Team #22

# Computer Vision Quality Assurance for Medical Linear Accelerators

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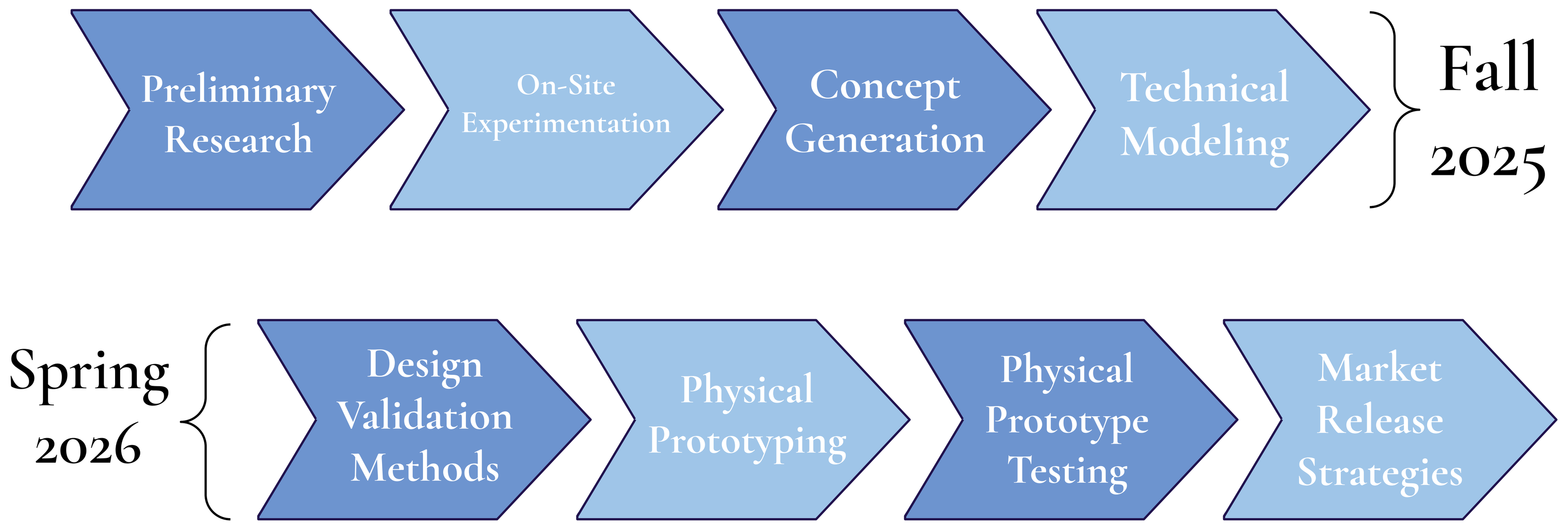
## Introduction/Background

Medical Linear Accelerators (Linacs) are the primary tool for radiational therapy for cancer patients, being tools valued for their efficient and non-invasive delivery of treatment. The accuracy and the consistency of existing mechanical QA tools for medical linear accelerators are limited by their heavy reliance on subjective, manual measurement. There exists a prevalent need in the market for advancements in automated measurement tools for mechanical linac movements.

## Mission Statement

StriX aims to advance radiation therapy outcomes through the innovation of precise, efficient, and automated devices for the testing and quality assurance of medical linear accelerators.

## Project Planning




## Design Inputs

**Table 1: Customer Design and Metric Table.** *Various needs expressed by clients as well as determined through external research.*

| Customer Need | Specification |
|---|---|
| Ease of Setup, removal and Operation | Must Set up, remove and operate quickly and simple |
| Minimal manual Effort Required | Must be operated by one person |
| Minimal Wires | Limit the number of wires used |
| Reliability | Must output consistent results |
| Precision | Must represent low measurement variance |

## Concept/Design

Currently, StriX is moving forward with the implementation of an autonomous LiDAR system that can integrate into the current C.V.Q.A. system to measure the vertical offset for ODI verification. The LiDAR will measure the distance and through its processing unit send the distance data wirelessly to the software ensuring the distance meets the threshold requirements.

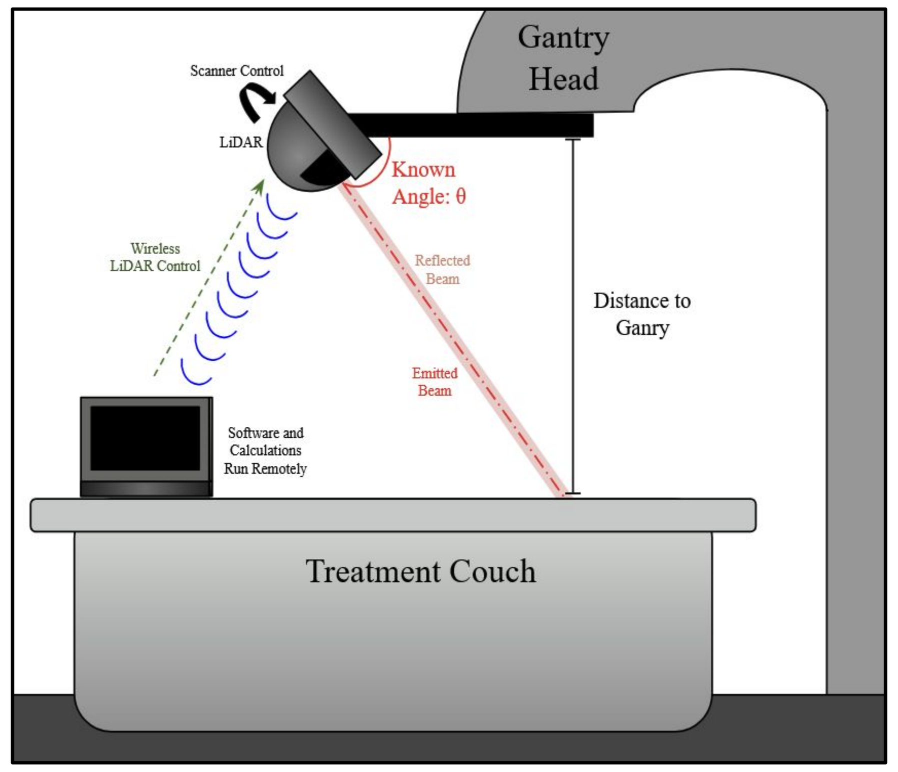



**Figure 1: Concept Design.** *This diagram visualizes the concept of the autonomous LiDAR system.*

## Product Architecture

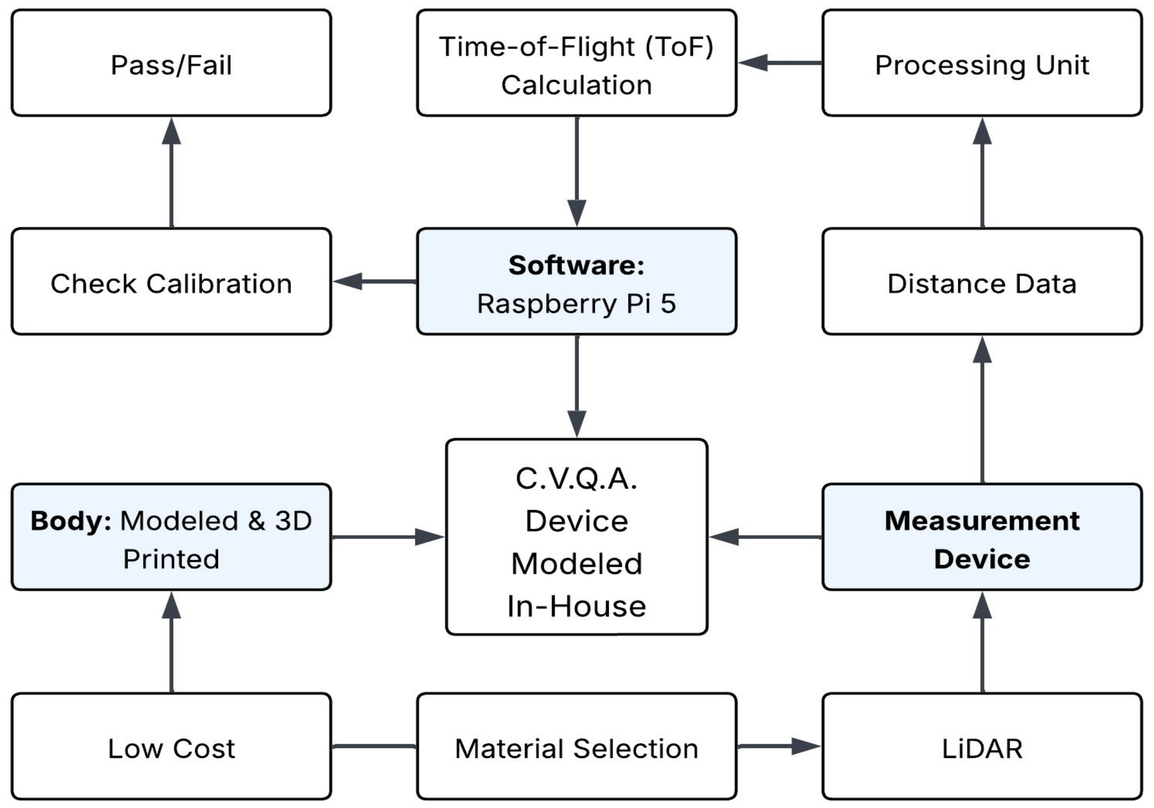



**Figure 2: Product Architecture.** *This diagram presents the most important aspects of the critical components and interfaces of the product architecture. A more detailed diagram can be found at the QR code in the bottom right corner.*

## Design for Manufacturing

**Table 2: Major Components & Manufacturing Considerations.** *This table represents the major components driving the device design and their estimated cost breakdowns*

| Major Components | Cost |
|---|---|
| 3D Printed C.V.Q.A Model | ~$50 |
| LiDAR | ~$5-25 |
| Raspberry Pi 5 | ~$25 |

## Final Product Specifications

**Table 3: Final Product Specification.** *Design specifications which StriX aims to achieve within the final product*

| Technical Specification | Description | Ideal Metric |
|---|---|---|
| Simple Setup | Low Time to Set Up Device | <5 Min |
| Ease of Storage | Device Occupancy between Sessions | 25" x 18" x 11" |
| Service Life | Operational Lifespan Without Failure | 5 Years |
| Long Wireless Life | Length of Operational Wireless | > 2 Hours |
| Automated | Amount of Human Effort Required | No Manual Labor |
| Large Memory | Amount of Past QA Sessions Stored | > 1 Year |
| High Durability | Low Rate of Crack/Tear Formation | Pass 2' Drop Test |

## Design Status/Future Work

The team completed the primary concept and product design for the autonomous LiDAR system and made sure that the sensing and processing pathway is functional. Currently, the focus is on modeling system performance and making sure that distance collection is performed correctly within the CVQA workflow. The team will now build the first working prototype, improve wireless communication, and do bench testing to check accuracy, reliability, and how well it works with clinical use cases.

## Acknowledgements

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Links: