# Laser Scan Readings for Propeller Measurement

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# Project Overview

Project Name: Laser Scan Readings for Propeller Measurement

Goal: Replacing propeller measurement system of Linden Propeller

Reason for change:

- Carbon fiber rods attached to scales are brittle
- Expensive to replace/repair
- Extended lead times

# Client Abstract

“I would like to convert our current scan arm from digital analog reader head and scales to laser beam technology. We currently use Newall scales that are easily susceptible to damage while in a shop environment. Also, the industry is moving towards 3D scanning devices which make my current system less desirable. A major design constraint would be to measure overlapping blade sections with a laser beam. We currently are able to measure those propellers with a special adapter mounted to the drop probe. We would have to overcome that constraint.”

# Constraints

- Accurate to 5 micrometers
- ≈ $3000
- Compatible with TrueProp
- Durable
- Fits on current frame

# Perceived Challenges

- Initial budget of $1000
- Angle of laser needs to be modular
- Software integration could be complicated
- Mounting space on current system could be cramped

# Product Research

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|---|---|
|  Magnescale BS78 | This laser scale is highly accurate and comes with a mounting rail which provides stability and strength. |
|  KEYENCE LK-G5000 Series | This laser sensor has a resolution of 5 nm, and an accuracy tolerance of 0.02%. |

| | |
|---|---|
|  Creaform HandySCAN 3D | It's very fast and accurate as well as portable. The website says it can run at 1.3 million measurements per second. |
|  ModelMaker H120 and MCAx S System | It is well suited to scanning complex objects and can handle molding sections. It comes mounted on a flexible arm so that users can move it around and easily scan objects |

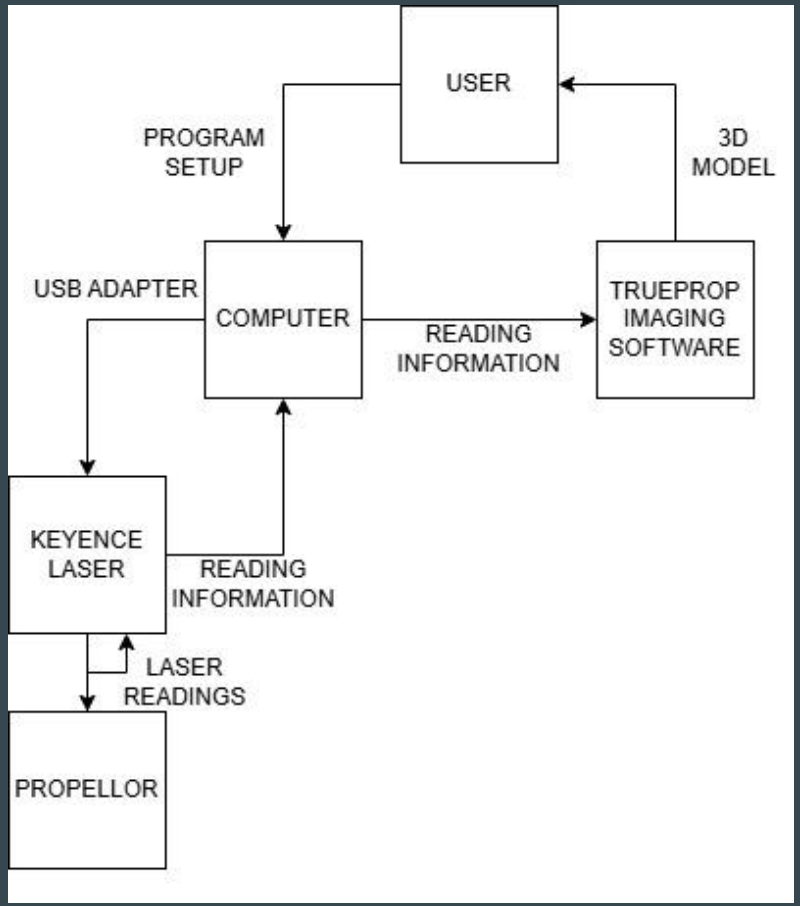
# KEYENCE Laser

Benefits

- Exceeds resolution constraint
- Designed for shop environments
- Even scans reflective surfaces
- Major discount - 75%

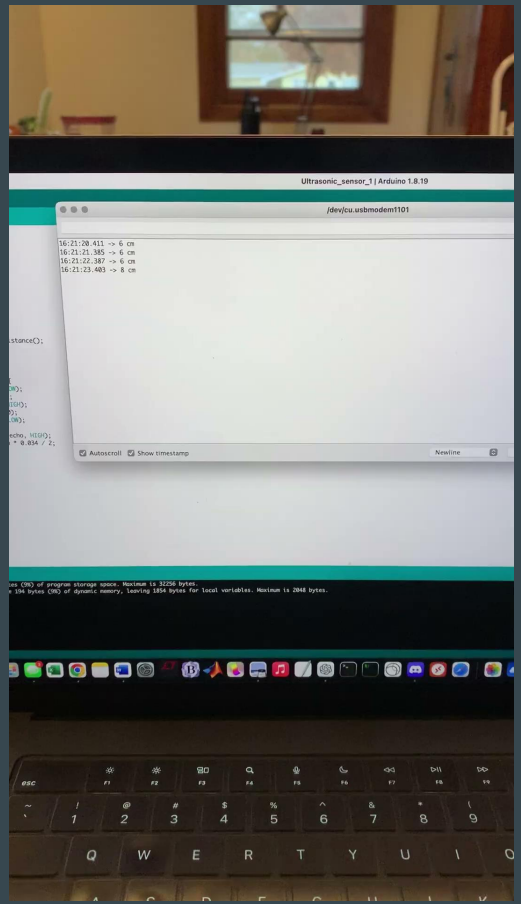
Downsides

- Has its own software and needs to adapt to TruProp
- Slightly out of budget range, even with discount



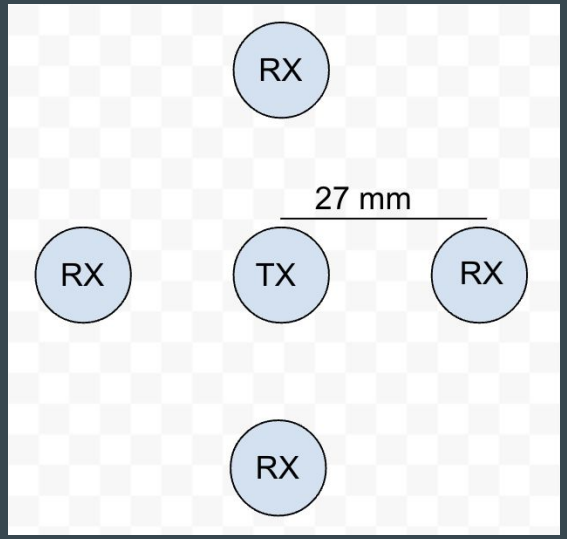
# Prototype 1: Ultrasonic

- Outputs were being produced relatively accurately
- Pushed to have similar code for IR to provide accurate comparisons



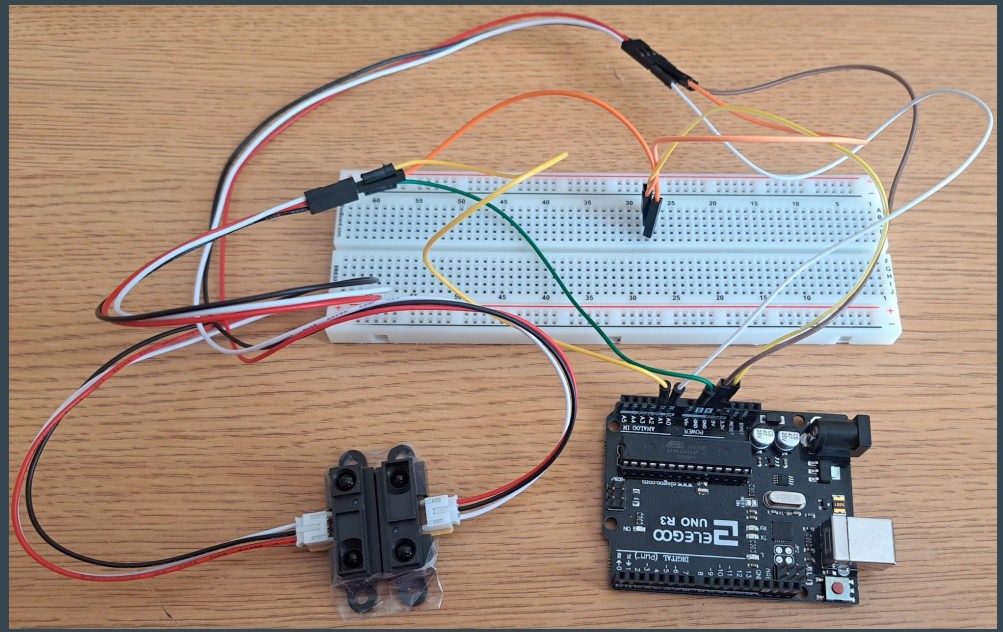
# Ultrasonic Data Fusion Concept

- Using multiple receivers can enable averaging of their readings to reduce random electronic noise or measurement jitter.
- This will be measuring a stable, flat surface have which will have minimal inherent noise.
- Averaging multiple, essentially identical signals provides incremental improvement.
- (3 mm) accuracy for this proof of concept



# Prototype 2: Infrared

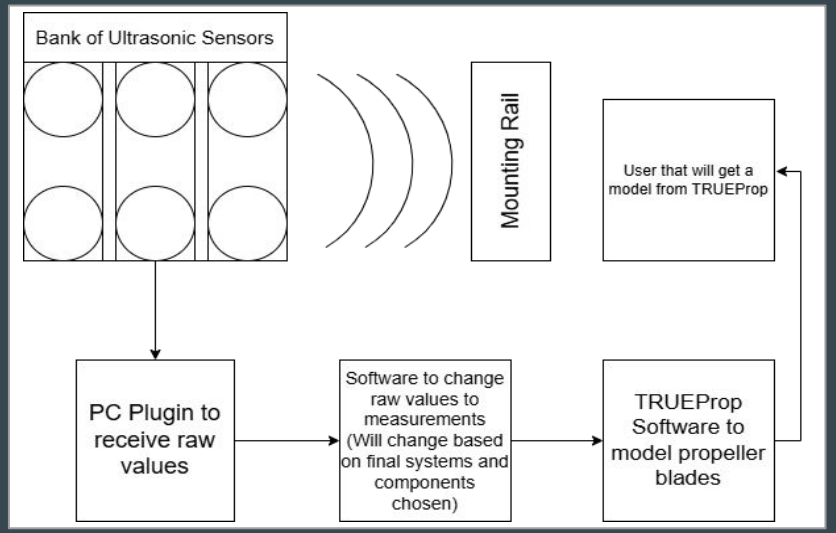
- 2-week delay due to missing group member that had equipment
- Initial difficulties connecting to Arduino
- Values were being received
- Data fusion was to be the next step



# Client Support

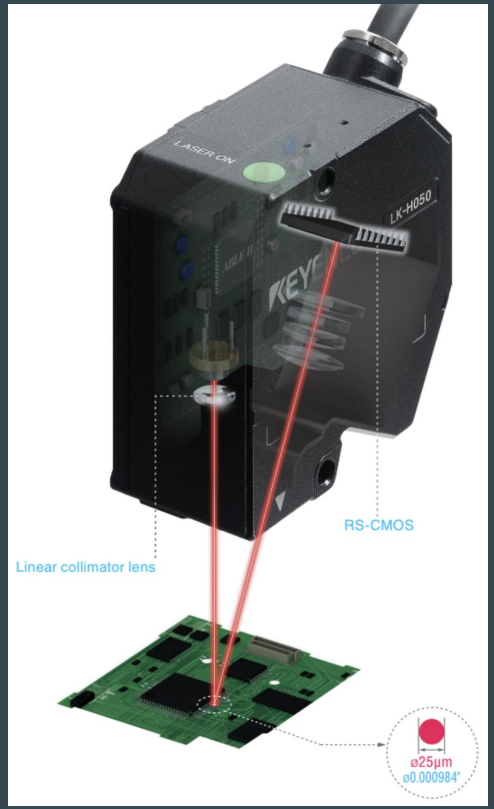
- A small piece of his mounting arm
- USB-4 data encoder box
- KEYENCE system


# Proposed Solutions

# Selected Solution

- Mr. Linden agreed to this solution once the new semester started
- Meets all of his requirements
- Can export data from KEYENCE software (LK-Navigator)
- Can directly connect from the head to a computer

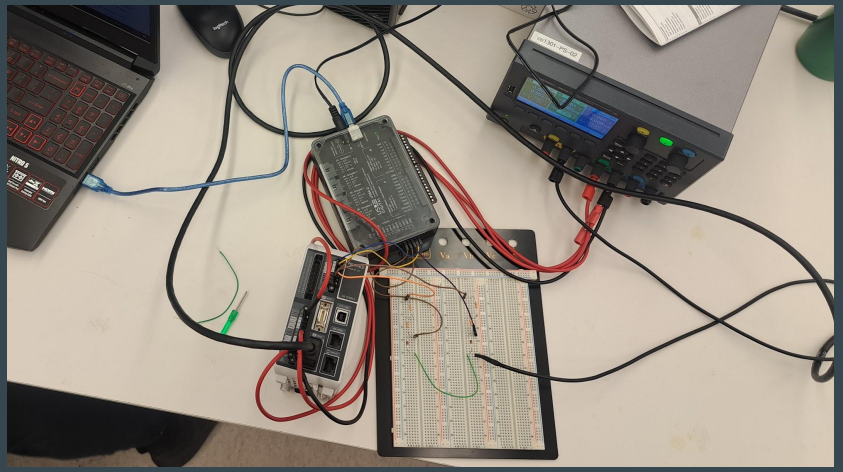


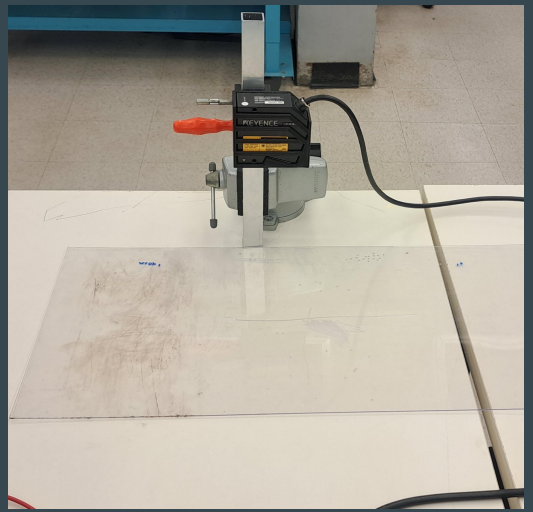
# Troubles and Concerns

- Inadequate budget in the beginning, but increased halfway through the second semester
- Our client was unable to be consistently contacted for months
- His purchase of the KEYENCE system was exceptionally late into second semester
- Limit of USB-4 data box input is 5V, our solution outputs at 12V
- No TrueProp license to test integration
- Our materials did not arrive in time for a proper demonstration

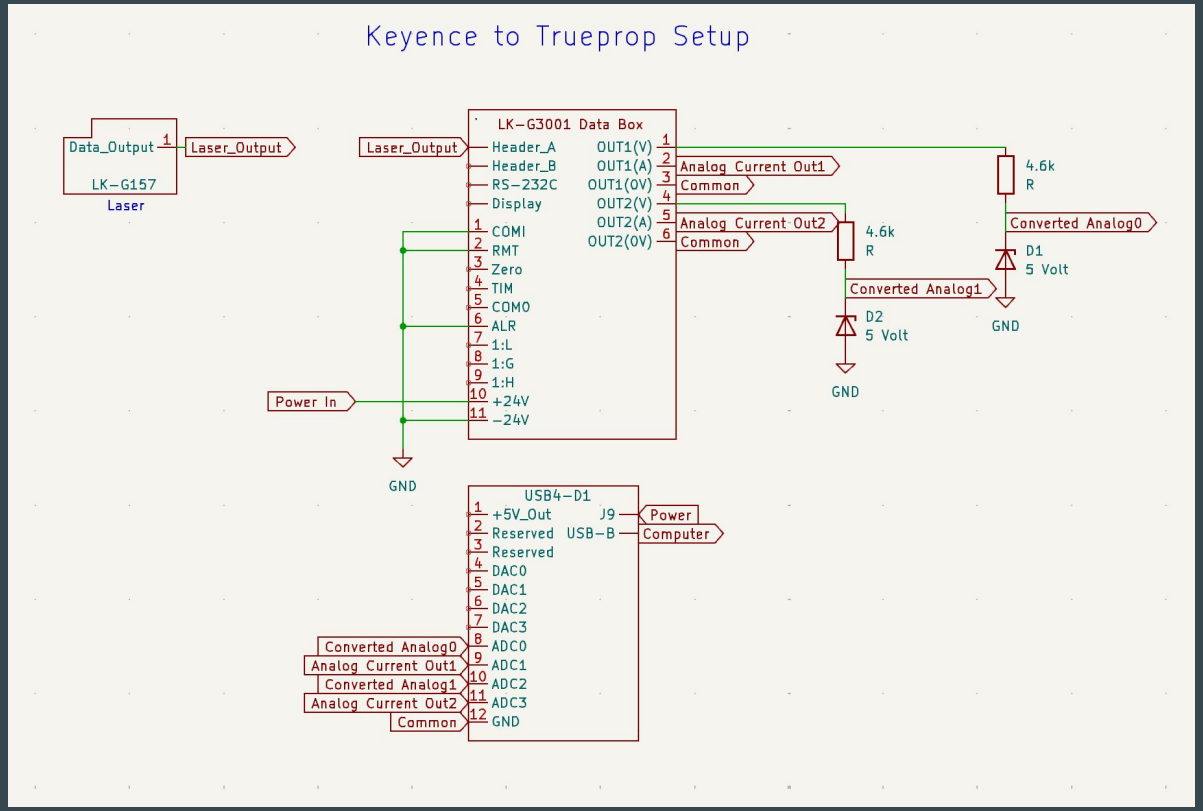
# Final Design

- Using KEYENCE system connected to USB-4 data encoder box
- Needed a voltage regulator to decrease voltage
- Design shown is with a breadboard; not enough time to design, print, and test a PCB
- 24V voltage source



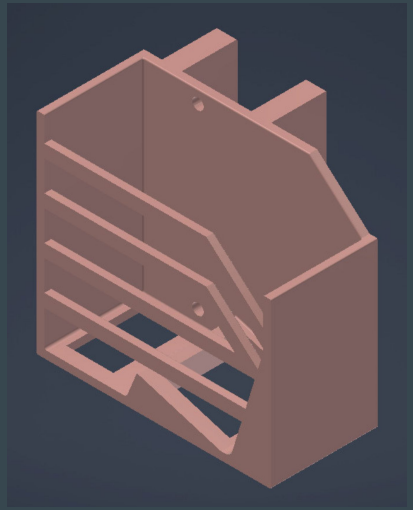


# Final Design Schematic



# Mounting Bracket Design

- Made using Autodesk Inventor
- Used exact specifications from the KEYENCE datasheet
- Designed to be mounted on a 1”x1” square channel
- Sufficient room for both the emitter and receiver



# Testing

- Plexiglass used as our surface material
- Tested using multiple environments
  - Dirt/dust
  - Scratches
  - Holes
  - Clean
- Laser held stationary with a vise grip
- One continuous measurement similar to shop procedure

# Conclusions

- Our system meets all mandatory requirements
- The system can be used with or without the USB4 box
- The system has an easily accessible and adaptable bracket if it needs to be moved
- While testing may have been rushed, acceptable results were produced even on limited time
- More detailed results would show the true capabilities of the system