the user in the operation of the scope with the end goal in mind of hitting the target at a distance.

Accurate - The end goal of hitting the target at a distance with great accuracy is a must. The smart scope will need to be able to accurately determine the drop off and compensation angle of the bullet and indicate to the user where they need to aim to hit the target with great accuracy.

Time-efficient - Another important specification is that the time that it takes the smart scope to determine where to aim to hit a target at a distance from the press of the button needs to be minimal. This is crucial as the user will need to determine where to aim quickly or sometimes in an instant to complete the end goal.

Engineering Requirement	**Spec Unit**
Lightweight	$\leq 1000g$
Cost-efficient	$\leq$ \$650
Accuracy	$\leq 200cm$
Time-efficient to determine target's distance	$\leq 2s$
Operating Temperature Range	0°C - 125°C
Battery levels	3.3V, 5V, and 12.77V
Power Consumption	$\leq 20W$

TABLE I: Engineering Specifications

IV. Standards

Our smart scope had to abide to several standards that we followed through the entire process of the design, testing, and build of our project. The standards that were used in our project that helped us fulfill the engineering requirement specifications above are the following:

ANSI Z136.1 - The laser used is a Class 1 laser which is safe and is exempt from any beam-hazard control measures.

Python Programming Standards - These standards exist in order to create readable code that can be understood such as indentation, imports, and naming conventions to name some.

Power Supply Standards - Our smart scope is under the circuit classification for Extra-Low Voltage (ELV) as it is a safe voltage level with basic PVC insulation.

Unit Standards - We're using MOA measurements for the adjustments and measurements on the scope because of the standards in the firearm community.

Soldering Standards - We'll be closely using the standard NASA-STD-8739.3 for our soldering electrical connections on our PCB, wire connections, and MCU.

V. Design

The first challenge in this design is relaying information to the user without having to distract or inconvenience the user. This is solved by integrating a device that can display information inside the housing of a rifle scope. The device used is a transparent OLED display, this display is 70% transparent when the display is turned off, allowing the user to see past the display and view their target. Along with indicating to the user where they should aim, the display will allow us to also indicate any arbitrary information. This makes future integration's there were not implemented in this design possible such as wind speed and humidity indicators.

Next, the user needs to be able to quickly measure the distance to the target with as little input from the user as possible. To do this, a rangefinder is mounted to the side of the rifle. A rangefinder with a distance of 100m to 2000m would be ideal. As distances shorter than that would not require significant adjustment and distances further than that would require adjustments outside the vertical range of the scope reticle. To trigger the rangefinder, a small button can be placed near the trigger of the rifle, allowing the user to measure the distance to the target with very little input needed.

The scope itself should be as user friendly as possible, to do this, an app was designed to help the user configure the scope to their needs and preferences as well as report data back from the scope to the help. This app communicates over a USB type-c connection with the scope. Over this connection, the app is able to update the data-sets used in the scope to calculate the reticle position vs. distance, configure the brightness of the integrated display, and toggle the rendering of extra information on the display. If connected while in use, the scope will automatically report back to the app information about distances measured, giving the user insights into their usage of the scope.

To coordinate communication between the display, rangefinder, and the app along with supplying power to these components, there needs to be a control board. For this project, a board was designed to run off of a single battery and supply power to the rangefinder and the display. The display connects directly into the board using a Zero insertion force (ZIF) connector. Power for the display is also provided via this connector as well as any data communication needed to run the display. The rangefinder is connected to the board via a cable that connects to the board and rangefinder which allows for the transmission of power and data.

VI. Display Lens

The display lens that was chosen was the 128x56 Transparent OLED Display by Crystalfontz. This display was chosen for this project as it was one of the only displays on the market that was small and transparent while also being inexpensive. The display itself operates on 3.3V for the logic circuit and 12.77V for the driving panel.

This display has a resolution of 128x56 pixels at 0.274mm per pixel. While this is not a very high resolution, it is more than enough for this project. While the display is turned off, it is around 70% transparent. When a pixel is lit, the pixel is full opaque, while still leaving until pixels transparent. The brightness of the display is controllable via software, allowing the display to be dimmed in dark lighting conditions and brightened in bright lighting conditions.

To communicate with the display, there were several different options. I2c, SPI, and Parallel. Because of other components using the I2c channel on the microcontroller, SPI was chosen as the communication protocol between the board and the display. Configuring the display to run in SPI mode was simply a process of pulling several pins on the 24-pin connector low. With basic communication and power setup, the entire display is able to be configured and controlled via software.

While the display itself meets most of the projects needs, there are a few small problems that had to be worked around.

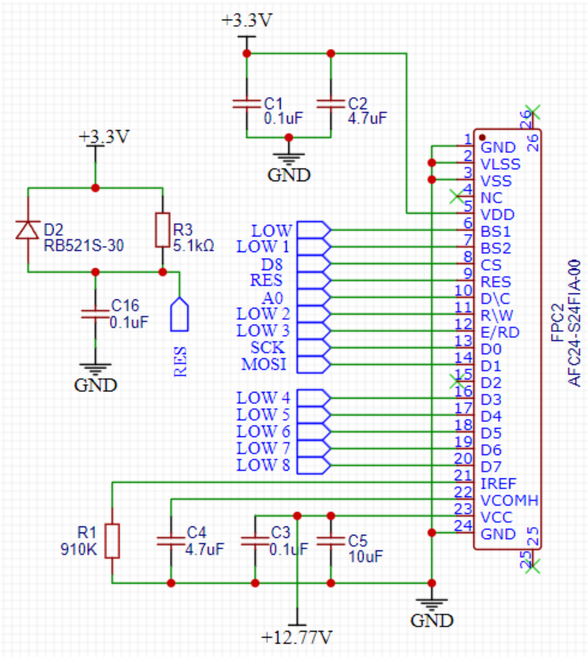

Fig. 1: Display Circuit

The first problem is the rectangular shape of the display. In most scopes, the lens is in the shape of a circle, having a rectangular shaped lens means that the housing of the scope will need to be able to accommodate both the round and rectangular pieces of the scope. The second problem was the rather short 24-pin cable used to connect it to the board. Due to the short length of the cable, this means the PCB that display connects to must be placed relatively close to the scope housing.

VII. Microcontroller & PCB

The ATMEGA-328P was the choice of microcontroller unit for this project. This is a popular low-power chip and is very compact. The chip runs at 16MHz and is powered via a 5V regulator. This microcontroller unit was chosen as it is simple to program, widely available, and several team members had prior experience with this chip. The chip includes several communication interfaces, including I2C, UART, SPI, as well as many data pins. In this project, nearly ever communication interface is utilized.

In the process of designing the PCB, nearly all components are surface mount components. This was done to minimize the size of the board and keep a low profile. Some parts though were through-hole due to either market constraints or easing development. The ATMEGA-328P is a through-hole component as it enables the removal of the MCU from the board so it can be placed on a development board, such as an Arduino UNO, and programmed. The USB-to-SPI chip is also a through-hole component as supply-line shortages have caused a lack of surface-mount variants of this chip.

The PCB was designed and created using an online software called EasyEDA. It's a 2 layer PCB as it has a great number of connections between the components. This allows to make connections without overlapping on the same layer. The design rules we followed were to have a track width of 0.254mm with a clearance in between tracks of 0.152mm as this aligned with the design capabilities of our PCB manufacturer. Also, we ensured that there were no 90° turns, this makes sure that there all good solid connections between components.

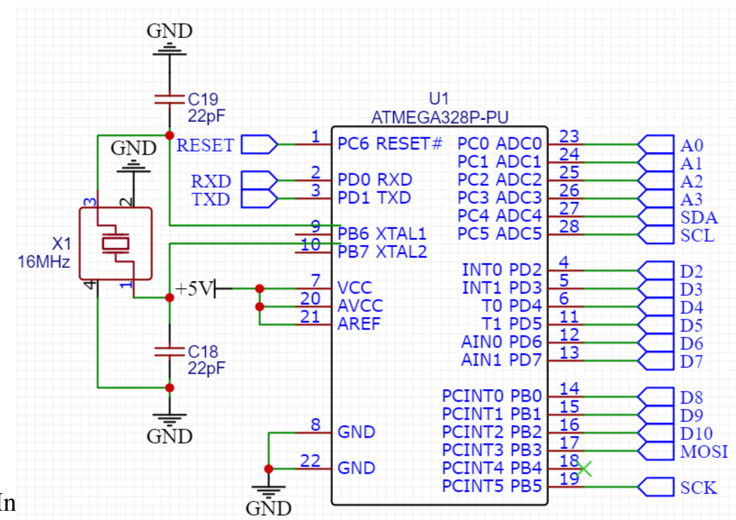

Fig. 2: Microcontroller Schematic

VIII. Rangefinder

The Rangefinder is one of the most important components of the project and was one of the hardest pieces to acquire. There are many rangefinders on the market, but many of them are either consumer products that cannot be interfaced with or are designed and sold to business that have a contract with the manufacturer.

After a few weeks of research, our team discovered the HR-1500 Rangefinder 4. This rangefinder was able to measure a minimum distance of 3 meters and a maximum distance 1500 meters, which meet the range requirements defined in the engineering specifications of the project. The rangefinder ended up being the most expensive component of the project, costing around $315.00.

To interface with this rangefinder, we are able to use the UART protocol to send and receive data. The ATMEGA-328P has support for this communication protocol, so this wasn't a problem. To send and receive data, the rangefinder uses a sequence of hexadecimal, '0D 0A' character to indicate the beginning and ending of a message. Commands are sent in the format of '0D 0A [COMMAND] 0D 0A'. To start taking measurements, the "ON" command is sent in the following format of '0D 0A 4F 4E 0D 0A' and to stop taking measurements the "OFF" command '0D 0A 4F 46 46 0D 0A'.

With this, the board is able to quickly and reliably take measurements by interfacing with the rangefinder. The only

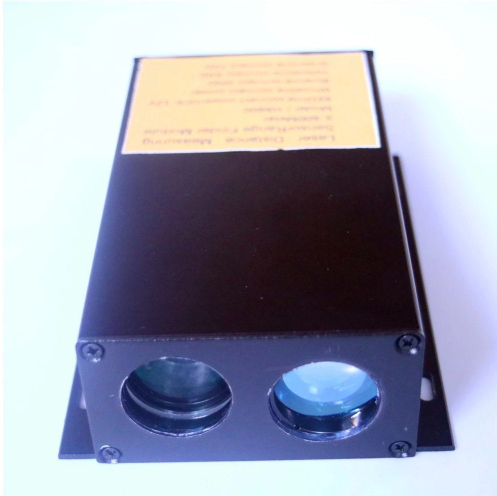

Fig. 3: Rangefinder

caveats are certain conditions that may give incorrect readings. These conditions include extreme light which could overwhelm the sensor, heave weather, and objects with very high light absorption. These are errors that can be handled via software allowing the user to know why they possible got a bad reading.

IX. USB Type-C Interface

The USB-to-SPI integrated circuit on the PCB is the interconnection of the USB Type C connector and the MSP2210 with the GPIO pins. This integrated circuit is built into the PCB design for a seamless design with all the components to be signaled and powered from the same PCB.

The USB Type C connector on the PCB powers the microchip MSP2210 directly. This input connector C-31-M-12 has 16 pins in a symmetrical fashion so that the cables can be reversed when connected. The USB Type C connector was mostly used for the SPI interface and input power, all the other unused input pins where connected with pull-down resistors to ground to ensure we keep those input signals LOW. The clock on this microchip is a ceramic resonator oscillator that runs at 12MHz which provides the proper frequency for the USB module to function properly.

For the app integration with the smartphone, the USB Type C connector is required to have connectivity with the smartphone and convert the USB signals to SPI interface to be able to communicate with each other. The microchip is able to convert the USB signals to SPI legible signals via the data lines on the connector. The PCB has some GPIOs pins, general purpose pins, which are connected directly to the microchip.

X. Power

In the following figure is a one-line diagram that demonstrates the distribution of power from the power supply, the 9.6V battery, to the different components in our project. We are using three voltage regulators to power all of our components

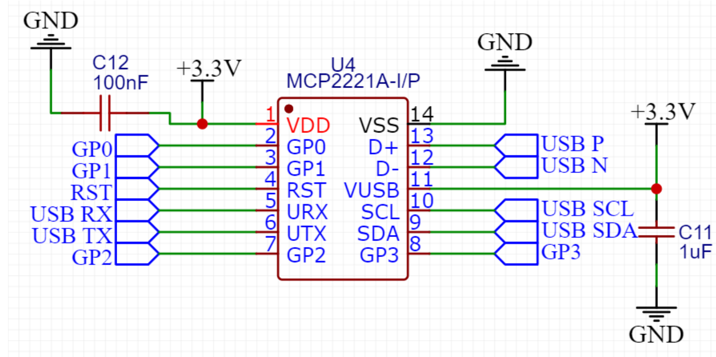

Fig. 4: USB to I2C Schematic

from the 9.6V battery power supply. Moreover, our design has three voltage levels to choose from: 3.3V, 5V, and 12.77V. We'll be using the HT7533-1 for the 3.3V output, the HT7550-1 for the 5V output, and the AP3012KTR-G1 for the 12.77V output. These voltage outputs will be regulated as they are being converted from an unregulated power supply, a 9.6V battery, to a regulated voltage through the voltage regulators. These three voltage levels that are available allow the power design to power all the components within their recommended input voltage range. The voltage regulators will ensure that the output voltage to the components stays constant in all operational conditions as it will regulate voltage during power fluctuations and variations in loads. Furthermore, these three voltage levels allow for any future expansion that might be required for any additional components that we might need if we add new features to our project.

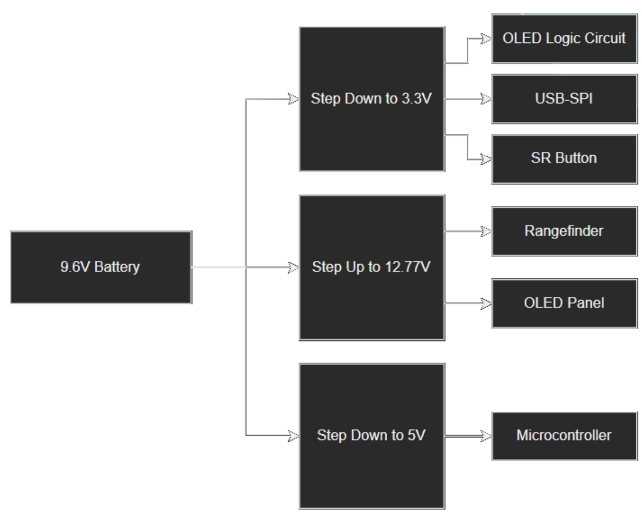

Fig. 5: Power Supply One-line Diagram

Initially, our battery design was to use two batteries for the power supply design. The first battery is 5V and the second is 12V. These batteries were going to feed into the corresponding components directly. The cons with this power supply design in comparison to our current one were that it was more expensive by almost double, it required more space which was an estimated double the size, and the voltage from the batteries was unregulated. On the other hand, the new and current power supply design only consists of one battery. It is a 9.6V battery and it will use voltage regulators to step up or down and output regulated voltage to protect components in the system. The pros with the current power supply design are that it's less expensive by almost half, it requires less space as it's only one battery instead of two, and it outputs regulated voltage. This power supply design classifies under the Extra-Low Voltage power supply standards which we meet as our design doesn't exceed 60VDC and our wires are protected by a basic PVC insulation.

To completely cover all the components and their voltage, current, and power consumption requirements we have a table displayed below breaking down their specifications. The voltage regulators will allow us to accurately output the operating voltage for each component. Once the voltage is outputted from the power supply, the voltage regulators connected step up or down to the necessary voltage, then the corresponding connections are connected to the input power pins. The total power consumption is less than 20W so it satisfies our engineering specification to keep the total wattage to a minimum for safe hand-help operation.

Component	**Operating Voltage (V)**	**Operating Current**	**Power Consumption (W)**
OLED Logic Circuit	2.8	19mA	0.04256
USB-to-SPI	3.3	11mA	0.0363
SR Button	3.3	0.075mA	0.0002475
Rangefinder	12.5	0.5A	3.75
OLED Panel	12.5	0.019A	0.19
Microcontroller	5	1.51A	10.89
Total Power Consumption (W)			14.9091075

TABLE II: Power Design

XI. Computer Programming

Our software development covered two systems that interface with all the components in the final build, the Microcontroller board and the Android Application. These two systems were integrated in tandem with a custom designed electrical board to allow for an easy transfer and programming to the final product. Additionally, this allowed us to perform integration testing without the need to dissemble and reassemble the product. The Android Application works as a standalone to the main unit and can connect to the main unit on a need-to basis. When a Mobile Android Device is connected it can interface with the Micro-controller to adjust the bullet speed according to the input from the micro-controller.

A. Android UNO

The micro-controller acts as a central brain that connects all three components together through UART and I2C connections. The micro-controller in question contains the same MCU as the one in the Adruino Uno, the range-finder is connected to the MCU through the digital pins which later get converted into RX and TX in the software through a library called (Software-Serial) so that the rangefinder may interface with the micro-controller through a UART connection. Our mobile-phone connector component is connected to the micro-controller through an I2C connection and depending the numbers of bytes in the package the micro-controller knows to change the bullet speed or weight. Finally our button connects to the micro-controller through digital pin two and from software we can setup it to recognize an input through a pull-up resistor.

B. Android Studio

To develop the mobile android application android studio was used, combining code from the producers of the I2C/UART Combo USB and from personal development we created an application that utilizes android libraries as well as libraries from the developers to send receive data from the I2C connection and the UART connection as well as send data through the same connections. The application also gives the ability to act as a serial monitor as well as configure settings to better match the connection at hand. For example, for the I2C connection we will configure it to use address eight and for the UART connections we would configure the GPIO pins to match that of the UART connection. To initialize the connection to the micro-controller all the user has to do is connect it to mobile device this allows the app to setup a USB Broadcast system that makes it connect on the fly and when disconnected it would operate just the same. For the purposes of our code we designed a code system for various activities; REQD is to request data from the micro-controller, SETS is to set the speed of our bullet for variety in guns, SETW is to set the weight both of these are parameters that would alter our bullet drop equation, and finally DISP allows us to display any string we would like it to this feature has been mainly built for testing purposes but is also flexible when wanting to test different rectiles and different formats in displaying data without the need to reprogram the micro-controller completely. These commands work on a package basis, what that means is that only one command is interpreted at the time the package is received.

C. Flow of Software

The flow of the software is simple to follow from a non-programmer's point of view. The figure below displays the flow of software as a Flow Chart. The entire program pivots on two main events, the button being pressed or its state being change and an I2C connection was established if neither of these events occur the code is set to display a simple rectile and do nothing else. In the event the button state changes, the code is set to send a UART package to the rangefinder with the start command in an array of hexadecimal format followed by receiving a range into a buffer than converted into a float that can be passed around to two functions that calculate the drop off and compensation angle. Finally this is displayed onto our OLED display in two formats, the first being the string literal which would be in the format of 15.67 for fifteen point sixty seven meters followed by a pixel that would utilize the the tangent of the compensation angle and the distance between the center and the edge of the screen in pixels this would allow us to get a value in pixels that can be used to display onto the OLED display. In the event that a mobile device is connected the micro-controller would receive a command into a character array then would parse that command and its value, if the parameter falls into one of four categories it would conduct the action as intended with the command, otherwise it would do nothing. One command works differently from the rest as it has to send data back, and that is the REQD command that would work similarly to pushing the button except it would capture data and send it back through the same open channel until all items have been sent.

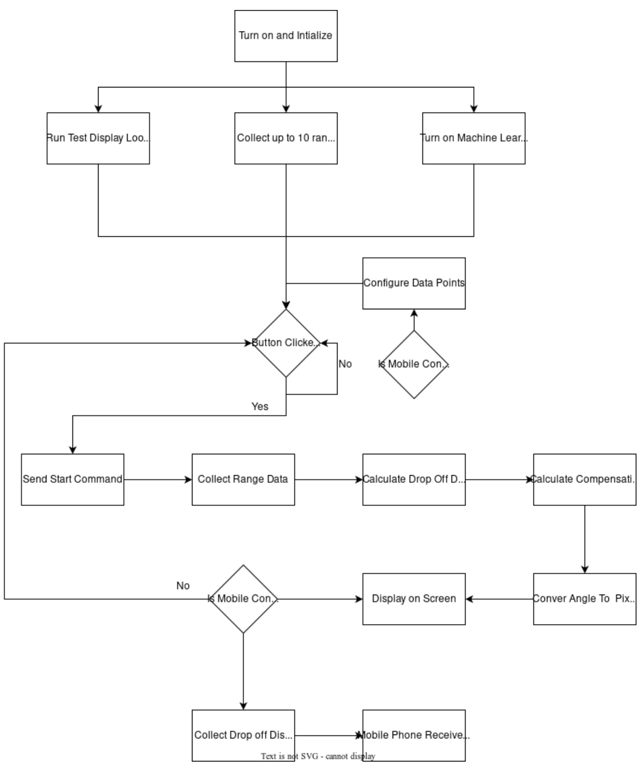

Fig. 6: Flow Chart

D. Activity Diagram

To better display the software an activity diagram was designed to the specifications of the software of our project. This activity diagram showcases the Object Orientated structure of the software. In the diagram each class is displayed in the format of InstanceName : ClassName and each class has its lifeline which display all the activities associated with that class with respect to time each time that class is performing a task and the class can not perform any other task a rectangle is drawn around the box to symbolize it being busy and in a non-interactive state, finally an arrow represents a direct interaction between the classes.

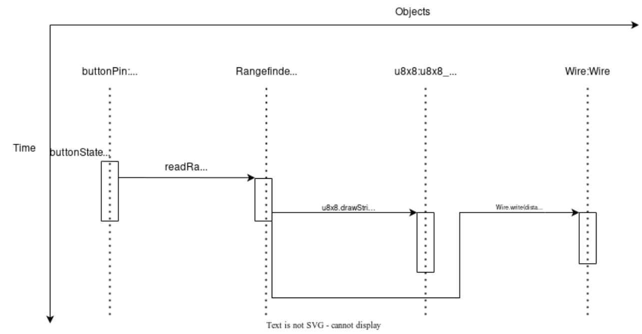

Fig. 7: Use Case Diagram

XII. Optical System

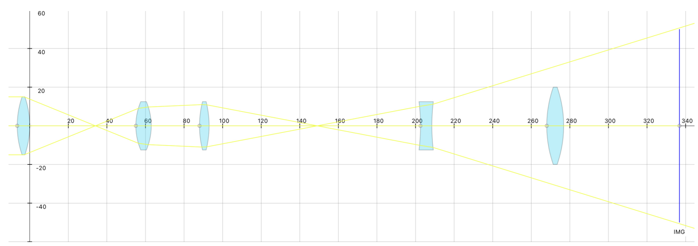
Fig. 8: Use Case Diagram

A. Optical Layout

The design for the optical system was focused around creating a zoom system that would accomplish a magnification ranging from one time to four times, that allows the user to view things at multiple distances with the option of changing the magnification as to enlarge the view. The initial challenge was to study current zoom systems that existed commercially to determine what types of lenses would be needed. The main assemblies in a scope are the eyepiece, which is what houses the magnification lens as well as the focal lens. The next step was to include an image reversal assembly to ensure that the sight picture was oriented properly to ensure the user had no upside-down images. Finally, the objective lens had to have been large enough in diameter to allow for an appropriate amount of light to enter the system, and a small enough focal length to ensure that objects at a farther distance. The concept for a zoom lens that was chosen was to use a biconcave lens that would change position between two biconvex lenses. This was tested with multiple different focal distances to achieve the desired effect. The optics that were considered were chosen from the catalog of Edmund Optics, as having custom optics created for the project was out of scope financially. Once the proper specifications were met, the remaining lenses were chosen to accommodate the user's eye, as previous experiences had all projected images onto a screen as opposed to a human eye, as well as having a large enough diameter to provide an appropriate field of view. The image reversal assembly was one of the simpler choices, as it just had to fall at a distance of twice the focal length away from the objective lens. The objective lens was chosen so that there was a small focal length but a large enough diameter for sufficient light transmission.

For this project, the optical system consists of five uncoated lenses to achieve a variable magnification system. There are four biconvex lenses as well as one biconcave lens used to achieve the desired magnification as well as to ensure an upright sight picture for the user. The main objective lens, which is the forward most lens that dictates the sight picture and amount of light being let in, has a diameter of 30 millimeters and a focal distance of 30 millimeters. The following lens is used as the image reversal assembly as to reorient the sight picture has a diameter of 25 millimeters and a focal length of 25 millimeters. The last three lenses will work in unison to create the eyepiece, which houses the lenses required for the variable magnification as well. The first lens has a diameter of 25 millimeters but a focal length of 50 millimeters. The middle lens in this assembly is a biconcave lens that will be able to move back and forth to achieve multiple magnifications, it has a diameter of 25 millimeters but a focal length of -100 millimeters. Finally, we have the largest lens to allow for a more comfortable viewing position, a biconvex lens with a diameter of 40 millimeters and a focal length of 60 millimeters. This lens acts as the focal lens, which determines the eye relief of the system. The is the distance from the lens to the eye of the user, though it also includes an optical path to the retina, so it is slightly different for most users. In this whole system, the OLED display that will be acting as a reticle is placed in the first focal plane, which lies between the objective lens and image reversal lens. The reason for this placement as opposed to the second focal plane is that magnification of the reticle was desired for this optical system. With a reticle falling in the second focal plane, the image exists right after the magnifying lens, so the reticle size remains unchanged with varying magnification.

B. Scope Housing

The housing is this project will be unconventional to the industry standard, as it will be a 3D printed structure with multiple rings set into place to hold the various lenses and other components. The housing consists of 3 main sections, mounting section which will also house all of the electronics and allow for connection to the rangefinder and a battery, and two sections of the optical tube, which is the eyepiece housing and reticle housing. The mounting section is essentially a box that was cut specifically for the electronics board that are using, with priority to ensure that the unit will not be able to shake due to the recoil of the system that it will ultimately face. The board will fit into a 80mm by 40mm box that also has posts that line up with mounting holes on the board, this will ensure that the electronics are always secure. There is also a cutout underneath to ensure that the mount to the rifle will be more secure when it is assembled. There is a groove cut out that matches perfectly with the picatinny riser, which is a mount that allows for extra height of an optic on a system. The picatinny prefix is a mounting system that uses a rail with overhanging tabs to tighten down accessories in the system and is a standardized mounting system in the industry. We chose this mounting solution as to make the design more universally usable, but having our 3D printed design be mounted using an aluminum base would make it easier to align the scope, as the parts could be more secure without bending the structure. There are also holes cut to allow a USB port if any adjustments should be made, as well as a hole for extra wiring to pass through, mainly for the battery and the rangefinder.

The eyepiece housing will be the largest piece of the scope, spanning roughly 195 millimeters and being 50 millimeters in diameter. This will house all 3 lenses of the eyepiece assembly and allow for movement of the magnifying lens from one end to the other of the scope. The end lenses of the eyepiece will have custom mounted rings so that they fit perfectly into either side without movement, and the magnifying lens will fall between them with movement being provided by a magnet on either side. There will be an outside ring that will also have magnets to provide this movement.

The reticle housing will be a much shorter tube, only spanning about 90 millimeters, but will attach to both the mounting base and the eyepiece section. There will be no adjustments on this section of the tube as we are going with a more modern approach where the adjustments are made digitally. Normal scopes have rotary dials, called turrets, to adjust the windage and elevation of the reticle, which control its direction in the x and y planes, where ours is intended to be app controlled. The main section of this housing will be the lenses, where the image reversal assembly and objective lens will use the same mounting system as in the other section of the scope, and the reticle will fit into a narrow slot cut specifically for it. This section will also be an imperfect cylinder, as there will be a flat side that lines up with the electronics housing to ensure that the fit is as perfect as possible, and the optical path is parallel with the rangefinder.

XIII. Conclusion

The senior design was a two semester project that has been an incredibly eye opening experience for all member's of the team, working together and facilitating meetings documentation and utilizing tools we have never used has been a struggle we are all grateful to have gone through.

In the meeting we discussed ideas on what to add to our design, and seeing them come to fruition has been a valuable experience for the group members, coming together to test modules then spend hours upon hours debugging taught us the value of good documentation and clear spec design as we all were forced to lean on each other for the entire duration of the project.

Bringing ideas together was not a struggle for our group yet we lacked an effective means to communicate ideas clearly and concisely through an engineers lens, we would often use words such as 'probably' and 'around that number' when we should been using 'this module is x meters long' etc. We managed to get it done through a considerable amount of meetings and communication between the members.

Overall, we believe we completed a project that has significant impact to an industry that follows all the teachings and guidance from professors and industry professionals.

To recap and close, the following table shows all the components that we carefully selected after a lot of research and testing. These are the components that fit our project's goals and objectives the best in accordance to what we can do with our constraints in mind. We have been able to successfully implement each of these components into our project's design and build.

Type	**Component Name**
Display Lens	CFAL12856A0-0151-B
Microcontroller	ATMEGA-328P
PCB	2 layers
Rangefinder	HR1500A
USB Type-C Interface	MSP2210
Voltage Regulators	HT7533-1, HT7550-1, AP3012KTR-G1
Battery	9V Battery
SR Button	QTEATAK

TABLE III: Summary of Selected Components

REFERENCES

[1] Argueta, Victor. "Types of Optical Designs Used for Rifle Scopes." OFH, https://www.opticsforhire.com/blog/optical-design-of-rifle-scope-part-1.

[2] Admin. "Optics Tutorial." High Power Optics, 29 Apr. 2020, https://highpoweroptics.com/optics-tutorial/.

[3] Andre, Cedar Glen. A Study on Zoom Lenses. Wyant College of Optical Sciences, https://www.optics.arizona.edu/sites/optics.arizona.edu/files/Cedar%20Andre%20--%20Master%27s%20Report%20--%20A%20Study%20on%20Zoom%20Lenses%20%28Update%29.pdf.

[4] Inc. CUI. Power supply standards. Available: https://www.cui.com/catalog/resource/power-supply-safety-standards-agencies-and-marks.

[5] Microchip Technology. MCP2210 USB to SPI Converter with GPIO (Master Mode). Available: https://www.microchip.com/en-us/product/MCP2210.

[6] Rockwell Laser Industries. Laser Standards and Classifications. Available: https://www.rli.com/resources/articles/classification.aspx.

XIV. TEAM MEMBERS

Ahmed Al Busaidi is a graduating Computer Engineering student. Ahmed's career goals are to advance his degree to obtain a Masters in Computer Vision and Machine Learning, and to work for a company such as HyperScience.

Collan Dimitri is a 25-year-old Photonic Science and Engineering student. His main aspiration is to pursue a career in optics in an engineering or defense environment such as Lockheed Martin or L3Harris. His goal with this project is to further his understanding of optics and learn how to design more advanced optical systems.

Jacob Clevenger is a senior student of the Electrical Engineering department at the University of Central Florida. Having previously interned at Lockheed Martin through UCF, he hopes to pursue a career in working with renewable energy or go into software development.

Jose Vasquez Dickson, a senior student studying electrical engineering with a focus on renewable energy at the University of Central Florida. He is currently working in the electrical design of substations with Power Grid Engineering. Throughout his career at UCF, he has done several internships to broaden the engineering knowledge of the different branches.