IFOBS - Integrated Fire-Control Optic and Ballistic Solution

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Introduction

IFOBS is an innovative and precise ballistics tracking system designed to calculate bullet drop points for shooting applications, enhancing accuracy and performance.

Background

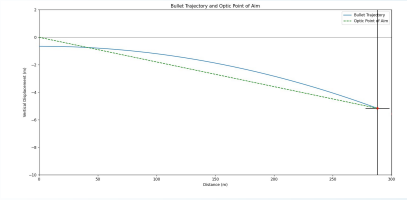
- Precision and accuracy serve as fundamental aspect for shooting applications.
- Relying on manual calculations for bullet trajectory and ensuring a perfectly level rifle reduces shooting accuracy and training efficiency.
- Lack of real-time feedback on bullet trajectory forces soldiers to make rapid adjustments based on limited information.

Problem

- Current military training lacks instant and accurate bullet trajectory feedback, hampering marksmen's ability to rapidly adjust and refine their shooting skills.
- Manual bullet drop calculations lead to inconsistent accuracy and prolonged training timelines, impeding mission success rates and combat readiness.

Key Requirements & Constraints

IFOBS Requirements:
- Detect target ranges over 100 yd.
- Detect the current rifle cant and elevation angles.
- Calculate the bullet drop quickly, reliably and display an intuitive UI to the user.
- Accommodate a wide range of commonly used bullets and rifle platforms.



Testbed Requirements:
- 70µm step resolution is required for 1cm adjustment at 100m. [1]
- 7.43Nm of linear torque required to maneuver Ruger 10/22.

Solution

- Cutting-edge ballistics solution system that automates the calculation of bullet drop points, revolutionizing shooting accuracy in military scenarios.
- Real-time and precise feedback on bullet trajectory enhances marksman training, enabling quicker skill development and improved performance outcomes.

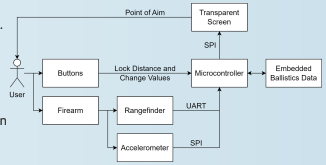
Main Functions & Project Modules (Optic)

Transparent Screen
- Shows the calculated point of impact and readings from the sensors.

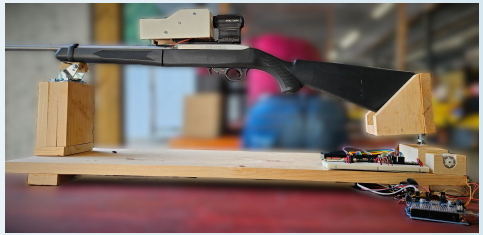
Rangefinder
- Measures the distance to the target.

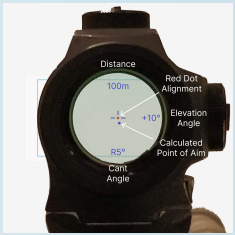
Accelerometer
- References the direction of gravity to calculate cant and elevation.

Microcontroller
- Calculates the point of impact from the sensor data and displays it on the screen.



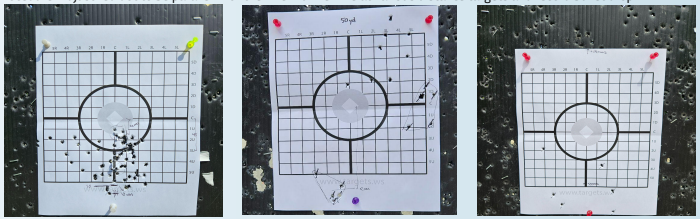
Proof of Concept





Test Result

Procedure: Adjust red dot to be parallel with the rifle muzzle. Fire at various distance targets and record bullet drop.

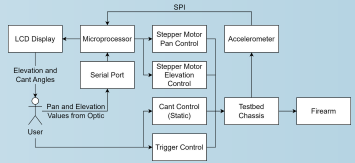


Distance	Actual Bullet Drop with offset	Actual Bullet Drop	Predicted Bullet Drop (IFOBS)
25 yd	70mm +/- 7mm	5mm	23mm
50 yd	120mm +/- 15mm	55mm	70mm
100 yd	320mm +/- 45mm	255mm	296mm

Main Functions & Project Modules (Testbed)

Stepper Motor
- Performs micro adjustments to the rifle based off optic predictions.

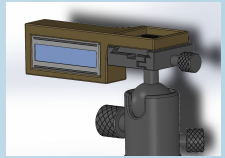
Rifle Sled
- Stabilizes the rifle and ensures repeatability of shots.



Problem Analysis and Future Work

Optic Improvements:
- Screen is not on the same optical plane as the red dot.
- Screen is hard to see in the sun.
- Slight accelerometer drift.
- Pixel width of green dot is large at long ranges and can obscure the target.
- Housing covers part of the display.
- No zero range cant compensation.

Testbed Improvements:
- Extremely slow when making macro (target to target) adjustments.
- Improve structural integrity.
- Minimize buttstop chair sagging.
- Cant adjustments not implemented.
- Integrate Testbed electronics on the same Microcontroller.



Conclusion

The Integrated Fire Control Optic and Ballistic Solution (IFOBS) holds significant potential to enhance shooting accuracy, and diligent efforts have been made to address associated risks, prioritize user needs, and deliver an effective solution for shooters and military applications.

References

[1] "Long range shooting - moa and mils explained," longrangeshooting, https://www.longrangeshooting.org/articles/moa-and-mils-explained (accessed Aug. 7, 2023).