Design and Prototyping of a Portable AI-Powered Field Device for Forest Monitoring Applications

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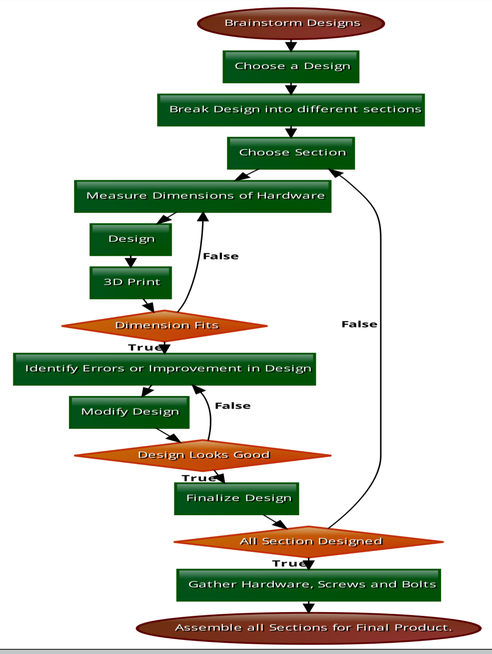
Background

- Wood chip quality (moisture, size) is key to sustainable forestry.
- Traditional lab methods are bulky and not field-friendly.
- Edge AI enables real-time, on-site analysis without internet.
- Using 3D design software like *SolidWorks* and *Fusion 360*, *we can* model and simulate parts digitally before printing them with a 3D printer.
- With NVIDIA Jetson Nano we can run AI models without needing the internet.

Objectives

- Design and fabricate a compact housing for components enabling portable, AI-driven wood chip evaluation.
- Enable integration of imaging, computing, and power systems within a single 3D-printed enclosure.
- Support offline functionality using embedded Jetson Nano and onboard ML model for moisture/dimension prediction.

Methodology

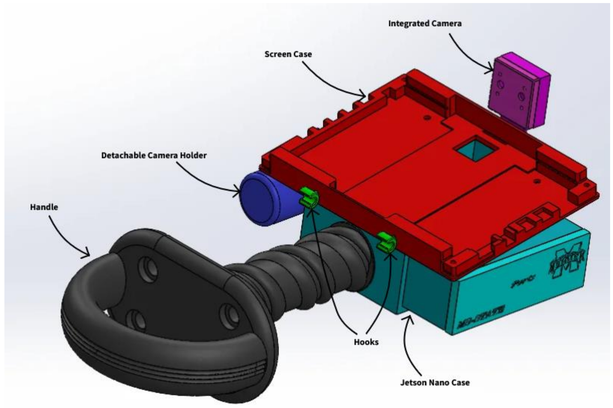


Results

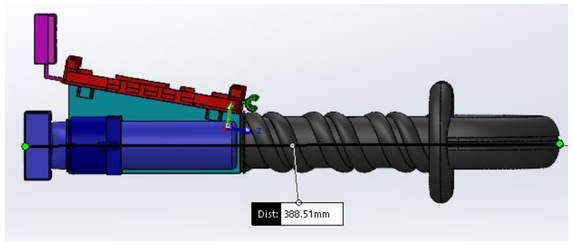
The resulting device successfully integrates all required hardware into a portable, compact, and field-ready enclosure. The product supports:

- Captures wood chip images using built-in and detachable cameras.
- Runs ML models directly on Jetson Nano without internet.
- Evaluates moisture and chip dimensions from images in real time.
- Features a touchscreen for user control and display.
- Powered by a swappable NP-F970 battery system.

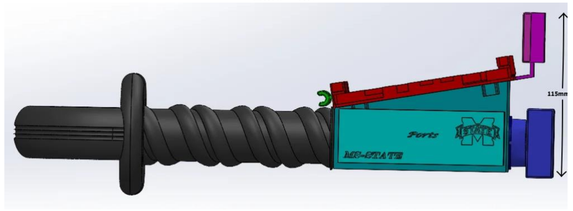
PrusaXL Printer



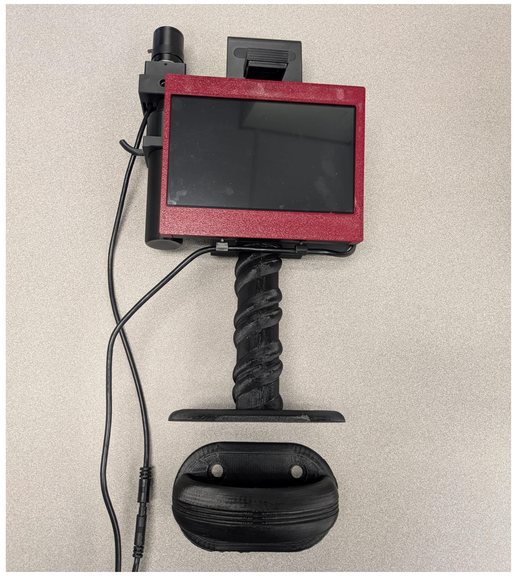
Isometric View



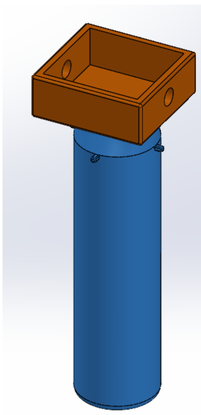
Left View



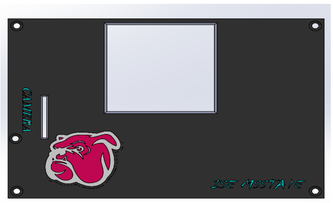
Right View



3D Printed



Camera Holder



Jetson Nano Case's Lid

Port Lid

Hardware / Software

Hardware

- NVIDIA Jetson Nano
- 7-inch HDMI touchscreen LCD
- 8.00 Megapixel USB camera
- NP-F970 battery and adapter plate
- Buck converter (power regulation)
- PrusaXL 3D Printer (Material-PLA)
- Bambu Lab X1 Carbon Printer (Material-PLA)

Software

- SolidWorks and Fusion 360 used for CAD modeling.
- PrusaXL Slicer used for converting design form CAD tools to printable formats.

Conclusions and Future Work

Conclusions

- Created a design that can operate with real-time data collection and analysis without relying on cloud connectivity.
- Successfully demonstrate how iterative design and 3D printing can lead to the rapid development of a custom and functional device.
- Understood potential of low-cost, accessible tools like SolidWorks, Fusion 360, and consumer-grade 3D printers in accelerating hardware prototyping.

Future Work

- Field testing to validate model accuracy on real wood chip samples
- Potential ruggedization for outdoor industrial deployment
- Modularizing the system for broader applications.

Acknowledgements

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