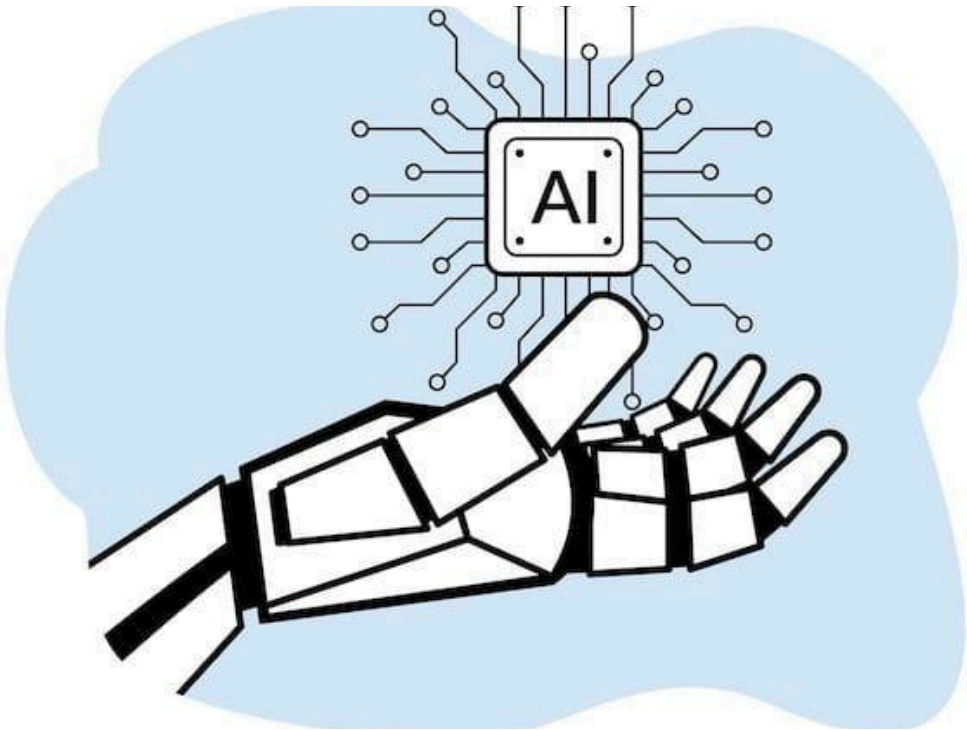
Capstone Project
Subject : Artificial Intelligence(843)
Project Title : IRIS



Amity International School
Sector-46, Gurugram

CERTIFICATE

This is to certify that this project titled ‘IRIS’ prepared by the students
of class XII of Amity International School, Sector-46, Gurgaon, under the guidance of Ms. Mukta Bimbrahw, Teacher in-charge of Artificial Intelligence, has submitted the same for evaluation as a partial fulfilment of curriculum for the session 2024-25.This is also certified that the project is originally written and does not indulge in any form of plagiarism. It is acknowledged that a lot of information and understanding has been collected/sourced from various sources that are already published and are accessible to general public which are separately acknowledged at the end of the report.

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Signature of Teacher/Guide Signature of Principal

AI PROJECT LOGBOOK

Resource for Students

(Adapted from "IBM E dTech Youth Challenge – P roject Logbook" developed by IBM in collaboration with Macquarie University, Australia and Australian Museum)

KEY PARTNERS

INDIA IMPLEMENTATION PARTNERS

GLOBAL PARTNERS

AI Project Logbook

PROJECT NAME: IRIS Project

SCHOOL NAME: Amity International School Sector-46 Gurugram

YEAR/CLASS: 2024-25 Class-12-B

TEACHER NAME: MS. MUKTA BIMBRAHW

TEACHER EMAIL: mbimbrahw@aisg46.amity.edu

TEAM MEMBER NAMES AND GRADES:

1. Harshit Sachdeva
2. Madhav Gupta
3. Amanjyot Singh
4. Sanvi Sharma

1. Introduction

Our project aims to create a device to help people with visual impairments. We're using YOLOv8 object detection and a TF-Luna LiDAR sensor with a Raspberry Pi 4. The device's main goal is to make it easier for people to navigate indoors.

With YOLOv8, the device can recognize objects like chairs, sofas, and tables in indoor spaces. The TF-Luna LiDAR sensor measures how far these objects are from the user within a 1.5 to 3-metre range. By combining data from these two sources, the device uses Google Text-toSpeech to turn this information into spoken messages that tell users about the objects and where they are.

Users can listen to these messages through an earpiece connected to the device. We've made sure to make the device easy to use and accessible, with options like voice commands and tactile controls for different users.

2. Team Roles

2.1 Who is in your team and what are their roles?

Role	Role description	Team Member Name
Project Leader	Schedules the task among the team member, Ensures the task is completed on time, and one source of contact	Sanvi Sharma
Data Expert	Decides upon the data required, type of data for training the model, collects the data, ensures the type of data, and its authenticity	Harshit Sachdeva and Madhav Gupta
Information Researcher	Gathers user questions, finds answers, and prepares a report for the project leader.	Amanjyot Singh and Harshit Sachdeva
Designer	Will create the design and the flow of how to go about making the solution for the problem statement.	Sanvi Sharma and Amanjyot Singh
Prototype Builder / Coder / Tester	Works to build the model, train it followed by testing the efficiency and accuracy of the model.	Madhav Gupta

*Everyone has contributing in ideation and logbook writing

Phase	Task	Planned start date	Planned end date	Planned (DURATION, HOURS, MINUTES)	Actual Start Date	Actual end date	Actual (DURATION, HOURS, MINUTES)	Who is attending	Notes/ Remarks
Preparing for the project	Coursework, readings	1/4/2024	Ongoing	20 - 30 HOURS	24-04-2024	Still working	21.5 hours done so far	Team members	Research work
	Set up a team folder on a shared drive	2/4/2024	30/06/2024	1.5 hours	23/06/2024	30/06/2024	15 hours	Team members	Collaborative work
Defining the problem	Team meeting to discuss issues and select an issue for the project	1/4/2024	1/4/2024	1.0 hour	30-04-2024	25-07-2024	1.5 hours	Team members	Get feedback from teachers and peers
		2/4/2024	2/4/2024	1.0 hour	30-04-2024	25-07-2024	1.5 hours	Team members	
		3/4/2024	3/4/2024	1.0 hour	30-04-2024	25-07-2024	1.5 hours	Team members	
		4/4/2024	4/4/2024	1.0 hour	30-04-2024	25-07-2024	1.5 hours	Team members	
		6/4/2024	6/4/2024	1.0 hour	30-04-2024	25-07-2024	1.5 hours	Team members	
		7/4/2024	7/4/2024	1.0 hour	30-04-2024	25-07-2024	1.5 hours	Team members	
		8/4/2024	8/4/2024	1.0 hour	30-04-2024	25-07-2024	1.5 hours	Team members	
		9/4/2024	9/4/2024	1.0 hour	30-04-2024	25-07-2024	1.5 hours	Team members	
		11/4/2024	11/4/2024	1.0 hour	30-04-2024	25-07-2024	1.5 hours	Team members	
		12/4/2024	12/4/2024	1.0 hour	30-04-2024	25-07-2024	1.5 hours	Team members	
		13-04-2024	13-04-2024	1.0 hour	30-04-2024	25-07-2024	1.5 hours	Team members	
		14-04-2024	14-04-2024	1.0 hour	30-04-2024	25-07-2024	1.5 hours	Team members	
		15-04-2024	15-04-2024	1.0 hour	30-04-2024	25-07-2024	1.5 hours	Team members	
		16-04-2024	16-04-2024	1.0 hour	30-04-2024	25-07-2024	1.5 hours	Team members	
		17-04-2024	17-04-2024	1.0 hour	30-04-2024	25-07-2024	1.5 hours	Team members	
		18-04-2024	18-04-2024	1.0 hour	30-04-2024	25-07-2024	1.5 hours	Team members	
	Background reading	025-04-2024	23/06/2024	1 hour	23-06-2024	23/06/2024	1 hour	Team members	Collaborative work
	Research issues in our community	26/04/2024 morning	23-06-2024	1.5 hours	23/06/2024 9 10:30	23-06-2024	1.5 hours	Team members	Collaborative work
	Complete section 3 of the Project Logbook	23/06/2024	23/06/2024	15 mins	23/06/2024	23/06/2024	15 mins	Team members	Collaborative work
Rate Yourselves : 3/3									

Understanding the users	Identify users	3-Mar	23/06/2024	30 mins	23/06/2024	23/06/2024	30 mins	Team members	Collaborative work
	Meeting with users to observe them	23/06/2024	24/06/2024	30 mins	24/06/2024 morning	24/06/2024	30 mins	Team members	Online interaction with users
	Interview with user (1)	24/06/2024	24/06/2024	15 mins	24/06/2024	24/06/2024	15 mins	Team members	Collaborative work
	Interview with user (2), etc	24/06/2024 09:00	24/06/2024	15 mins	24/06/2024	24/06/2024	15 mins	Team members	Collaborative work
	Complete section 4 of project logbook	24/06/2024 09:30	24-06-2024	30 mins	24/06/2024	24/06/2024	30 mins	Team members	Collaborative work
	Rate yourselves : 3/3								
Brainstorming	Team meeting to generate ideas for a solution	3/6/2024	24/06/2024 End of the	1.5 hours	24/06/2024	24/06/2024	1.5 hours	Everyone	
	Complete section 5 of the Project Logbook	24/06/2024	24/06/2024 End of the day	30 mins	24/06/2024	24/06/2024	30 mins	Team	Collaborative work
	Rate Yourselves 3/3								
Designing the solution	Team meeting to design the solution	25/06/2024	25/06/2024 End of the day	3 hours	25/06/2024	25/06/2024	3 hours	Team	Collaborative work
	Complete section 6 of logbook	27/06/2024	25/06/2024	30 mins	25/06/2024	25/06/2024	30 mins	Team	Collaborative work
Rate Yourself 3/3									
Collecting and preparing data	Team meeting to discuss data requirements	3/3/2024	23/06/2024	30 mins	23/06/2024	23/06/2024	30 mins		
Collecting and preparing	Data collection	23-06-2024	24/06/2024 morning	30 mins	23/06/2024	24/06/2024	30 mins	Team members	
Data Prototyping	Data preparation and labelling	23/06/2024	25/06/2024	3 hours	25/06/2024	25/06/2024	3 hours	Team members	While designing
	Complete section 6 of the project logbook	25-06-2024	25/06/2024	30 mins	25/06/2024	25/06/2024	30 mins	Team members	Collaborative work
	Team meeting to plan prototyping phase	25/06/2024	25/06/2024	3 hours	25/06/2024	25/06/2024	3 hours	Team members	During the designing time
Prototyping Testing	Train your model with input dataset	25/06/2024	25/06/2024 End of the day		25/06/2024	25/06/2024		Team members	Done during designing
	Test your model and keep training with more data until you think your data is accurate	26/06/2024	27/06/2024	15 mins	26/06/2024	27/06/2024	15 mins	Team members	Collaborative work
	Write a program to initiate actions based on the result of your model	28/06/2024	28/06/2024	15 mins	28/06/2024	28/06/2024	2 hours	Madhav	Python code
	Complete section 8 of project logbook	5	25/06/2024	15 mins	25/06/2024	25/06/2024	15 mins	Team	Collaborative work

	Team meeting to discuss meeting plans	20-06-2024	26/06/2024	10 mins	26/06/2024	26/06/2024	10 mins	Team	Whatsapp
Testing	Invite users to test your prototype	26/06/2024	29/06/2024	15 mins	29/06/2024	29/06/2024	15 mins	Team	
Creating the video	Conduct testing with users	28/06/2024	29/06/2024	30 mins	29/06/2024	29/06/2024	30 mins	Team	
	Complete section 9 of project logbook	29/06/2024	29/06/2024	30 mins	29/06/2024	29/06/2024	30 mins	Team	Collaborative work
Rate Yourself 3/3									
	Team meeting to discuss video creation	29/06/2024	29/06/2024	15 mins	29/06/2024	29/06/2024	15 mins	Team	Collaborative work
	Write your script	29/06/2024	29/06/2024	10 mins	29/06/2024	29/06/2024	10 mins	Team	
	Film your video	29/06/2024	29/06/2024	20 mins	29/06/2024	29/06/2024	20 mins	Team	
	Edit your video	29/06/2024	29/06/2024	10 mins	29/06/2024	29/06/2024	10 mins	Team	
Completing the logbook	Reflect on the project with your team	29/06/2024	30/06/2024	10 mins	30/06/2024	30/06/2024	10 mins	Team	
	Complete sections 10 and 11 for project logbook	30/06/2024	30/06/2024	10 mins	30/06/2024	30/06/2024	10 mins	Team	
	Review your Project logbook and video	30-06-2024	30/06/2024	10 mins	30/06/2024	30/06/2024	10 mins	Team	
Submission	Submit your entries on iris	30/06/2024	30/06/2024	10 mins	30/06/2024	30/06/2024	10 mins	Team members	0

2.3 Communications Plan

Will you meet face to face, online or a mixture of each to communicate?

Ans. Mixture of online and offline meetings

How often will you come togeather to share your progress?

Ans. Once in every 2 days in the AI period in school and maybe online.

Who will set up online documents and ensure that everyone is contributing?

Ans. Since everyone has contributed to the project and worked on different parts, we all have worked on the main project document. The group leader ensured that everyone is contributing.

2.4 Team meeting minutes

Date of meeting: April 9, 2024
Who attended: Madhav, Harshit, Sanvi, Amanjyot
Who wasn't able to attend: -
Purpose of meeting: Discuss initial concept for the Mind Map Website

Items discussed:

1. Brainstorming on UI/UX design
2. Tools and technologies required
3. Project timeline

Things to do (what, by whom, by when)

1. Create a draft design (Madhav, by April 5)
2. Research tools (Sanvi, by April 7)
3. Prepare project plan (Harshit, by April 8)

Date of Meeting: April 12, 2024
Who Attended: Madhav, Sanvi, Harshit, Amanjyot
Purpose of Meeting: Discuss initial concept for the Mind Map Website

Items Discussed:

- Brainstorming on UI/UX design
- Tools and technologies required
- Project timeline

Things to Do:

- Create a draft design (Madhav, by April 12)
- Research tools (Sanvi, by April 14)
- Prepare project plan (Harshit, by April 15)

Date of meeting: April 17, 2024
Who attended: Madhav, Harshit, Amanjyot, Sanvi
Purpose of meeting: Review initial design of the Blind People Stick

Items discussed:

1. Feedback on design
2. Integration with sensors
3. Next steps

Things to do (what, by whom, by when)

1. Refine design (Madhav, by April 15)
2. Research sensor integration (Harshit, by April 18)
3. Plan prototype development (Amanjyot, by April 20)

Date of meeting: April 20, 2024
Who attended: Madhav, Sanvi, Harshit, Amanjyot
Purpose of meeting: Discuss improvements for Transformer Shoe

Items discussed:

1. Design enhancements
2. Battery life optimization
3. User feedback

Things to do (what, by whom, by when)

1. Update design (Sanvi, by April 17)
2. Research better battery options (Madhav, by April 19)
3. Conduct user surveys (Harshit, by April 22)

Date of meeting: April 24, 2024
Who attended: Madhav, Harshit, Sanvi, Amanjyot
Purpose of meeting: AI Tuition Teacher: Initial concept discussion

Items discussed:

1. Scope of the project
2. Target audience
3. AI technologies to be used

Things to do (what, by whom, by when)

1. Draft project scope (Harshit, by April 20)
2. Identify target audience (Madhav, by April 22)
3. Research AI tools (Sanvi, by April 25)

Date of meeting: April 27, 2024
Who attended: Sanvi, Amanjyot, Madhav, Harshit
Purpose of meeting: AI Quilt development discussion

Items discussed:

1. Materials selection
2. Integration of AI in fabric
3. Production timeline

Things to do (what, by whom, by when)

1. Research materials (Sanvi, by April 23)
2. Prototype design (Amanjyot, by April 25)
3. Plan production phases (Harshit, by April 28)

Date of meeting: May 2, 2024
Who attended: Madhav, Sanvi, Harshit, Amanjyot
Purpose of meeting: Finalize design for AI Makeup Artist

Items discussed:

1. User interface options
2. AI algorithms
3. User testing

Things to do (what, by whom, by when)

1. Finalize UI (Madhav, by April 28)
2. Research AI algorithms (Sanvi, by April 30)
3. Plan user testing (Harshit, by May 2)

Date of meeting: May 6, 2024
Who attended: Madhav, Sanvi, Harshit, Amanjyot
Purpose of meeting: Tracker device brainstorming session

Items discussed:

1. GPS integration
2. Battery life
3. Durability

Things to do (what, by whom, by when)

1. Research GPS options (Sanvi, by May 3)
2. Battery life optimization (Madhav, by May 5)
3. Design for durability (Harshit, by May 7)

Date of meeting: May 9, 2024
Who attended: Madhav, Harshit, Amanjyot, Sanvi
Purpose of meeting: Physical Organizer Folder: Initial discussion

Items discussed:

1. Materials and durability
2. Design and usability
3. Production costs

Things to do (what, by whom, by when)

1. Research materials (Harshit, by May 6)
2. Create design draft (Madhav, by May 8)
3. Estimate production costs (Amanjyot, by May 10)

Date of meeting: May 7, 2024
Who attended: Sanvi, Amanjyot
Who wasn't able to attend: Madhav, Harshit
Purpose of meeting: Discuss development of Lazer Paper Ink Remover

Items discussed:

1. Laser technology
2. Ink removal efficiency
3. Safety considerations

Things to do (what, by whom, by when)

1. Research laser technology (Sanvi, by May 10)
2. Test ink removal (Amanjyot, by May 12)
3. Assess safety (Madhav, by May 15)

Date of meeting: May 10, 2024
Who attended: Madhav, Sanvi, Harshit
Who wasn't able to attend: Amanjyot
Purpose of meeting: AI Suitcase Device: Final design review

Items discussed:

1. Design improvements
2. AI integration
3. Manufacturing plan

Things to do (what, by whom, by when)

1. Finalize design (Madhav, by May 13)
2. AI integration testing (Sanvi, by May 15)
3. Plan manufacturing (Harshit, by May 18)

Date of meeting: May 15, 2024
Who attended: Madhav, Amanjyot
Who wasn't able to attend: Sanvi, Harshit
Purpose of meeting: Immortality project conceptual discussion

Items discussed:

1. Ethical implications
2. Technological feasibility
3. Research directions

Things to do (what, by whom, by when)

1. Draft ethical considerations (Madhav, by May 18)
2. Research feasibility (Amanjyot, by May 20)
3. Outline research plan (Sanvi, by May 22)

Date of meeting: May 19, 2024
Who attended: Madhav, Sanvi
Who wasn't able to attend: Harshit, Amanjyot
Purpose of meeting: Optic Nerve Camera: Initial concept discussion

Items discussed:

1. Technology required
2. Potential medical applications
3. Prototype design

Things to do (what, by whom, by when)

1. Research technology (Madhav, by May 22)
2. Outline medical applications (Sanvi, by May 25)
3. Start prototype design (Harshit, by May 27)

Date of meeting: May 23, 2024
Who attended: Sanvi, Harshit
Who wasn't able to attend: Madhav, Amanjyot
Purpose of meeting: 3D Molecular Representation: Brainstorming session

Items discussed:

1. 3D visualization tools
2. Molecular data sources
3. User interface design

Things to do (what, by whom, by when)

1. Research visualization tools (Sanvi, by May 26)
2. Gather molecular data (Harshit, by May 28)
3. Start UI design (Madhav, by May 30)

Date of meeting: May 28, 2024
Who attended: Madhav, Sanvi
Who wasn't able to attend: Harshit, Amanjyot
Purpose of meeting: Automatic Book Page Flipper: Concept discussion

Items discussed:

1. Mechanism design
2. Speed control
3. Material selection

Things to do (what, by whom, by when)

1. Design mechanism (Madhav, by May 31)
2. Research speed control methods (Sanvi, by June 2)
3. Choose materials (Harshit, by June 4)

Date of meeting: June 1, 2024
Who attended: Madhav, Sanvi
Who wasn't able to attend: Harshit, Amanjyot
Purpose of meeting: AI Gardener: Initial

Items discussed:

1. AI capabilities
2. Gardening tasks
3. Prototype development

Things to do (what, by whom, by when)

1. Draft AI capabilities (Sanvi, by June 4)
2. List gardening tasks (Madhav, by June 6)
3. Plan prototype (Harshit, by June 8)

Date of meeting: June 5, 2024
Who attended: Madhav, Harshit
Who wasn't able to attend: Sanvi, Amanjyot
Purpose of meeting: AI Medicine Dispenser: Initial discussion

Items discussed:

1. Medicine storage options
2. AI dosage control
3. Safety features

Things to do (what, by whom, by when)

1. Research storage options (Madhav, by June 8)
2. Design AI control (Harshit, by June 10)
3. Plan safety features (Sanvi, by June 12)

Date of meeting: June 10, 2024
Who attended: Sanvi, Amanjyot
Who wasn't able to attend: Madhav, Harshit
Purpose of meeting: Physical Organizer Folder: Prototype review

Items discussed:

1. Material durability
2. Usability feedback
3. Cost analysis

Things to do (what, by whom, by when)

1. Test durability (Sanvi, by June 13)
2. Collect usability feedback (Amanjyot, by June 15)
3. Reassess costs (Madhav, by June 18)

Date of meeting: June 15, 2024
Who attended: Madhav, Sanvi
Who wasn't able to attend: Harshit, Amanjyot
Purpose of meeting: 3D Molecular Representation: Final design review

Items discussed:

1. UI finalization
2. Data integration
3. Launch planning

Things to do (what, by whom, by when)

1. Finalize UI (Madhav, by June 18)
2. Test data integration (Sanvi, by June 20)
3. Plan product launch (Harshit, by June 22)

Date of meeting: June 19, 2024
Who attended: Madhav, Harshit
Who wasn't able to attend: Sanvi, Amanjyot
Purpose of meeting: Mind Map Website: Mid-development review

Items discussed:

1. Progress assessment
2. Feedback collection
3. Adjustments and improvements

Things to do (what, by whom, by when)

1. Review progress (Madhav, by June 22)
2. Collect feedback (Harshit, by June 24)
3. Implement improvements (Sanvi, by June 26)

Date of meeting: June 23, 2024
Who attended: Madhav, Sanvi
Who wasn't able to attend: Harshit, Amanjyot
Purpose of meeting: AI Quilt: Mid-development review

Items discussed:

1. Material testing
2. AI integration status
3. Adjustments and improvements

Things to do (what, by whom, by when)

1. Test materials (Sanvi, by June 26)
2. Review AI integration (Madhav, by June 28)
3. Implement adjustments (Harshit, by June 30)

Date of meeting: June 28, 2024
Who attended: Sanvi, Amanjyot
Who wasn't able to attend: Madhav, Harshit
Purpose of meeting: AI Medicine Dispenser: Mid-development review

Items discussed:

1. Dosage control testing
2. Safety features review
3. User feedback

Things to do (what, by whom, by when)

1. Test dosage control (Sanvi, by July 1)
2. Review safety features (Amanjyot, by July 3)
3. Collect user feedback (Madhav, by July 5)

Date of meeting: July 2, 2024
Who attended: Madhav, Harshit
Who wasn't able to attend: Sanvi, Amanjyot
Purpose of meeting: Transformer Shoe: Final design review

Items discussed:

1. Design finalization
2. Battery life review
3. User testing

Things to do (what, by whom, by when)

1. Finalize design (Madhav, by July 5)
2. Test battery life (Harshit, by July 7)
3. Plan user testing (Sanvi, by July 10)

Date of meeting: July 7, 2024
Who attended: Madhav, Sanvi, Harshit
Who wasn't able to attend: Amanjyot
Purpose of meeting: Immortality project: Mid-research review

Items discussed:

1. Ethical considerations review
2. Technological feasibility assessment
3. Adjustments and improvements

Things to do (what, by whom, by when)

1. Review ethics (Madhav, by July 10)
2. Assess feasibility (Sanvi, by July 12)
3. Implement research adjustments (Harshit, by July 14)

Date of meeting: July 12, 2024
Who attended: Madhav, Harshit
Who wasn't able to attend: Sanvi, Amanjyot
Purpose of meeting: Final review for Lazer Paper Ink Remover

Items discussed:

1. Laser technology testing
2. Ink removal efficiency
3. Final adjustments

Things to do (what, by whom, by when)

1. Test laser technology (Madhav, by July 15)
2. Evaluate ink removal (Harshit, by July 17)
3. Implement final adjustments (Sanvi, by July 19)

Date of meeting: July 15, 2024
Who attended: Madhav, Sanvi, Harshit, Amanjyot
Who wasn't able to attend: -
Purpose of meeting: Optic Nerve Camera: Final review

Items discussed:

1. Prototype testing
2. Medical applications assessment
3. Launch planning

Things to do (what, by whom, by when)

1. Finalize prototype (Madhav, by July 18)
2. Review medical applications (Sanvi, by July 20)
3. Plan product launch (Harshit, by July 22)

Final Project Selected

Date of meeting: August 1, 2024
Who attended: Madhav, Sanvi, Harshit
Who wasn't able to attend: Amanjyot
Purpose of meeting: Initial discussion on YOLOv8 integration

Items discussed:

1. Object detection accuracy
2. Model training data
3. Integration challenges with Raspberry Pi 4

Things to do (what, by whom, by when)

1. Madhav - Fine-tune YOLOv8 model - August 8, 2024
2. Harshit - Test model on Raspberry Pi 4 - August 7, 2024
3. Sanvi - Source additional training data - August 9, 2024

Date of meeting: August 3, 2024
Who attended: Madhav, Harshit, Amanjyot
Who wasn't able to attend: Sanvi
Purpose of meeting: TF Luna LiDAR sensor implementation

Items discussed:

1. Distance measurement precision
2. Sensor calibration
3. Integration with object detection module

Things to do (what, by whom, by when)

1. Harshit - Calibrate LiDAR sensor - August 10, 2024
2. Madhav - Integrate with YOLOv8 - August 11, 2024
3. Amanjyot - Test accuracy in different environments - August 12, 2024

Date of meeting: August 5, 2024
Who attended: Madhav, Sanvi, Harshit
Who wasn't able to attend: Amanjyot
Purpose of meeting: Discussion on Google Text-to-Speech integration

Items discussed:

1. Real-time audio feedback
2. Language and voice options
3. Synchronization with object detection

Things to do (what, by whom, by when)

1. Sanvi - Explore voice customization - August 12, 2024
2. Madhav - Sync with object detection output - August 13, 2024
3. Harshit - Test in real-time scenarios - August 14, 2024

Date of meeting: August 7, 2024
Who attended: Madhav, Harshit, Amanjyot
Who wasn't able to attend: Sanvi
Purpose of meeting: Raspberry Pi 4 hardware setup

Items discussed:

1. Performance optimization
2. Peripheral connections
3. Power management with UPS HAT

Things to do (what, by whom, by when)

1. Harshit - Optimize Raspberry Pi 4 performance - August 14, 2024
2. Madhav - Set up UPS HAT - August 15, 2024
3. Amanjyot - Ensure stable peripheral connections - August 16, 2024

Date of meeting: August 9, 2024
Who attended: Madhav, Sanvi, Harshit, Amanjyot
Who wasn't able to attend: -
Purpose of meeting: Volume buttons design and Braille integration

Items discussed:

1. Button placement
2. Braille engraving accuracy
3. User interface design

Things to do (what, by whom, by when)

1. Sanvi - Finalize button placement - August 16, 2024
2. Harshit - Ensure Braille accuracy - August 17, 2024
3. Madhav - Test user interface with buttons - August 18, 2024

Date of meeting: August 11, 2024

Who attended: Madhav, Harshit, Amanjyot

Who wasn't able to attend: Sanvi

Purpose of meeting: Budget review and cost management

Items discussed:

1. Component costs
2. Budget allocation
3. Future expenses projection

Things to do (what, by whom, by when)

1. Harshit - Review current expenses - August 18, 2024
2. Madhav - Plan for additional sensors - August 19, 2024
3. Amanjyot - Adjust budget allocation - August 20, 2024

Date of meeting: August 13, 2024

Who attended: Madhav, Sanvi, Harshit

Who wasn't able to attend: Amanjyot

Purpose of meeting: Dataset expansion planning

Items discussed:

1. Collection of diverse data
2. Improving model performance
3. Augmenting existing dataset

Things to do (what, by whom, by when)

1. Sanvi - Source new data - August 20, 2024
2. Madhav - Augment dataset - August 21, 2024
3. Harshit - Test model with expanded data - August 22, 2024

Date of meeting: August 15, 2024

Who attended: Madhav, Sanvi, Harshit, Amanjyot

Who wasn't able to attend: -

Purpose of meeting: Prototype development discussion

Items discussed:

1. Hardware assembly
2. Prototype testing
3. Refinements and adjustments

Things to do (what, by whom, by when)

1. Madhav - Assemble hardware components - August 22, 2024
2. Harshit - Test prototype functionality - August 23, 2024
3. Amanjyot - Implement refinements - August 24, 2024

Date of meeting: August 17, 2024

Who attended: Madhav, Harshit, Amanjyot

Who wasn't able to attend: Sanvi

Purpose of meeting: Sensor expansion discussion

Items discussed:

1. Integration of ultrasonic sensors
2. Improved obstacle detection
3. Power consumption management

Things to do (what, by whom, by when)

1. Harshit - Research ultrasonic sensors - August 24, 2024
2. Madhav - Test integration with existing setup - August 25, 2024
3. Amanjyot - Analyze power consumption impact - August 26, 2024

Date of meeting: August 19, 2024

Who attended: Madhav, Sanvi, Harshit

Who wasn't able to attend: Amanjyot

Purpose of meeting: Accessory design for mounting options

Items discussed:

1. Versatile mounting options
2. Durability of accessories
3. User feedback considerations

Things to do (what, by whom, by when)

1. Sanvi - Design initial accessory mockups - August 26, 2024
2. Madhav - Test durability of designs - August 27, 2024
3. Harshit - Gather user feedback - August 28, 2024

Date of meeting: August 21, 2024

Who attended: Madhav, Sanvi, Harshit, Amanjyot

Who wasn't able to attend: -

Purpose of meeting: Final review of object detection and feedback loop

Items discussed:

1. Accuracy of object detection
2. Real-time feedback responsiveness
3. User experience refinement

Things to do (what, by whom, by when)

1. Madhav - Fine-tune detection accuracy - August 28, 2024
2. Harshit - Optimize feedback loop - August 29, 2024
3. Sanvi - Conduct user testing - August 30, 2024

Date of meeting: August 23, 2024

Who attended: Madhav, Harshit, Amanjyot

Who wasn't able to attend: Sanvi

Purpose of meeting: Indoor navigation testing and analysis

Items discussed:

1. Safe navigation in various environments
2. Obstacle avoidance testing
3. User feedback on navigation

Things to do (what, by whom, by when)

1. Harshit - Test navigation in different settings - August 30, 2024
2. Madhav - Analyze obstacle avoidance efficiency - August 31, 2024
3. Amanjyot - Gather user feedback - September 1, 2024

Date of meeting: August 27, 2024

Who attended: Madhav, Sanvi, Harshit, Amanjyot

Who wasn't able to attend: -

Purpose of meeting: Long-term project planning

Items discussed:

1. Future expansions
2. Continuous improvement strategy
3. Potential market applications

Things to do (what, by whom, by when)

1. Harshit - Research market applications - September 3, 2024
2. Madhav - Plan for future expansions - September 4, 2024
3. Amanjyot - Develop improvement strategy - September 5, 2024

Date of meeting: August 29, 2024

Who attended: Madhav, Sanvi, Harshit, Amanjyot

Who wasn't able to attend: -

Purpose of meeting: Review of project cost and budgeting

Items discussed:

1. Review of total project cost (INR 13,673)
2. Budget adjustments for additional components
3. Financial planning for future enhancements

Things to do (what, by whom, by when)

1. Madhav - Review and finalize costs - September 5, 2024
2. Harshit - Adjust budget for new components - September 6, 2024
3. Sanvi - Plan financials for future enhancements - September 7, 2024

Date of meeting: August 31, 2024

Who attended: Madhav, Sanvi, Harshit, Amanjyot

Who wasn't able to attend: -

Purpose of meeting: Final project wrap-up and next steps

Items discussed:

1. Final testing results
2. Project documentation
3. Future research directions

Things to do (what, by whom, by when)

1. Madhav - Compile final documentation - September 7, 2024
2. Harshit - Finalize testing reports - September 6, 2024
3. Sanvi - Propose future research areas - September 8, 2024

3. Problem Definition

3.1 List important local issues faced by your school or community

1. **Accessibility for Visually Impaired Individuals:** Limited availability of assistive technologies and devices that aid in navigation and independence for visually impaired people.
2. **Safety Concerns:** Increased risk of accidents or disorientation for visually impaired individuals in unfamiliar or complex indoor environments.
3. **Lack of Inclusivity:** Insufficient infrastructure and support for integrating visually impaired individuals fully into community activities and everyday tasks.
4. **Educational Resources:** Limited access to educational resources and tools that cater specifically to the needs of visually impaired students and adults

3.2 Which issues matter to you and why?

The issue that matters most is Accessibility for Visually Impaired Individuals. This is because ensuring that visually impaired individuals can navigate their surroundings safely and independently is crucial for their quality of life and autonomy. Improving accessibility can significantly reduce their dependence on others and help them participate more fully in community life.

3.3 Which issue will you focus on?

We should focus on Accessibility for Visually Impaired Individuals. This issue aligns with our project's goal of developing an assistive device to enhance independence and safety for visually impaired people. By addressing this issue, we aim to make a meaningful impact on their daily lives.

3.4 Write your team's problem statement in the format below .

How can we help visually impaired individuals find a way to safely navigate and understand their surroundings so that they can achieve greater independence and confidence in indoor environments?

Rate yourself: 3 Point

Problem Definition

1 point - A local problem is described
2 points - A local problem which has not been fully solved before is described.
3 p oints - A local problem which has not been fully solved before is explained in detail with supporting research.

4. The Users

4.1 Who are the users and how are they affected by the problem?

Users: Visually Impaired Individuals (partial to complete blindness).
Impact:

- **Safety:** Difficulty navigating unfamiliar or complex indoor spaces increases the risk of accidents and disorientation.
- **Independence:** Lack of assistive technologies leads to reliance on others, limiting autonomy.
- **Confidence:** Inadequate real-time feedback reduces confidence in navigating and engaging in activities alone.
- **Quality of Life:** Challenges in interacting with surroundings affect overall quality of life and restrict community participation.

4.2 What have you actually observed about the users and how the problem affects them?

Observations:

- **Navigational Challenges:** Users often struggle with orientation and finding their way in complex or changing indoor environments, leading to increased anxiety and reliance on caregivers or companions.
- **Difficulty in Object Detection:** Many visually impaired individuals find it challenging to detect and avoid obstacles or identify objects around them, which can lead to accidents or frustration.
- **Limited Feedback:** The current assistive technologies may not provide real-time, detailed feedback, which can leave users feeling uncertain about their environment and hinder their independence.

Effects:

- **Increased Dependence:** Users frequently need assistance from others to navigate or perform tasks, which can diminish their sense of self-reliance and confidence.
- **Safety Risks:** Navigating environments without sufficient aids increases the risk of accidents, such as bumping into objects or falling.
- **Social Isolation:** The challenges in navigation and interaction can lead to social isolation, as users may avoid situations where they feel uncomfortable or unsafe.

4.3 Record your interview questions here as well as responses from users.

Question: Can you describe some challenges you face when navigating indoor spaces?
Response: "I often have difficulty detecting objects in my path, which makes me feel anxious about moving around. Sometimes, I bump into things or struggle to find specific locations like rooms or doors."

Question: How does the current technology or assistance you use help you with navigation?
Response: "The technology I use is somewhat helpful but not always reliable. Sometimes the feedback is delayed or unclear, which can be frustrating and make me feel unsure about where I'm going."

Question: What features would you find most useful in an assistive device for navigation?
Response: "I would benefit from real-time, clear audio feedback about obstacles and distances. Features like easy-to-use controls and something that can provide information about the layout of a space would be very helpful."

Question: How do navigation challenges affect your daily life and independence?
Response: "It affects my independence a lot. I often need help from others to get around, which can be tiring for them and frustrating for me. It limits my ability to go out or move around freely."

Question: What improvements would you like to see in assistive devices currently available?
Response: "I'd like to see devices that are more accurate and responsive, with better real-time feedback. Also, a device that is easy to use and doesn't require a lot of technical knowledge would be ideal."

4.4 Empathy Map

Map what the users say, think, do and feel about the problem in this table

What our users are saying	What our users thinking
"I have trouble detecting obstacles in my path, which makes me anxious." "The technology I use isn't always reliable; sometimes it doesn't provide timely feedback." "I need clearer and more accurate information about my surroundings." "I often rely on others for help, which can be frustrating and limiting."	"I wish there was a way to navigate more confidently without constantly needing assistance." "I wonder if there's a more intuitive way to receive information about my environment." "I'm concerned about my safety and whether I might accidentally bump into something or get lost." "I hope there's a solution that will enhance my independence and make me feel more secure."
What our users are doing	**How our users feel**
Using assistive technology devices to help with navigation. Relying on friends, family, or caregivers for assistance in unfamiliar or complex indoor environments. Trying to adapt to the limitations of current tools, often by moving slowly and cautiously. Seeking out additional resources or technology that might offer better support.	Anxious: Worried about navigating safely and avoiding obstacles. Frustrated: With the current limitations of technology and the need for constant assistance. Isolated: Feeling limited in their ability to move independently and participate fully in activities. Hopeful: Looking for advancements or improvements in technology that can enhance their independence and confidence.

4.5 What are the usual steps that users currently take related to the problem and where are the difficulties?

Usual Steps in Navigation and Associated Difficulties

1. **Initial Navigation Attempt**
   Difficulty: Users often start without a clear understanding of their surroundings, causing anxiety about obstacles and the path ahead.
2. **Use of Assistive Technology**
   Difficulty: Devices may provide inconsistent or delayed feedback, leading to frustration and uncertainty.
3. **Verbal Cues from Devices or Caregivers**
   Difficulty: Instructions can be too general or untimely, making it hard to respond accurately.
4. **Slow and Cautious Movement**
   Difficulty: Moving slowly to avoid obstacles can be tiring and time-consuming, reducing efficiency and independence.
5. **Seeking Assistance from Others**
   Difficulty: Relying on others can be inconvenient and may create feelings of dependence and frustration.
6. **Adjusting Path Based on Feedback**
   Difficulty: Feedback may be unclear, causing frequent and imprecise adjustments.
7. **Checking for Obstacles**
   Difficulty: Constant checking can be mentally exhausting and may not always prevent collisions.
8. **Using Familiar Landmarks**
   Difficulty: Navigating new or unfamiliar environments is challenging when users cannot rely on memory alone.
9. **Utilizing Manual Aids (e.g., cane, guide dog)**
   Difficulty: These aids may not provide complete environmental information, posing potential safety risks.
10. **Reassessing and Reattempting Navigation**
    Difficulty: Repeated reassessment can be frustrating and often doesn't result in a better navigation strategy, increasing stress.

Addressing these difficulties can improve navigation by enhancing independence, safety, and confidence for visually impaired individuals.

4.6 Write your team's problem statement in the format below.

Visually impaired individuals are experiencing issues with navigating indoor spaces safely and independently today because of inconsistent feedback from assistive technologies and a lack of real-time, detailed information about their surroundings.

Rate yourself: 3 Point

The Users

1 point - The user group is described but it is unclear how they are affected by the problem.
2 points - Understanding of the user group is evidenced by completion of most of the steps in this section.
3 points - Understanding of the user group is evidenced by completion of most of the steps i n this section and thorough investigation

5. Brainstorming

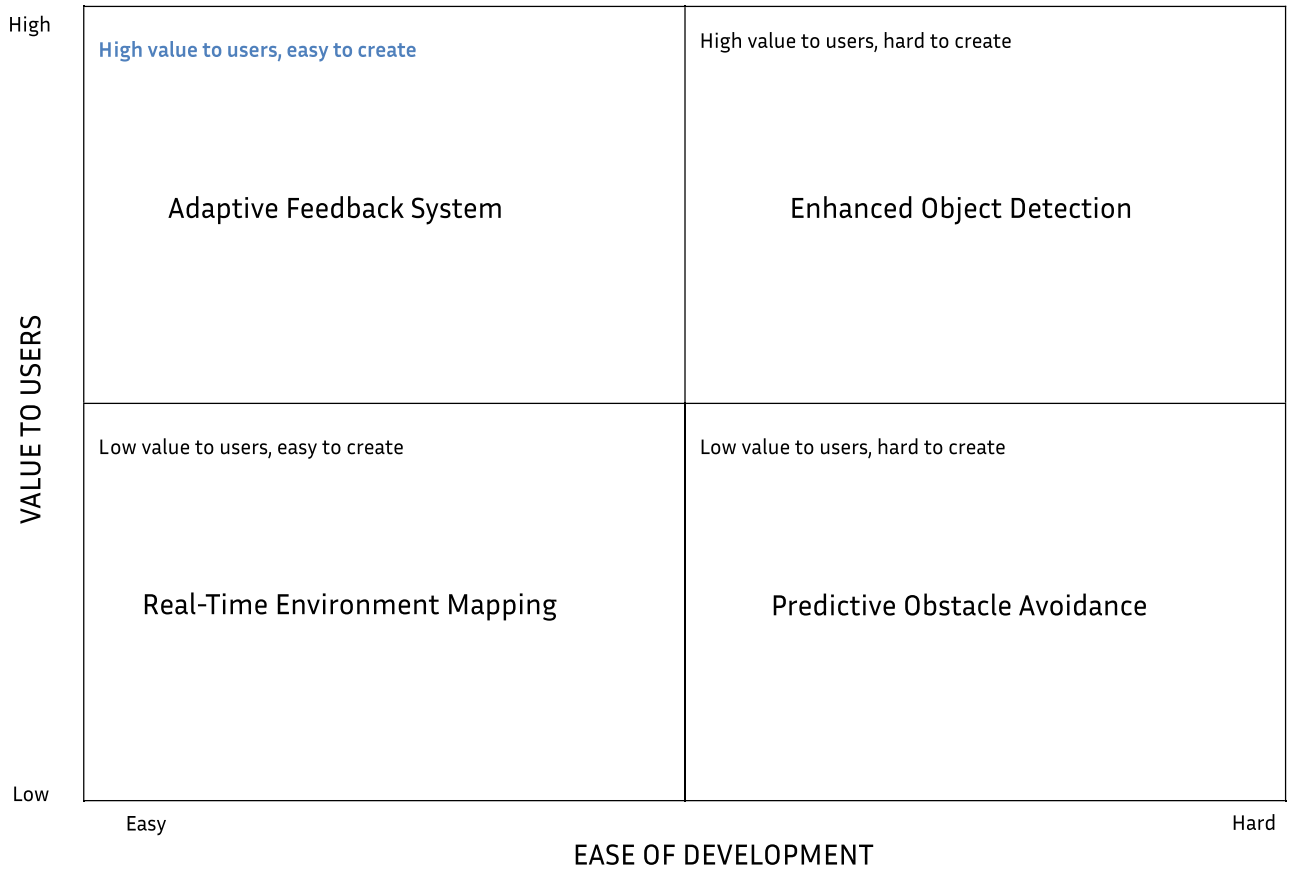
5.1 Ideas

How might you use the power of AI/machine learning to solve the users ' problem by increasing their knowledge or improving their skills?

AI Idea #1: Enhanced Object Detection	Use AI to improve object detection accuracy in real-time. Integrate a machine learning model with YOLOv8 to better identify and classify objects in the environment, providing precise information on obstacles and navigational aids.
AI Idea #2: Contextual Pathfinding Assistance	Implement an AI-driven system that maps out indoor spaces and provides contextual navigation assistance based on user's current location and destination. This could include generating spoken directions and warnings about upcoming obstacles
AI Idea #3: Adaptive Feedback System	Develop an AI system that learns user preferences and adapts feedback based on their individual needs and movement patterns. This could involve personalised audio cues or haptic feedback to enhance navigation ease and accuracy.
AI Idea #4: Real-Time Environment Mapping	Use AI to create dynamic, real-time maps of indoor spaces as users move through them. This system would update the map with detected objects and changes in the environment, helping users to better understand and navigate their surroundings.
AI Idea #5: Predictive Obstacle Avoidance	Implement machine learning algorithms that predict and alert users to potential obstacles based on their movement patterns and environment. This predictive system could help users adjust their path proactively, reducing the likelihood of collisions.

5.2 Priority Grid

Evaluate your five AI ideas based on value to users and ease of creation and implementation.



5.3 Based on the priority grid, which AI solution is the best fit for your users and for your team to create and implement?

Briefly summarize the idea for your solution in a few sentences and be sure to identify the tool that you will use.

The Adaptive Feedback System leverages AI to learn and adapt to individual user preferences, providing tailored audio and haptic feedback based on their navigation patterns. This solution is high-value because it directly addresses the issues of inconsistent feedback and personalization, which are crucial for enhancing the user's navigation experience. It is relatively easier to implement compared to more complex solutions like real-time environment mapping or predictive obstacle avoidance. The tool for this solution will involve integrating machine learning algorithms with existing assistive devices and feedback systems to personalise and optimise the user experience.

Rate yourself: 3 Points

Brainstorming

1 point – A brainstorming session was conducted. A solution was selected.
2 points - A brainstorming session was conducted using creative and critical thinking. A solution was selected with supporting arguments in this section
3 points - A brainstorming session was conducted using creative and critical thinking. A compelling solution was selected with supporting arguments in this section .

6. Design

6.1 What are the steps that users will now do using your AI solution to address the problem?

Setup and Calibration
- Users set up the device and calibrate it to their preferences and environmental conditions.

Initial Training
- The system collects initial data on the user's movement patterns and preferences to tailor the feedback.

Start Navigation
- Users begin navigating indoor spaces with the device providing real-time audio and haptic feedback.

Receive Real-Time Feedback
- The system delivers adaptive feedback about obstacles, distances, and navigation directions based on the user's current location.

Adjust Path Based on Feedback
- Users adjust their movement according to the feedback to avoid obstacles and reach their destination.

Provide Feedback to System
- Users give feedback on the system's performance, which helps in fine-tuning the AI's responses.

Monitor and Learn
- The AI system continuously learns from user interactions and adjusts its feedback to improve accuracy and relevance.

Navigate to New Areas
- Users use the system to explore new or unfamiliar areas, receiving guidance and support throughout.

Review Navigation History
- Users review their navigation history and adjust settings if needed for better future performance.

Continuous Usage and Improvement
- Users consistently use the system, which keeps learning and adapting to provide better support over time.

Rate yourself: 3 Points

Design

1 point – The use of AI is a good fit for the solution.
2 points - The use of AI is a good fit for the solution and there is some documentation about how it meets the needs of users
3 points - The use of AI is a good fit for the solution. The new user experience is clearly documented showing how users will be better served than they are tod ay.

7. Data

7.1 What data will you need to train your AI solution?

- **Object detection data:** Images and labels of various indoor obstacles and objects.
- **User movement data:** Patterns of movement and responses to feedback.
- **Environmental data:** Layouts and characteristics of different indoor spaces.

7.2 Where or how will you source your data?

Data Needed	Where Will the Data Come From?	Who Owns the Data?	Do You Have Permission to Use the Data?	Ethical Considerations
Object Detection Data	Public datasets, user contributions	Dataset creators, users	Yes, with appropriate licences and consent	Ensure privacy and avoid sensitive information
User Movement Data	Collected through user interactions	Data collected by the system	Yes, with user consent	Anonymize data and protect user privacy
Environmental Data	Indoor space scans, architectural plans	Space owners, public sources	Yes, with proper permissions	Respect intellectual property and privacy
Want/Need	Want: More diverse object detection data. Need: Accurate and comprehensive user movement data.			
Nice to have	Data on various indoor environments and user feedback for refinement.			

Rate yourself: 3 Points

Data

1 point – Relevant data to train the AI model have been identified as well as how the data will be sourced or collected.
2 points - Relevant data to train the AI model have been identified as well as how the data will be sourced or collected. There is evidence that the dataset is balanced.
3 points - Relevant data to train the AI model have been identified as well as how the data will be sourced or collected. There is evidenc e that the dataset is balanced , and that safety and privacy have been considered.

8. Prototype

8.1 Which AI tool(s) will you use to build your prototype?

- **TensorFlow or PyTorch:** For training the machine learning models for object detection and adaptive feedback.
- **OpenCV:** For image processing and real-time object detection.
- **Google Cloud AI:** For integrating text-to-speech functionalities.

8.2 Which AI tool(s) will you use to build your solution?

- **TensorFlow or PyTorch:** To build and refine the object detection model.
- **Custom APIs:** For integrating adaptive feedback and real-time environment mapping.
- **Google Text-to-Speech API:** For providing audio feedback.

8.3 What decisions or outputs will your tool generate and what further action needs to be taken after a decision is made?

- **Decisions/Outputs:** Identification of obstacles, distance measurements, navigation directions, and adaptive feedback.
- **Further Action:** Continual model training based on user feedback, refinement of feedback mechanisms, and deployment of updates for improved performance.

Rate yourself: 3 Point

Prototype

1 point – A concept for a prototype shows how the AI model will work.
2 points - A prototype for the solution has been created and trained.
3 points - A prototype for the solution has been created and successfully trained to meet users' requirements.

9. Testing

9.1 Who are the users who tested the prototype?

- Visually impaired individuals who are representative of the target user group.
- Assistive technology users who have experience with current navigation aids.
- Caregivers or support staff who assist visually impaired individuals and can provide valuable feedback on usability and effectiveness.

9.2 List your observations of your users as they tested your solution.

- **Ease of Use:** How easily users can understand and interact with the prototype.
- **Effectiveness of Feedback:** Whether the real-time audio and haptic feedback helps users navigate more effectively.
- **Confidence in Navigation:** If users feel more confident and independent while using the prototype.
- **Clarity of Information:** How clear and useful the information provided by the prototype is for avoiding obstacles and navigating spaces.

9.3 Complete the user feedback grid

What works	What needs to change
Real-time feedback should improve navigation Adaptive features could increase personalization	Clarity and accuracy of feedback might need enhancement Usability of controls and setup process may require refinement
Questions?	**Ideas**
Will users find the feedback intuitive and helpful? How well does the system adapt to different environments?	Explore integrating additional types of feedback. Develop customization options for different user needs.

9.4 Refining the prototype: Based on user testing, what needs to be acted on now so that the prototype can be used?

- **Finalize Testing Protocols:** Develop detailed plans for conducting user tests, including scenarios and success criteria.
- **Prepare for Feedback Collection:** Set up mechanisms for collecting user feedback effectively, such as surveys or interviews.
- **Ensure Support Availability:** Arrange for technical support and assistance during testing to address any issues that may arise.

9.5 What improvements can be made later?

- **Iterative Enhancements:** Based on initial testing feedback, refine the prototype's features and functionality.
- **Expand Testing:** Include a broader range of environments and user profiles in future testing phases to ensure comprehensive validation.
- **Integrate Advanced Features:** Explore adding more sophisticated features or functionalities based on user suggestions and technological advancements.

Rate yourself: 3 Point

Testing

1 point – A concept for a prototype shows how it will be tested.
2 points - A prototype has been tested with users and improvements have been identified to meet user requirements.
3 points - A prototype has been tested with a fair representation of users and all tasks in this section have been completed .

10. Team collaboration

10.1 How did you actively work with others in your team and with stakeholders?

- **Collaborative Planning:** Worked with team members to develop testing protocols and identify key stakeholders for feedback.
- **Regular Updates:** Provided regular updates and progress reports to team members and teachers to keep everyone informed and aligned.
- **Feedback Integration:** Incorporated feedback from preliminary discussions with users into the design and development process to ensure the solution meets user needs effectively

Rate yourself: 3 Points

Team collaboration

1 point – T here is some evidence of team interactions among peers and stakeholders.
2 points - Team collaboration among peers and stakeholders is clearly documented in this section .
3 points - Effective team collaboration and communication among peers and stakeholders is clearly documented in this section.

11. Individual learning reflection

11.1. Team Reflections

A good way to identify what you have learned is to ask yourself what surprised you during the project. List the things that surprised you and any other thoughts you might have on issues in your local community.

Team member name: Sanvi Sharma - Project Leader & Designer

As the Project Leader, I made it my priority to keep our team organized and ensure that everyone was clear on their tasks and deadlines. I enjoyed coordinating the work and seeing how our individual efforts came together. Being the main point of contact was challenging at times, but it helped me improve my communication and leadership skills. As the Designer, I focused on creating a plan for how we would address the problem statement, and I'm proud of the design solutions we developed. Balancing these roles was a great learning experience, and I'm happy with how we worked as a team to achieve our goals.

Team member name: Madhav Gupta - Data Expert & Prototype Builder/Coder/Tester

Working as both a Data Expert and the Prototype Builder/Coder/Tester allowed me to contribute significantly to both the planning and execution phases of our project. In the Data Expert role, I collaborated with Harshit to ensure we were using the most accurate and suitable data for our model, which I believe was crucial to our project's foundation. Building and testing the prototype was a rewarding challenge—I enjoyed coding the model and making sure it ran efficiently and accurately. Seeing the final product perform well was the best part, and I'm glad I could use my technical skills to help our team succeed.

Team member name: Harshit Sachdeva - Data Expert & Information Researcher

In my dual roles, I took on the responsibility of both managing the data for our model and conducting research to support our project. As a Data Expert, I worked closely with Madhav to decide on the types of data we needed, ensuring it was relevant and authentic. I enjoyed digging into the details and knowing that our data would set a strong foundation for the model. As an Information Researcher, I gathered key insights and user questions that helped guide our project. This role allowed me to contribute valuable context that shaped our direction, and I feel that my research skills really supported the team's success.

Team member name: Amanjyot Singh - Information Researcher

As an Information Researcher, my main task was to gather and compile information that would guide our project decisions. I enjoyed exploring user needs and finding the answers that could best inform our approach. I worked closely with Harshit to ensure that our findings were relevant and useful, and I took pride in preparing detailed reports for our project leader. I feel that my contributions helped provide a clear direction for our project, and it was satisfying to see how our research influenced the overall strategy and decision-making process.

Rate yourself: 3 Points

Individual Learning Reflection

1 point – Some team members present an account of their learning during the project.
2 points - E ach team presents an account of their learning during the project.
3 points - Each team member presents a reflective and insightful account of their learning during the project.

12. Video link

Enter the URL of your team video:

Enter the password (if any):

https://youtu.be/LRy-uAsT1LU?si=S7CsoqM3rFHC4tt4

Appendix

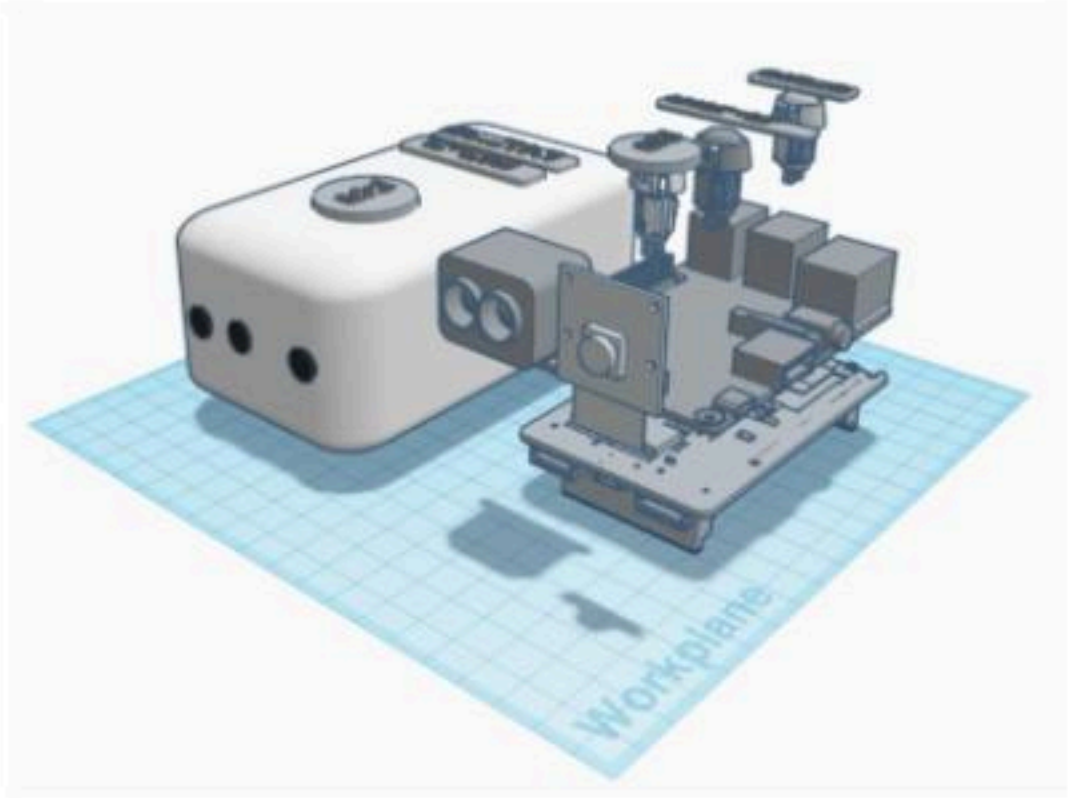
Recommended Assessment Rubric (for Teachers)

LOGBOOK AND VIDEO CONTENT

Steps	3 points	2 points	1 point	Points Given
Problem definition	A local problem which has not been fully solved before is explained in detail with supporting research.	A local problem which has not been fully solved before is described.	A local problem is described	
The Users	Understanding of the user group is evidenced by completion of all of the steps in Section 4 The Users and thorough investigation.	Understanding of the user completion of most of thegroup is evidenced by steps in Section 4 The Users .	The user group is des cribed but it is unclear how they are affected by the problem.	
Brainstorming	A brainstorming session was conducted using creative and critical thinking. A compelling solution was selected with supporting arguments from Section 5 Brainstorming.	A brainstorming session was conducted using creative and critical thinking. A solution was selected with supporting arguments in Section 5 Brainstorming.	A brainstorming session was conducted. A solution was selected.	
Design	The use of AI is a good fit for the solution. The new user experience is clearly documented showing how users will be better served than they are today.	The use of AI is a good fit for the solution and there is some documentation about how it meets the needs of users.	The use of AI is a good fit for the solution. o train	
Data	Relevant data to train the AI model have been identified as well as how the data will be sourced or collected. There is evidence that the dataset is balanced, and that safety and privacy have been considered.	Relevant data to train the AI model have been identified as well as how the data will be sourced or collected. There is evidence that the dataset is balanced.	Relevant data t the AI model have been identified as well as how the data will be sourced or collected.	
Prototype	A prototype for the solution has been created and successfully trained to meet users' requirements.	A prototype for the solution has been created and trained.	A concept for a prototype shows how the AI model will work	
Testing	A prototype has been tested with a fair representation of users and all tasks in Section 9 Testing have been co mpleted.	A prototype has been tested with users and improvements have been identified to meet user requirements.	A concept for a prototype shows how it will be tested.	
Team collaboration	Effective team collaboration and communication among peers and stakeholders is clearly documented in Section 10 Team collaboration.	Team collaboration among peers and stakeholders is clearly documented in Section 10 Team collaboration .	There is some eviden ce of team interactions among peers and stakeholders.	
Individual learning	Each team member presents a reflective and insightful account of their learning during the project.	Each team presents an account of their learning during the project.	Some team members present an account of their learning during the project.	
Total points				

VIDEO PRESENTATION

Crite ria		Points Given 3 – excellent 2 – very good 1 -satisfactory
Communication	The video is well-paced and communicated, following a clear and logical sequence.	
Illustrat ive	Demonstrations and/or visuals are used to illustrate examples, where appropriate.	
Accurate language	The video presents accurate science and technology and uses appropriate language.	
Passion	The video demonstrates passion from team members about their chosen topic/idea.	
Sound and image quality	The video demonstrates good sound and image quality.	
Length	The content is presented in the video within a 3-minute timeframe.	
Total points		



Object Detection and Distance Measurement Device

Object Detection and Distance Sensing for Visually impaired people

Made by-
Sanvi Sharma
Madhav Gupta
Harshit Sachdeva
Amanjyot Singh

Table of Contents

Abstract

The aim of this project is to introduce an innovative assistive device designed to empower individuals with visual impairments. Built on the Raspberry Pi 4 platform, this device combines YOLOv8 object detection with the TF-Luna LiDAR sensor to detect indoor objects within a 1.5-to-3-meter range. The collected data is transformed into audio messages using Google Text-to-Speech (gTTS) and transmitted to an earpiece via an auxiliary (AUX) connector. This portable and user-friendly device offers real-time information and facilitates safe indoor navigation. It is documented and open source, aiming to enhance the quality of life and promote independence for the visually impaired.

Introduction

Our project aims to create a device to help people with visual impairments. We're using YOLOv8 object detection and a TF-Luna LiDAR sensor with a Raspberry Pi 4. The device's main goal is to make it easier for people to navigate indoors.

With YOLOv8, the device can recognize objects like chairs, sofas, and tables in indoor spaces. The TF-Luna LiDAR sensor measures how far these objects are from the user within a 1.5 to 3-meter range. By combining data from these two sources, the device uses Google Text-to-Speech to turn this information into spoken messages that tell users about the objects and where they are.

Users can listen to these messages through an earpiece connected to the device. We've made sure to make the device easy to use and accessible, with options like voice commands and tactile controls for different users.

Literature Review

In the world of helping blind people, there are cool gadgets like smart glasses that use AI, headphones that work through your bones, and special keyboards for Braille. But our device is different because it does more than just tell you what's around. It also tells you exactly how far away things are. This helps blind people know more about what's around them.

Other tools are great, but our device is super advanced and can make blind people more independent and safer. It helps them understand their surroundings better, so they know what's going on when they're moving around.

Hardware components:

Raspberry Pi 4: A compact, versatile computer that serves as the core platform for our project, facilitating data processing and communication.

TF-Luna LiDAR Distance Sensor: A precise LiDAR sensor designed for measuring distances, enabling the device to determine the proximity of detected objects within a range of 1.5 to 3 meters.

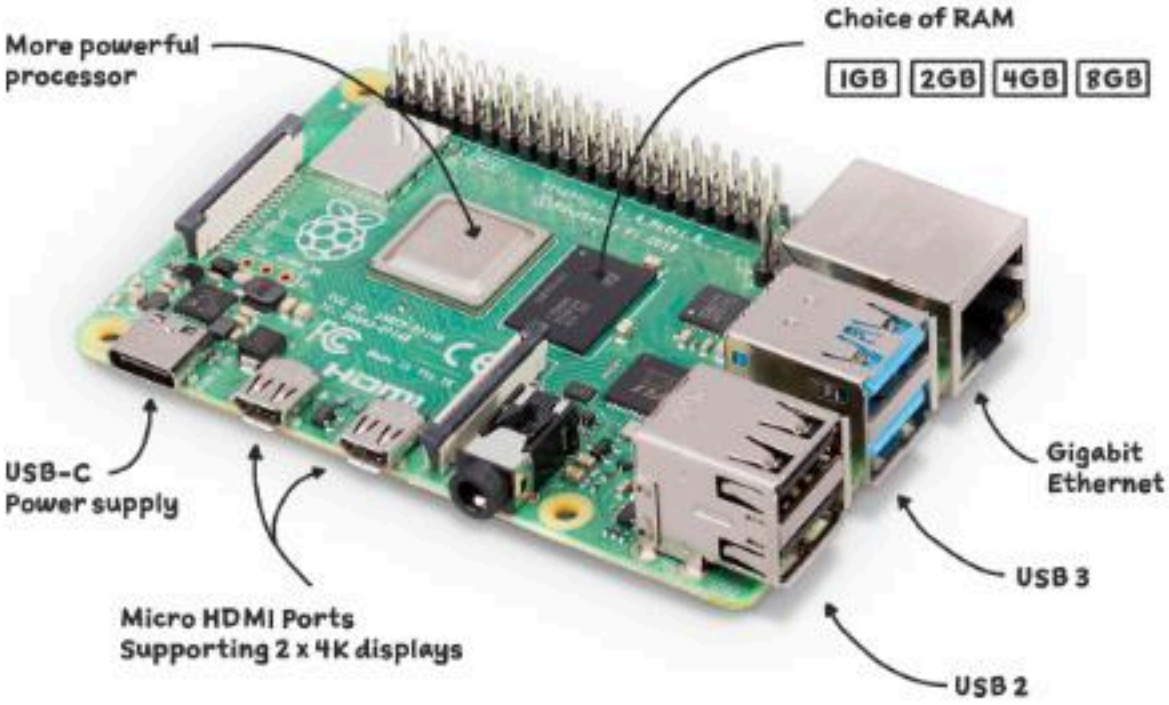
The Raspberry Pi Camera Module V2: It is a small, high-quality camera designed for Raspberry Pi boards. It features an 8-megapixel sensor and provides clear and vibrant images and videos. With its compact size and ease of integration, it is a popular choice for a wide range of DIY and IoT projects.

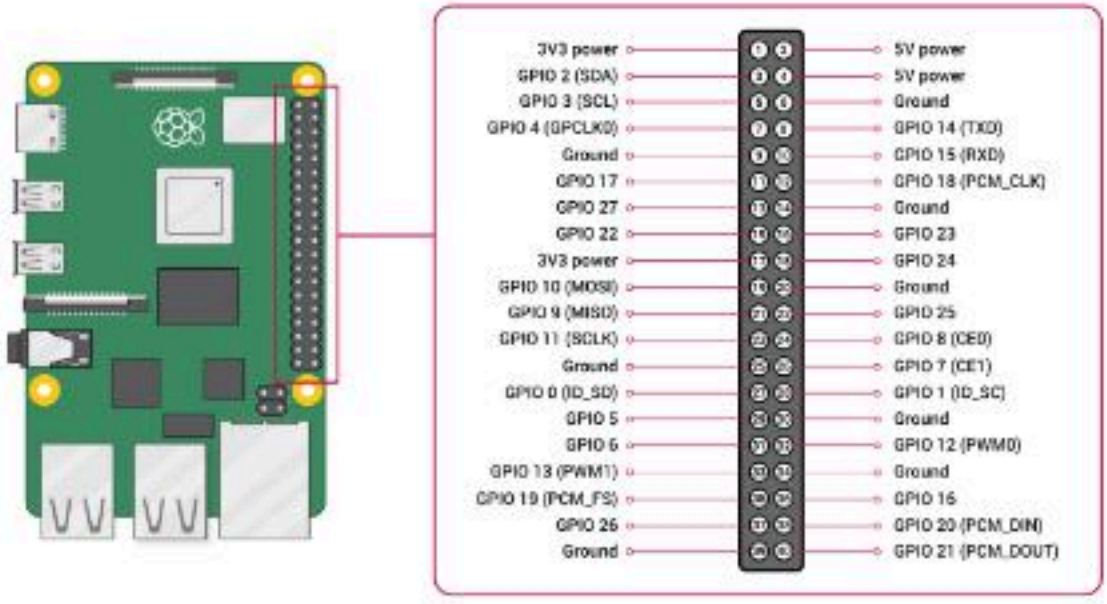
The UPS HAT (D): It is a specialized variant of the Uninterruptible Power Supply (UPS) hardware attachment designed for Raspberry Pi boards. It provides backup power during outages or voltage fluctuations, safeguarding data and ensuring continuous operation. The "(D)" signifies unique features or specifications specific to this UPS HAT model, which may include extended battery life, additional ports, or enhanced power management.

Momentary buttons: It is often referred to as push buttons, are electrical switches that remain in the "off" state until they are pressed. When pressed, they momentarily make an electrical connection, allowing current to flow temporarily. These buttons are commonly used in various electronic devices, such as keyboards and control panels, to trigger specific actions or functions when pressed and released.

Raspberry Pi 4 Model B

The Raspberry Pi 4 is a single-board computer developed by the Raspberry Pi Foundation. It is the fourth generation in the Raspberry Pi series, and it was released in June 2019. The Raspberry Pi 4 is a credit card-sized computer that is popular for its affordability, versatility, and the ability to run various operating systems.





We picked the Raspberry Pi 4 Model B because it's a strong computer with lots of ways to connect things to it, and many people can help us use it. This makes it a good choice for our device to help blind people. It can easily handle the job of detecting objects with YOLOv8 and using the TF-Luna LiDAR sensor. It's also small and doesn't use much power, so it's easy to carry around and will send audio messages to an earpiece to help blind people stay safe and independent.

Technical Details

Processor	Broadcom BCM2711, quad-core Cortex-A72 (ARM v8) 64-bit SoC @ 1.5GHz
Memory	1GB, 2GB, 4GB or 8GB LPDDR4 (depending on model) with on-die ECC
Connectivity	2.4 GHz and 5.0 GHz IEEE 802.11b/g/n/ac wireless LAN, Bluetooth 5.0, BLE Gigabit Ethernet 2 × USB 3.0 ports 2 × USB 2.0 ports
GPIO	Standard 40-pin GPIO header (fully backwards-compatible with previous boards)
Video & sound	2 × micro-HDMI ports (up to 4Kp60 supported) 2-lane MIPI DSI display port 2-lane MIPI CSI camera port 4-pole stereo audio and composite video port
Multimedia	H.265 (4Kp60 decode); H.264 (1080p60 decode, 1080p30 encode); OpenGL ES, 3.0 graphics
SD card support	Micro SD card slot for loading operating system and data storage
Input power	5V DC via USB-C connector (minimum 3A1) 5V DC via GPIO header (minimum 3A1) Power over Ethernet (PoE)–enabled (requires separate PoE HAT)
Environment	Operating temperature 0–50ºC

Raspberry Pi Camera Module 2

The Raspberry Pi Camera Module 2 has a Sony IMX219 8-megapixel sensor. It can be used to take high-definition video, as well as stills photographs.

It's a leap forward in image quality, colour fidelity, and low-light performance. It supports 1080p30, 720p60 and VGA90 video modes, as well as still capture. It attaches via a 15cm ribbon cable to the CSI port on the Raspberry Pi.

We chose the Raspberry Pi Camera Module v2 because it works well with the Raspberry Pi 4, has the right image quality, is small and affordable, and has good community support. These qualities made it the best fit for our blind assistance device.

We have significantly reduced the size of the footage we are capturing to only capture the objects that are directly in front of the device.

This also prevents the object detection model from reporting all the objects detected in one frame.

Technical Details

Size	Around 25 × 24 × 9 mm
Weight	3g
Still resolution	8 Megapixels
Video modes	1080p47, 1640 × 1232p41 and 640 × 480p206
Sensor	Sony IMX219
Sensor resolution	3280 × 2464 pixels
Sensor image area	3.68 x 2.76 mm (4.6 mm diagonal)
Pixel size	1.12 µm x 1.12 µm
Optical size	1/4"
Focus	Adjustable
Depth of field	Approx 10 cm to ∞
Focal length	3.04 mm
Horizontal Field of View (FoV)	62.2 degrees
Vertical Field of View (FoV)	48.8 degrees
Focal ratio (F-Stop)	F2.0
Maximum exposure times (seconds)	11.76

UPS HAT (D)

The UPS HAT (D) is a special board for Raspberry Pi that ensures power stays on. It has a built-in battery charger, boost converter, and voltage/current monitor. It can charge and provide steady 5V power. Battery information like voltage and capacity level can be checked through I2C. Plus, it shows the battery level on the Pi for easy monitoring.

Reasons for choosing UPS HAT (D) by Waveshare:

- **Reliability:** A UPS HAT ensures steady power for our device, which is crucial for helping visually impaired individuals, as it prevents data loss, safety risks, or unexpected stops when the power goes out.
- **Data Integrity:** The UPS HAT keeps the power stable, so our system can process data safely. This data includes things like object detection, distance measurements, and sound output. If the data is wrong or gets messed up, it can be dangerous for users and make the device less useful.
- **User Safety**: Keeping the device working all the time makes it safer for users. They depend on accurate information from the device for navigation and decisions, and a power problem could be bad.

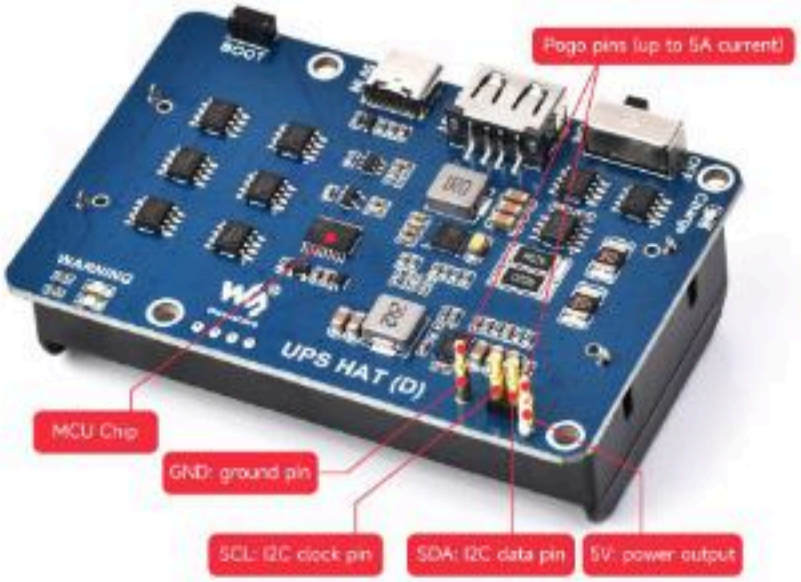
Technical Details

Output voltage	5V
Control bus	I2C
Battery support	21700 rechargeable Li battery 3.6V
Charger support	5V, Micro USB interface
Current capacity	5000mAh (Standard)
Dimensions	56 × 85mm
Mounting hole size	3.0mm

The UPS HAT (D) includes a USB Type C charging port with a 5V input voltage. LED indicators show charging status.

It has a power switch marked ON/OFF

Using the battery for power output requires activation of the battery protection chip by charging it or pressing the BOOT button.

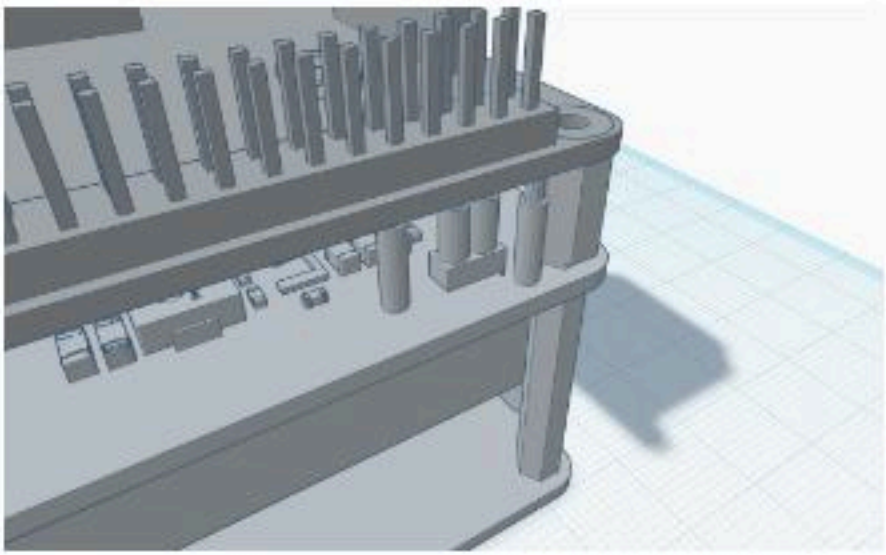


Safety Precautions

- Reversing the battery's negative and positive connection during charging or discharging should be avoided
- Batteries used should be compatible with Raspberry Pi 4

Hardware Setup

To correctly connect the UPS HAT (D) we just need to carefully mount the Pi on the UPS as shown.



The pogo pins connect to the GPIO Pin 2 (5V), Pin 3 and 5 (for IC2 Communication) and Pin 9 (Ground)

Code

Step-1

First we need the enable IC2 interface. Running the following command in terminal will open the configuration interface.

```
sudo raspi-config
```

Step-2

Next navigate to Interfacing Options, select I2C and enable the I2C kernel driver.

Step-3

Reboot the Pi:

```
sudo reboot
```

Step-4

Install 7zip and download the UPS HAT (D) demo files:

```
sudo apt-get install p7zip
wget https://files.waveshare.com/wiki/UPS-HAT-(D)/UPS_HAT_D.7z
7zr x UPS_HAT_D.7z -r -o./
cd UPS_HAT_D
```

Step-5

Run the demo using the following command:

```
python3 INA219.py
```

The demo will output battery voltage, current, power, and remaining battery capacity percentage.

Step-6

This will display the battery level icon in the upper right corner:

```
cd ~/UPS_HAT_D
./main.sh
sudo reboot
```

After rebooting, we should be able to see a battery icon with battery information.

When the battery level drops below 5%, a low battery warning will appear.

After 60 seconds, the Raspberry Pi will power off automatically. If you plug in the power supply during the warning, it will exit the warning interface.

Volume Buttons

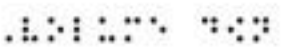
Code Link:

https://github.com/fall-blue/IRIS-Project/blob/main/IRIS_Volume_Control.py

(NOTE: Please avoid copying and pasting the code directly from this document, as it may cause formatting issues, please use the link for that)

We have incorporated two buttons with Braille engravings to facilitate volume control, enhancing accessibility for individuals with visual impairments.


Volume up


Volume down

Key Concepts

1. **GPIO:** GPIO stands for General Purpose Input/Output. It allows us to control and interact with external devices using digital signals.
2. **Volume Control:** Adjusting the volume level of audio output.

Code Structure

The code begins by importing the necessary libraries: RPi.GPIO and alsaaudio. The RPi.GPIO library provides functions to control the GPIO pins, while the alsaaudio library allows us to control the audio volume.

Next, we define the GPIO pins for volume control. We have two buttons: one for increasing the volume and another for decreasing the volume. The pins for these buttons are defined as VOLUME_UP_PIN and VOLUME_DOWN_PIN, respectively.

We then set up the GPIO mode and configure the pins as inputs with pull-up resistors. This ensures that the buttons are in the correct state when not pressed.

The code defines a constant VOLUME_STEP which represents the amount by which the volume will be increased or decreased each time the volume button is pressed. In this example, the volume is adjusted by **5 units.**

Next, we define two functions: increase_volume and decrease_volume. These functions are called when the volume buttons are pressed. The increase_volume function retrieves the current volume level, increases it by VOLUME_STEP, and sets the new volume level using the mixer.setvolume() function from the alsaaudio library. Similarly, the decrease_volume function decreases the volume level.

We use the GPIO.add_event_detect() function to detect button presses. When the volume up button is pressed, the increase_volume function is called. When the volume down button is pressed, the decrease_volume function is called.

Finally, we enter a loop that continuously runs until a keyboard interrupt (Ctrl+C) is detected. This loop ensures that the program remains active and can respond to button presses. The GPIO.cleanup() function is called to clean up the GPIO pins when the program is terminated.

Code Examples

```
import RPi.GPIO as GPIO
import alsaaudio

mixer = alsaaudio.Mixer()

# This sets the volume button pins
VOLUME_UP_PIN = 17
VOLUME_DOWN_PIN = 18

GPIO.setmode(GPIO.BCM)
GPIO.setup(VOLUME_UP_PIN, GPIO.IN, pull_up_down=GPIO.PUD_UP)
GPIO.setup(VOLUME_DOWN_PIN, GPIO.IN, pull_up_down=GPIO.PUD_UP)

# Every time we press the volume button, the volume will be increased or
decreased by 5
VOLUME_STEP = 5

# Function to increase volume
def increase_volume(channel):
    current_volume = mixer.getvolume()[0]
    new_volume = min(100, current_volume + VOLUME_STEP)
    mixer.setvolume(new_volume)

# Function to decrease volume
def decrease_volume(channel):
    current_volume = mixer.getvolume()[0]
    new_volume = max(0, current_volume - VOLUME_STEP)
    mixer.setvolume(new_volume)

GPIO.add_event_detect(VOLUME_UP_PIN, GPIO.FALLING, callback=increase_volume,
bouncetime=200)
GPIO.add_event_detect(VOLUME_DOWN_PIN, GPIO.FALLING, callback=decrease_volume,
bouncetime=200)

try:
    while True:
        pass
except KeyboardInterrupt:
    GPIO.cleanup()
```

To run this code, we must follow the following steps:

Step-1

Open terminal and install some essential programs by running the following command:

```
pip install RPi.GPIO
pip install pyalsaaudio
```

Step-2

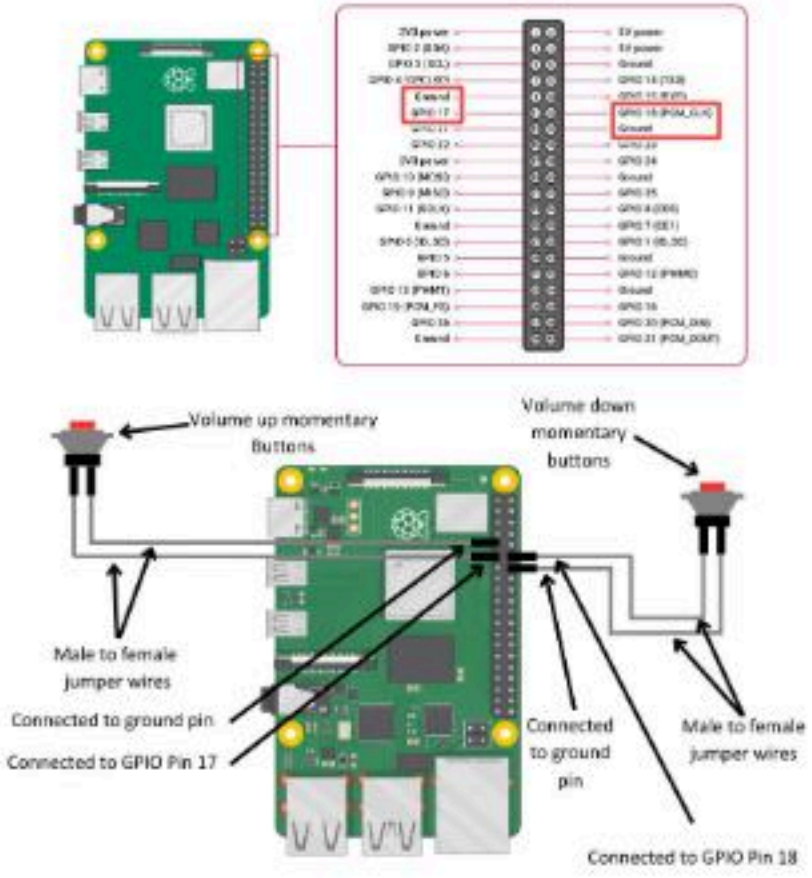
Save the above code as IRIS_Volume_Control**.py**

Step-3

Run the python script by running the following command in terminal.

```
python IRIS_Volume_Control.py
```

Hardware Setup



LiDAR Distance Sensor

LiDAR Sensors

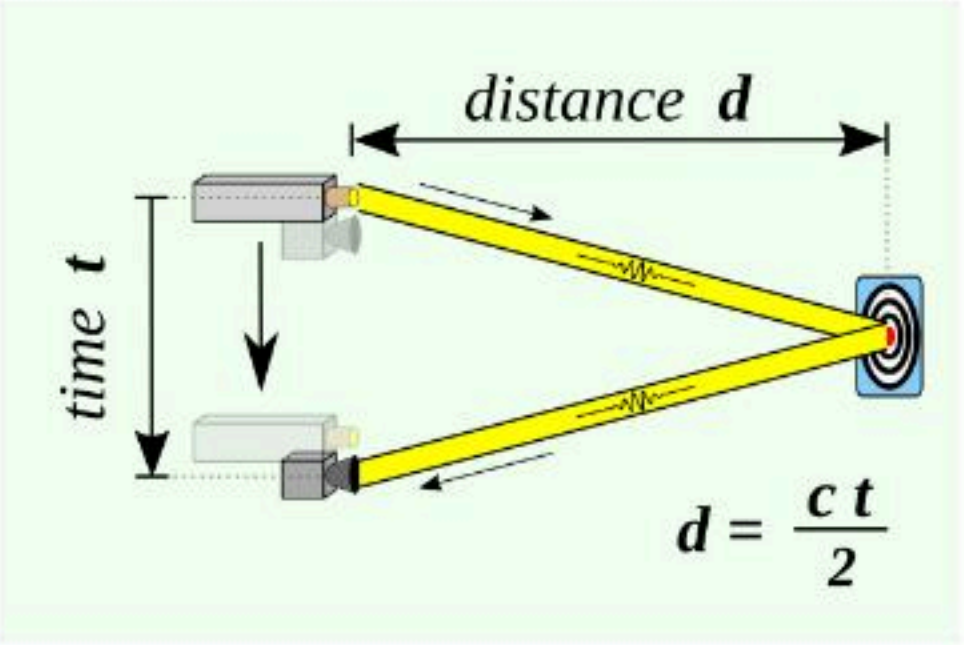
LiDAR stands for Light Detection and Ranging. It's a method of 3-D laser scanning.

Lidar sensors provide 3-D structural information about an environment. Advanced driving assistance systems (ADAS), robots, and unmanned aerial vehicles (UAVs) employ lidar sensors for accurate 3-D perception, navigation, and mapping.

Lidar is an active remote sensing system that uses laser light to measure the distance of the sensor from objects in a scene. A lidar sensor emits laser pulses that reflect off surrounding objects. The sensor then captures this reflected light and uses the time-of-flight principle to measure its distance from objects, enabling it to perceive the structure of its surroundings.

Time of flight principle

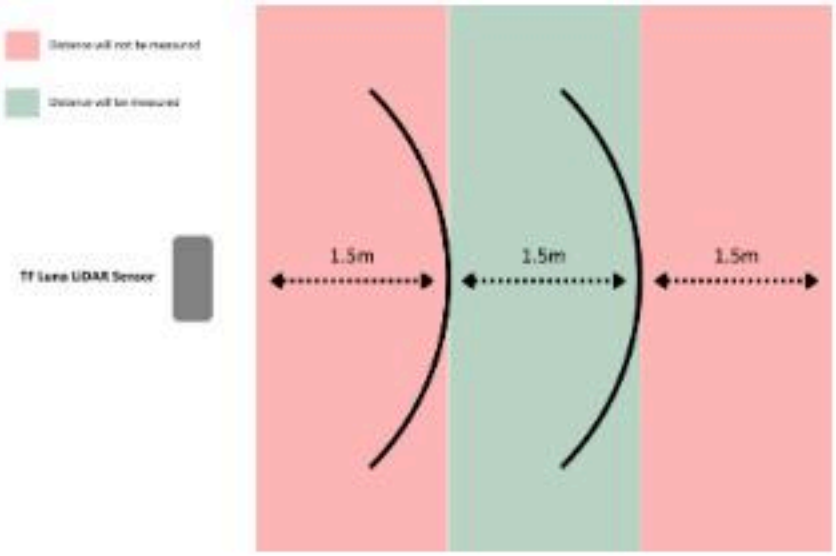
The Time-of-Flight principle (ToF) is a method for measuring the distance between a sensor and an object, based on the time difference between the emission of a signal and its return to the sensor, after being reflected by an object. Various types of signals (also called carriers) can be used with the Time-of-Flight principle, the most common being sound and light.



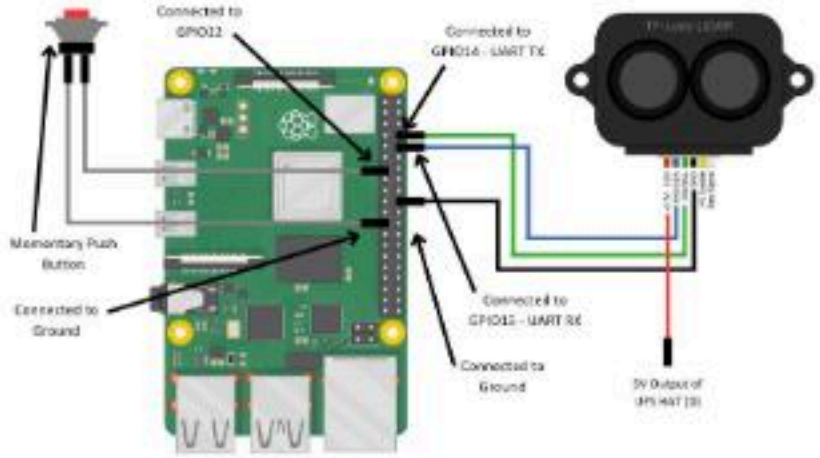
- d=distance
- c=speed of light
- t=time taken by the laser pulse to hit the object and return

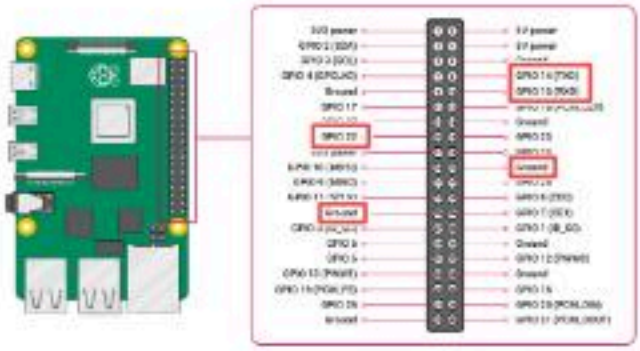
In our device we have used TF-Luna Distance LiDAR Sensor which uses the ToF principle to measure the distance of the objects which are located between 1 and 2 meters of the device.

We decided to measure objects between 1.5 and 3 meters from the device. Things closer than 1.5 meter are already accessible to the blind person, and objects farther than 3 meters don't matter since the sensor will eventually measure them as the person moves forward.



Hardware Setup





Object Detection

Object detection is a computer vision technique for locating instances of objects in images or videos. Object detection algorithms typically leverage machine learning or deep learning to produce meaningful results.

Yolov8 is an object detection algorithm that aims to detect objects in images or video frames. Our model is trained to detect the following objects

- Chairs
- Tables
- Sofas
- Fireplaces

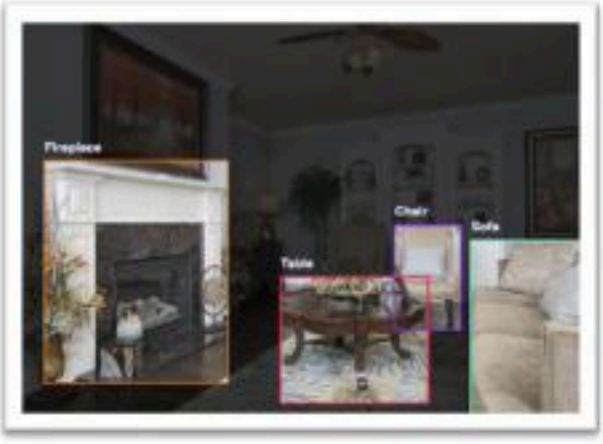
Architecture:

YOLOv8 short for "You Only Look Once version 8" is a state-of-the-art object detection model that belongs to the YOLO family of models. YOLOv8 is a deep neural network designed for real-time object detection in images and video frames. It is characterized by its efficient and streamlined architecture, making it suitable for applications where fast and accurate object detection is essential.

YOLOv8's architecture typically consists of numerous convolutional layers, down-sampling and up-sampling layers, and detection layers. These components work together to process input images and produce bounding boxes, class predictions, and confidence scores for detected objects.

Training Data

Our YOLOv8 Model is trained on a diverse dataset of 258 images containing labeled images with objects of interest. The training dataset is crucial for enabling the model to recognize a wide range of objects accurately.



Real-Time Detection

One of the distinguishing features of YOLOv8 is its ability to perform real-time object detection. Our model is optimized for speed without compromising accuracy. This real-time capability makes it suitable for applications where quick and responsive object detection is critical, such as in our assistive device for the blind.

Object Detection Process

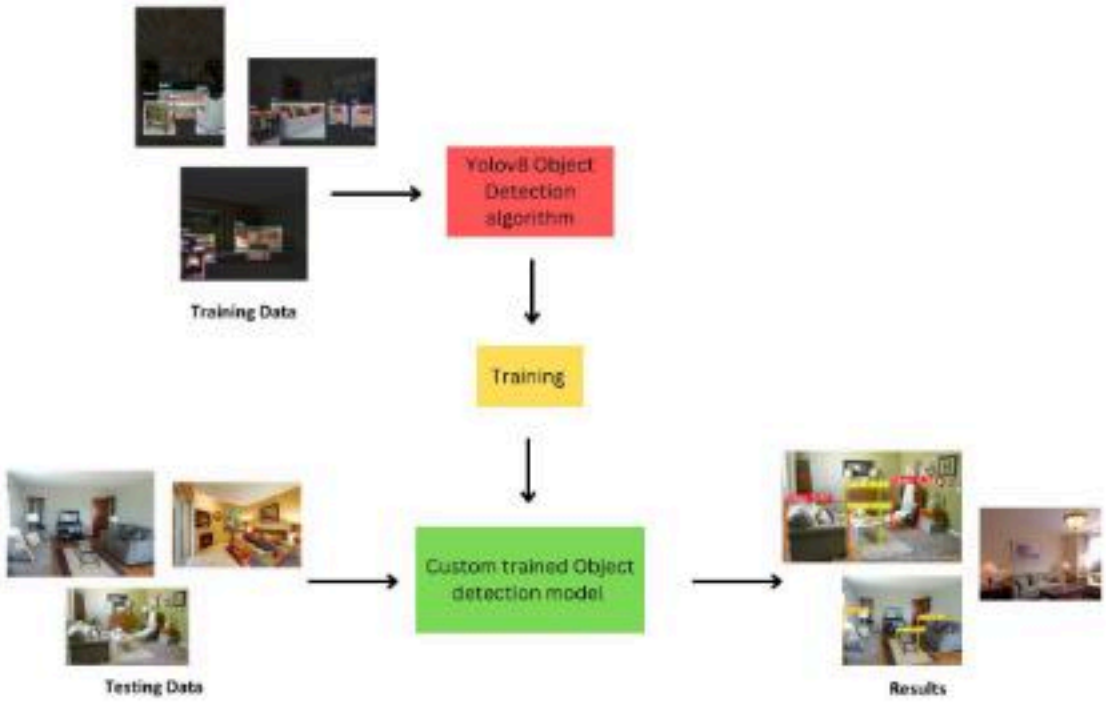
The primary function of YOLOv8 is to detect objects in images or video frames. The detection process can be summarized as follows:

- **Input Data:** YOLOv8 takes an image or video frame as input.
- **Bounding Boxes:** The model processes the input and draws bounding boxes around objects it recognizes in the image. Each bounding box specifies the location and size of a detected object.
- **Confidence Scores:** YOLOv8 assigns a confidence score to each bounding box, indicating the model's level of confidence in the presence of an object. High confidence scores signify strong model certainty, while lower scores may imply uncertainty.
- **Class Labels:** In addition to confidence scores, YOLOv8 assigns class labels to the detected objects, specifying what each object is. For example, if the model identifies a chair, it will attach the class label "chair" to the corresponding bounding box.

(The numbers that you can see on top of the bounding box is the confidence score)

Performance and accuracy

YOLOv8 is known for its exceptional balance between speed and accuracy. Incorporating YOLOv8 into our assistive device for the visually impaired provides the capability to recognize objects and offer real-time feedback to users, enhancing their independence and safety. The efficient architecture and training approach of YOLOv8 make it an excellent choice for your project's object detection needs.



Code links:

This is the development code. In this colab file you can see how we developed the object detection model:

https://colab.research.google.com/drive/1ZGJYXYCFE017xDfoDHoJFxh5euxfAbX3?usp=sharing

In this colab file you can test our object detection model on your own dataset.

https://colab.research.google.com/drive/1epjUgjLYKvbi_0NmRiSrUMa7BkGdZwqR?usp=sharing

DISCLAIMER: this is just a prototype, and the model is still in development. We are actively working on expanding our dataset to incorporate more object classes, enhancing the model's versatility, performance and accuracy.

Object Detection with LiDAR Integration

Code link:

https://github.com/fall-blue/IRIS-Project/blob/main/IRIS_Lidar_Object_Detection.py

(NOTE: Please avoid copying and pasting the code directly from this document, as it may cause formatting issues, please use the link for that)

Introduction

This code implements an object detection system that integrates LiDAR (Light Detection and Ranging) technology. The system uses a Raspberry Pi, a LiDAR sensor, a camera, and a pre-trained object detection model to detect objects within a certain distance range and play an audio message indicating their presence.

Key Concepts

1. **Object Detection:** The process of identifying and localizing objects within an image or video.
2. **LiDAR:** A remote sensing technology that uses laser light to measure distances and create detailed 3D maps of the environment.
3. **Raspberry Pi:** A small, single-board computer that can be used for various projects and applications.
4. **gTTS:** A Python library that allows text-to-speech conversion using Google Text-to-Speech API.
5. **OpenCV:** A popular computer vision library that provides various functions for image and video processing.
6. **Torch:** A deep learning framework that provides tools for building and training neural networks.

Code Structure

The code is structured as follows:

1. Importing the necessary libraries and modules.
2. Loading the object detection model.
3. Initializing the LiDAR sensor and camera.
4. Defining the central region dimensions for object detection.
5. Implementing functions for collecting LiDAR data, detecting objects, and playing audio messages.
6. Setting up a loop to continuously monitor the button state and start/stop data collection.
7. Handling exceptions and cleaning up GPIO resources.

Code Examples

Here are some key code snippets from the provided code:

Loading the object detection model:

```
model = torch.load("")
```

This line loads our object detection model. The path needs to be specified in the torch.load() function.

Collecting LiDAR data:

```
def collect_data():
    global collecting_data
    try:
        while collecting_data:
            data = sensor_serial.readline().decode("utf-8").strip()
            if data:
                print("LiDAR Data:", data)
                distance = float(data) / 100  # this will convert LiDAR data to
meters
                detect_and_play_audio(distance)
    except Exception as e:
        print(f"Error in collect_data: {e}")
    finally:
        sensor_serial.close()
```

This function reads data from the LiDAR sensor and converts it to meters. It then calls the detect_and_play_audio() function to perform object detection and play audio messages.

Detecting objects and playing audio messages:

```
def detect_and_play_audio(distance):
    try:
        while True:
            ret, frame = camera.read()  # this will read a frame from the camera

            cropped_frame = frame[:, central_x:central_x + central_width]  # this
will crop the central region

            results = model(cropped_frame)  # this will perform object detection
on the cropped frame

            for result in results.xyxy[0].cpu().numpy():
                class_id = int(result[5])
                class_label = model.names[class_id]
                if 1.5 <= distance <= 3.0:  # this will filter objects within
1.5-3.0 meters
                    print(f"Detected {class_label} at {distance} meters")
                    play_audio_message(class_label, distance)
```

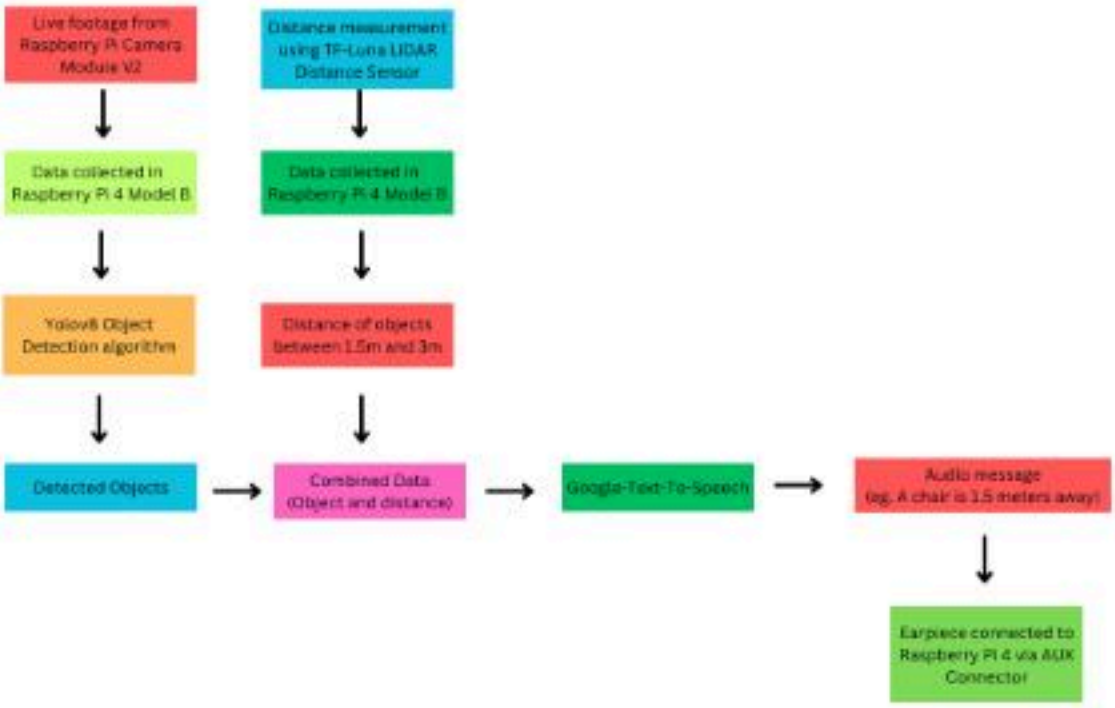
```
            cv2.imshow("Object Detection", cropped_frame)  # this will display
the video frame
            key = cv2.waitKey(1) & 0xFF

            if key == ord("q"):
                break
    except Exception as e:
        print(f"Error in detect_and_play_audio: {e}")
    finally:
        camera.release()
        cv2.destroyAllWindows()
```

This function reads frames from the camera, crops the central region, performs object detection using the pre-trained model, and plays audio messages for detected objects within the specified distance range.

Conclusion

This code demonstrates how to integrate LiDAR technology with object detection using a Raspberry Pi. By combining LiDAR data with visual information from a camera, the system can accurately detect objects within a certain distance range and provide audio feedback.



To run this code we must follow the following steps:

Step-1

Open terminal and run the following commands **individually** to install the required programs:

```
sudo apt-get update
sudo apt-get install python3
sudo apt-get install python3-pip
pip install gTTS opencv-python ultralytics
sudo apt-get install mpg123
pip install torch torchvision torchaudio
pip install pyserial
```

Step-2

Run the following command to install the object detection model.

```
git clone https://github.com/fall-blue/Living-Room-Object-Detection.git
```

Step-3

We need to enable UART interface for the lidar sensor.

(UART is a method for devices to talk to each other by sending data one piece at a time, like a conversation between a microcontroller or computer and other gadgets.)

Use the following command to access the configuration menu:

```
sudo raspi-config
```

Step-4

Under interfacing options enable the Serial interface and disable the login shell over serial.

Step-5

Locate the object detection model. It will be saved as **Yolov8_ObjectDetection.pt**

Copy file path and paste it here:

Step-6

After pasting the file path in between the inverted commas. Save the main code as IRIS_Lidar_Object_Detection.**py**

Step-7

Run the following command in terminal.

```
python IRIS_Lidar_Object_Detection.py
```

Running IRIS_Lidar_Object_Detection.py on Raspberry Pi 4 bootup

This code will automatically run the python script and start detection and distance measurement when the Raspberry Pi 4 turns on.

(NOTE: Please avoid copying and pasting the code directly from this document, as it may cause formatting issues)

Step-1

Open terminal and run the following command. This will create a service unit file.

```
sudo nano /etc/systemd/system/IRIS_Lidar_Object_Detection.service
```

Step-2

Add the following data to the service file that was just created. Then save and exit the file.

(NOTE: make sure to write the file path in ExecStart and folder path in Working directory)

```
[Unit]
Description=Object Detection and Lidar Data Collection

[Service]
ExecStart=/usr/bin/python3 /replace this with the exact path of
IRIS_Lidar_Object_Detection.py
WorkingDirectory=/replace this with the exact path of the folder where
IRIS_Lidar_Object_Detection.py is saved
Restart=always
User=pi

[Install]
WantedBy=multi-user.target
```

Step-3

This will enable the service when the Raspberry Pi 4 turns on.

```
sudo systemctl enable IRIS_Lidar_Object_Detection.service
```

Step-4

Running this command will start the service.

```
sudo systemctl start IRIS_Lidar_Object_Detection.service
```

Step-5

To check the status of the service run the following command. If there are any errors, then we will be able view them here as it will show us the output generated by IRIS_Lidar_Object_Detection.py

```
sudo systemctl status IRIS_Lidar_Object_Detection.service
```

Step-6

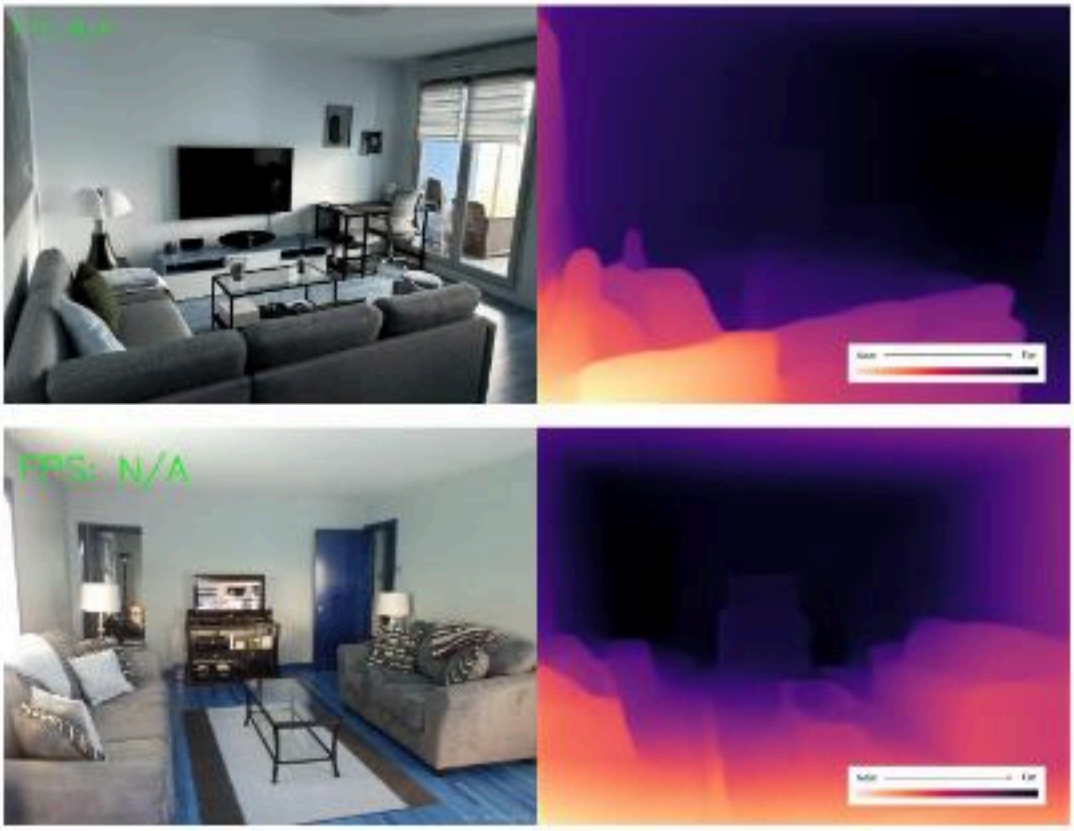
To test the service, reboot the Raspberry Pi. You can run the following command to reboot.

```
sudo reboot
```

Depth Estimation MiDaS Neural Network

MiDaS (Multiple Depth Estimation Accuracy with Single Network) is a deep learning based residual model built atop Res-Net for monocular depth estimation. MiDaS is known to have shown promising results in depth estimation from single images.

Examples:



Code link:

In this colab file you can test your own images and use estimate depth:

https://colab.research.google.com/drive/1kavGULJsKu3lzpxc6mA0FdAZ_F3cWabF?usp=sharing

Architecture

MiDaS uses two main parts: the encoder extracts important information from the input, and the decoder creates a depth map using this information.

Backbone

MiDaS uses a robust network like ResNet-50 or ResNet-101 to capture different details in the input images at various scales, which helps create depth maps effectively.

Multi-Scale Feature Fusion

In MiDaS, they do a few clever things to make sure they get depth information from pictures as accurately as possible.

First, they combine different pieces of information from the picture taken at different distances to get a better overall idea of how far things are from the camera. This helps make the depth estimation more precise.

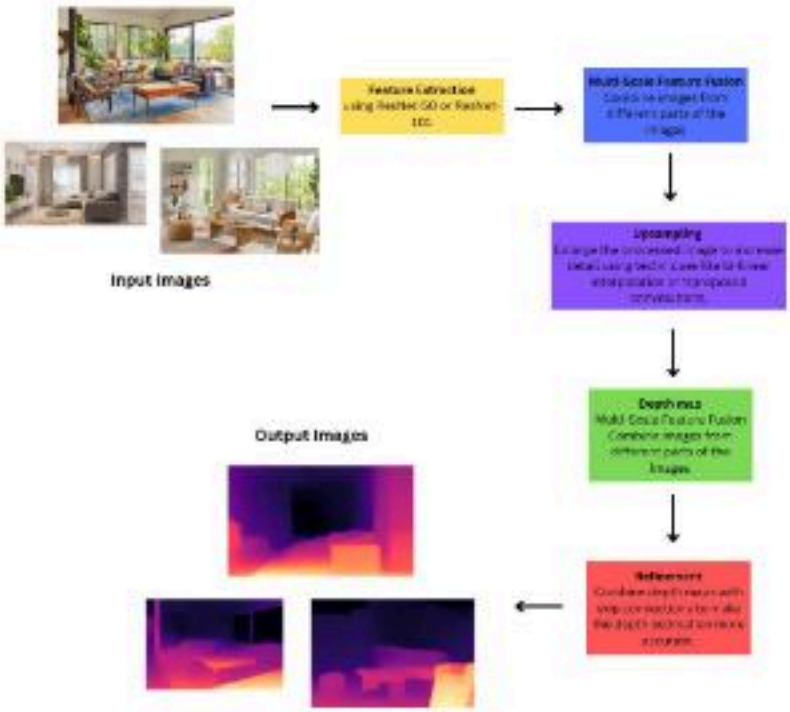
Second, they connect the parts of the picture with a lot of detail (like fine lines and textures) to the parts that look more general. This way, the model can use both the fine details and the bigger picture to figure out depth.

Finally, they take all these combined pieces of information and put them together to make a better depth map. This map helps understand how far away things are in the picture. All of these techniques make the depth estimation more accurate.

Up-Sampling and Refinement

To create the depth map, MiDaS makes the picture bigger and more detailed. They do this using methods like stretching the picture or adding extra information to it. This makes the depth estimation more precise.

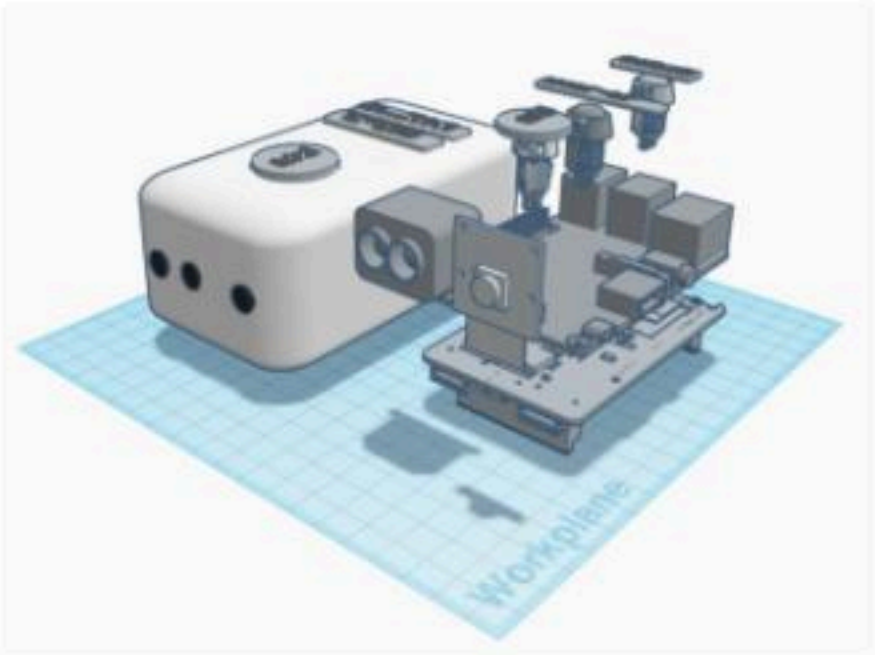
Then, they take all the different depth maps and combine them with related connections in the picture. This helps improve the accuracy of the depth estimation.

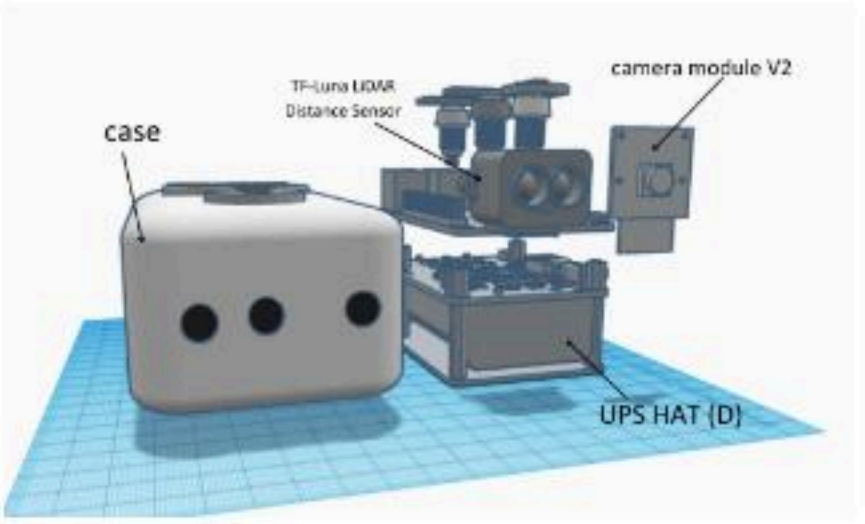


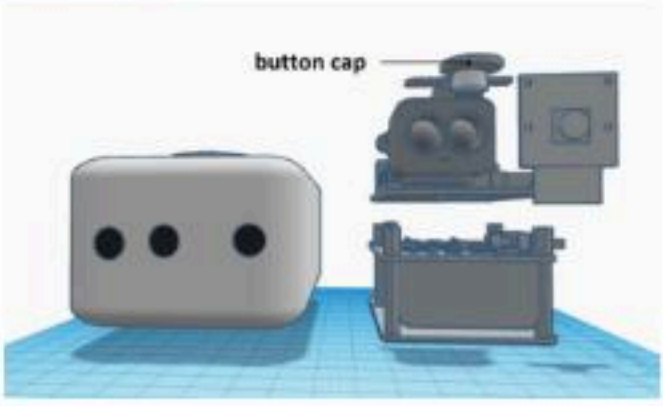
Originally, our plan was to use this Midas depth estimation model to measure object distances detected by our YOLOv8 system on a Raspberry Pi 4 camera in real-time. However, due to the high computational requirements and lack of suitable hardware, we've decided not to implement this at the moment. Instead, we've opted for LIDAR sensors as a more feasible solution. We still decided to share this information because we believe that in the future, integrating the Midas model alongside LIDAR data could significantly enhance accuracy.

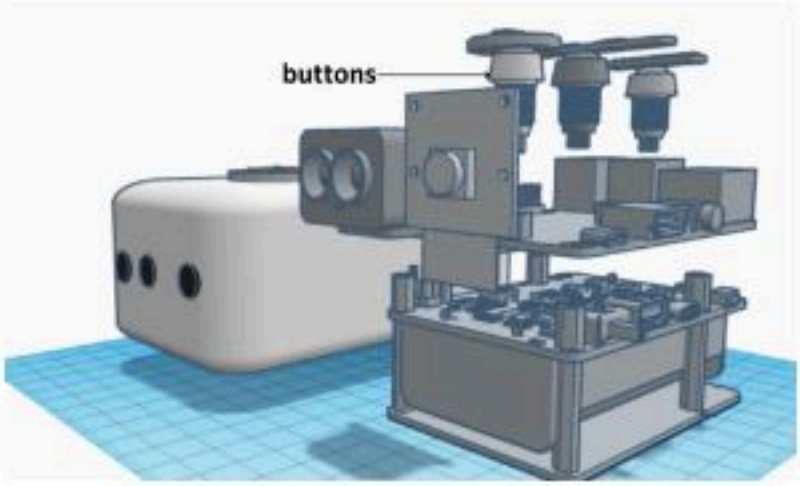
3D Model

Link: https://autode.sk/3Qg4uBW





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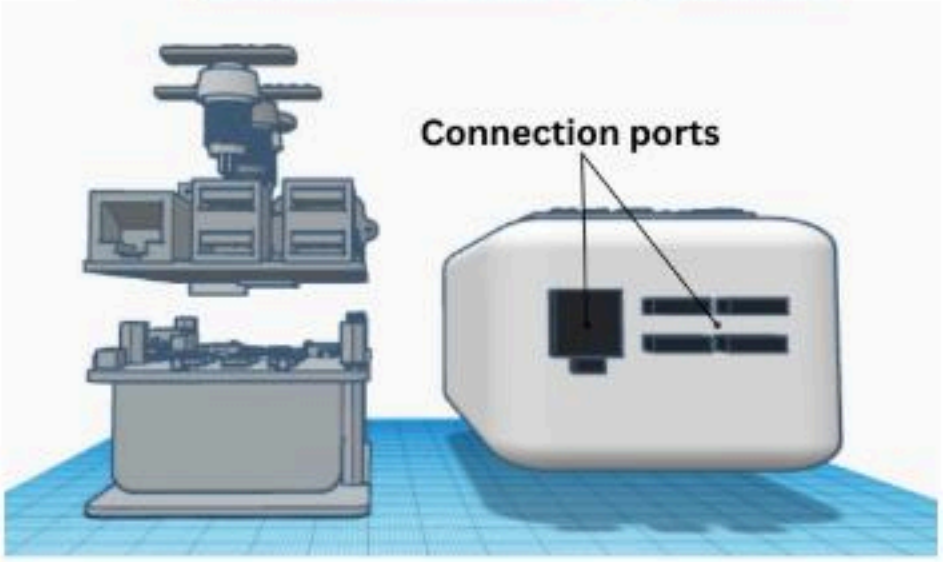
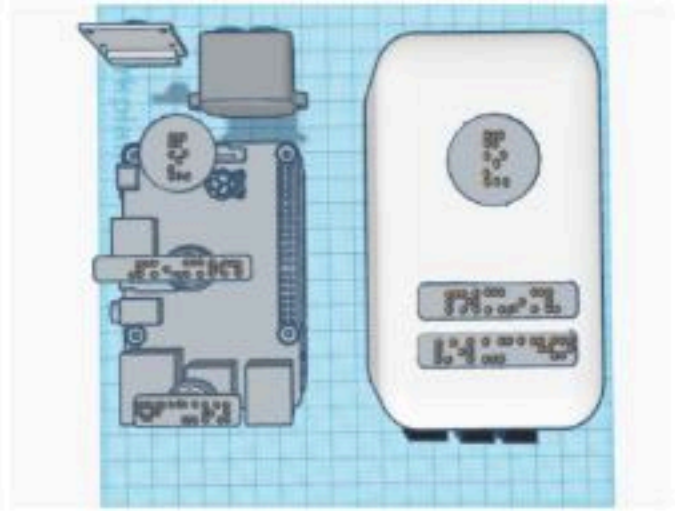

Connection ports



Conclusion

We've successfully developed a device to assist blind individuals, and we're excited about its potential to make a positive impact on their lives. Our creation centers around a Raspberry Pi 4 and integrates cutting-edge technologies to enhance mobility and awareness for visually impaired individuals.

First and foremost, we've implemented YOLOv8, a state-of-the-art object detection model. This remarkable technology enables us to recognize everyday objects such as chairs, sofas, and tables, providing critical information about the environment in real time.

To ensure our users' safety and confidence, we've integrated a TF Luna LiDAR distance sensor. This sensor accurately measures the distance to detected objects within a range of 1 to 2 meters, giving our users precise spatial information to navigate safely and confidently.

But we didn't stop there; we wanted to make this information accessible in the most user-friendly way. That's why we've incorporated Google Text-to-Speech to convert the data into audio messages. These messages are sent to an earpiece through an aux connector, allowing our users to receive immediate, verbal feedback about their surroundings.

In summary, our device is a powerful combination of advanced object detection, precise distance sensing, and clear, real-time audio feedback. We're incredibly proud of this creation, and we believe it has the potential to greatly improve the independence and safety of visually impaired individuals as they navigate their world.

Cost:

Device	Quantity	Cost (INR)	Link
Raspberry pi 4 model B	1	5,783	https://amzn.eu/d/apDu8Ko
Raspberry pi camera module V2	1	2,060	https://amzn.eu/d/apDu8Ko
TF-Luna LiDAR Distance Sensor	1	2000	https://robu.in/product/tf-luna-lidar-distance-sensor/
The UPS HAT (D)	1	3800	https://shorturl.at/hpFHM
Momentary buttons	3	30	https://shorturl.at/hCIKT
3D Printed Case	1	Unknown at the moment	
TOTAL	-	13673	-

Future Work:

1. We will make a real-life prototype.
2. We will work on expanding our dataset to incorporate more object classes, enhancing the model's versatility, performance and accuracy.
3. Add more sensors like ultrasonic sensors to improve object detection and distance measurement.
4. Improve the overall device in all aspects
5. Make accessories for this device so that it can be mounted on wheelchairs, sticks, shoulders etc.

References

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https://www.waveshare.com/wiki/UPS_HAT_(D)

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