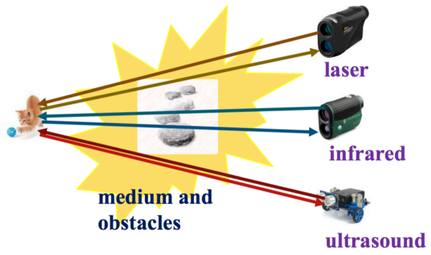
Automatic Rangefinder Using Multiview Images (ARFUMI)

Zachary Faircloth, Steven Lindig, Vonzell Williams, Matthew Torres, Austin Rome| Mr. John Scalzo | Louisiana State University

Background

This project started when Dr. Hsiao-Chun Wu designed a signal-processing, range finding algorithm that iteratively determines the range/size of an object from two images taken at different points in a 2'x2' plane. Optical range measuring typically has a 30% error. Dr. Wu's program—capable of a 3% or lower error—needed a means of being tested effectively and precisely.

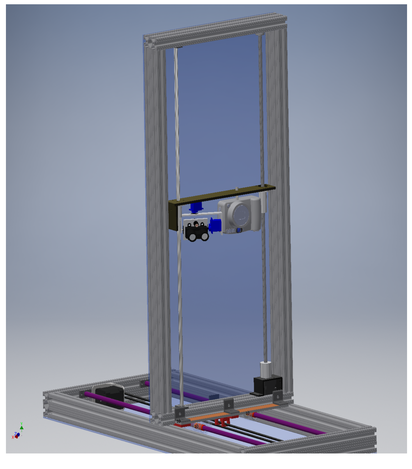


Objectives

- Determine the height of an object with two or more images of that object
- Provide a more accurate, effective way to move a camera on a two axis plane
- Minimize the error involved with moving a camera precisely to capture images
- Send the information measured accurately to the signal processing algorithm

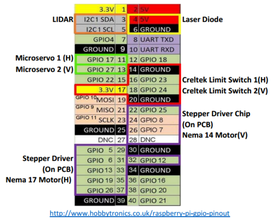
Engineering Specifications

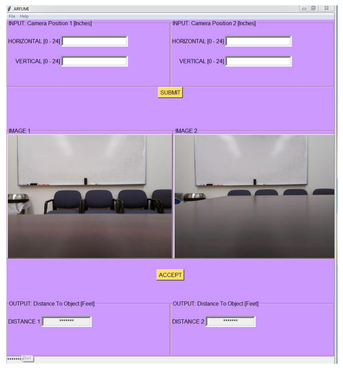
Engineering Requirements	Justification
1. The overall dimensions must not exceed 3'H x 3'W x 3'D	Limitation given was at most 3 feet in the X and Y direction
2. The system will include a mechanism to control the X and Y axis movement within 2 feet (with less than 1% error) through a user interface	Limitation given was at most 3 feet in the X and Y direction
3. The system must be designed for indoor use	The system will be used in a controlled environment
4. The system must function properly (at least 30 min) without needing to be recharged	An experiment typically requires 15 minutes
5. The system's range finders must be able to detect the distance from the measurable object to within 1% error	The range finders will be used to determine the distance from the object
6. The entire system must cost less than $1,500 with minimal upkeep cost	The budget is $1,500
7. The system should be able to remotely capture images	Remote capture allows user to capture image without having to manually move positions and interface with the camera

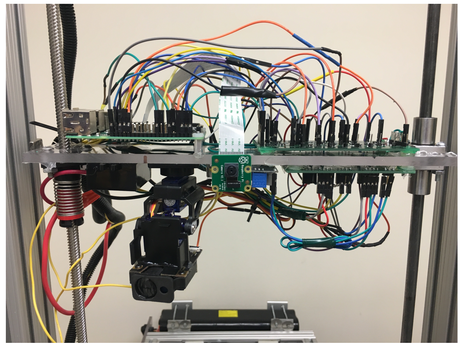


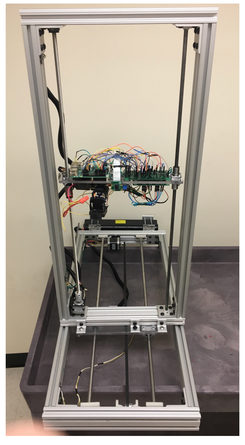
Concept Selection and Testing

- Using a Raspberry Pi 3 to drive a Graphical User Interface (GUI), a LIDAR rangefinder, and two team-designed PCBs with stepper drivers and DC voltage, the ARFUMI is able to accurately measure NEMA 14 and 17 motor steps compared to distance in the vertical and horizontal directions for precision movement and remote image capture
- Two microservo motors position the LIDAR on a particular object based on user feedback
- The GUI retrieves an accurate LIDAR-read distance and the accurate distance for the user and inputs into Matlab
- Dr. Wu's algorithm in Matlab will be cross-checked with the result



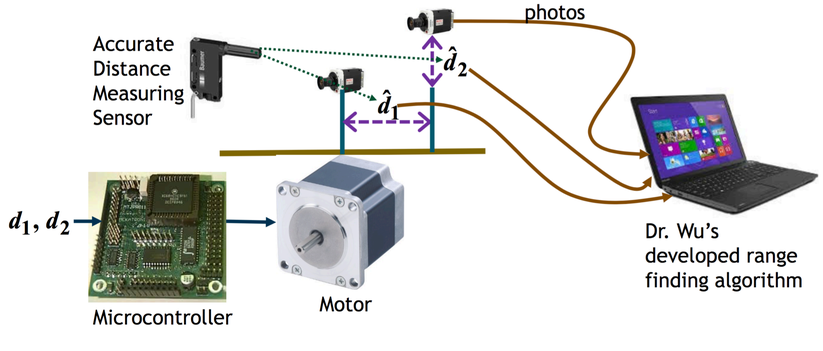






Conclusion

- The ARFUMI accurate moves and measures a precise distance in two directions within 1% error
- The overall dimensions are smaller than 3'H x 3'W x 3'D, but it will not be collapsible
- The systems allows for hands-free control in both directions with remote image capture; however, it fall short of the 2'x2' goal
- The battery life of the ARFUMI is greater than seven hours of continuous operation
- The final budget was $1,196.99, and the ARFUMI could be replicated for under $1,000



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- Thank you to Dr. Hsiao-Chun Wu for his mentorship through the designing of the ARFUMI