



# LAKSHYA

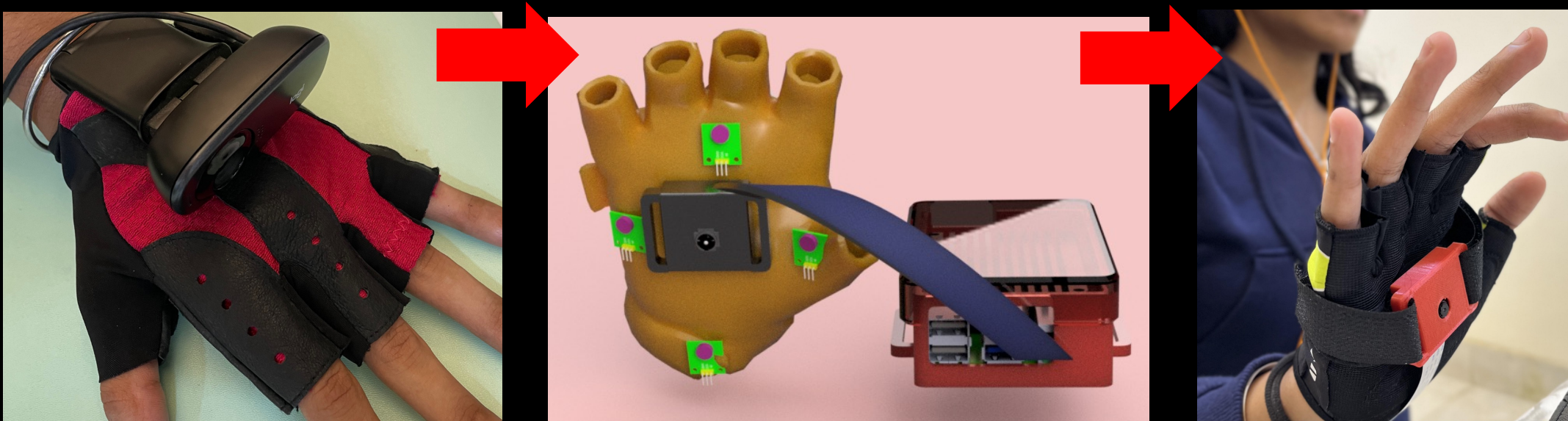
AUGMENT YOUR SENSES

## ABSTRACT

Currently 295 million people worldwide are visually-impaired, 90% of whom live in underdeveloped countries without access to expensive tech to help them. These visually-impaired people struggle with simple tasks on a daily basis such as: picking up a glass of water, choosing what to wear, or figuring out if other people are present in a room. In this paper I present an affordable device - LAKSHYA costing Rs.6000 - which uses live video feed from the person's point of view, to identify neighboring objects, using pre-trained AI/ML models. LAKSHYA comprises a miniscule microphone-camera mounted on a hand-worn glove wired to a CPU (Raspberry Pi 4) which processes the live feed using - TENSORFLOW ML library. On accurately identifying the desired object, LAKSHYA notifies the person of the object's position via audio prompts on Bluetooth headphones, guiding them towards the object.

To test the efficacy of LAKSHYA I designed and conducted 8 experiments to validate the various hypotheses (H1 to H8) proposed. These include everyday situations using LAKSHYA (test-setup) and without LAKSHYA (control-setup) in which a blind person attempts to identify objects of different colours, shapes, sizes, dangerous items, famous monuments/personalities, faces of family members, etc. The device proved all 8 hypotheses correct with an average 92.5% success rate. To further test the hypotheses, I conducted literature surveys of papers, user surveys, and followed Stanford's Design Thinking Process as discussed in the paper. I am further enhancing and experimenting with LAKSHYA to help blind persons navigate safely while walking around.

## EVOLUTION OF LAKSHYA'S DESIGN



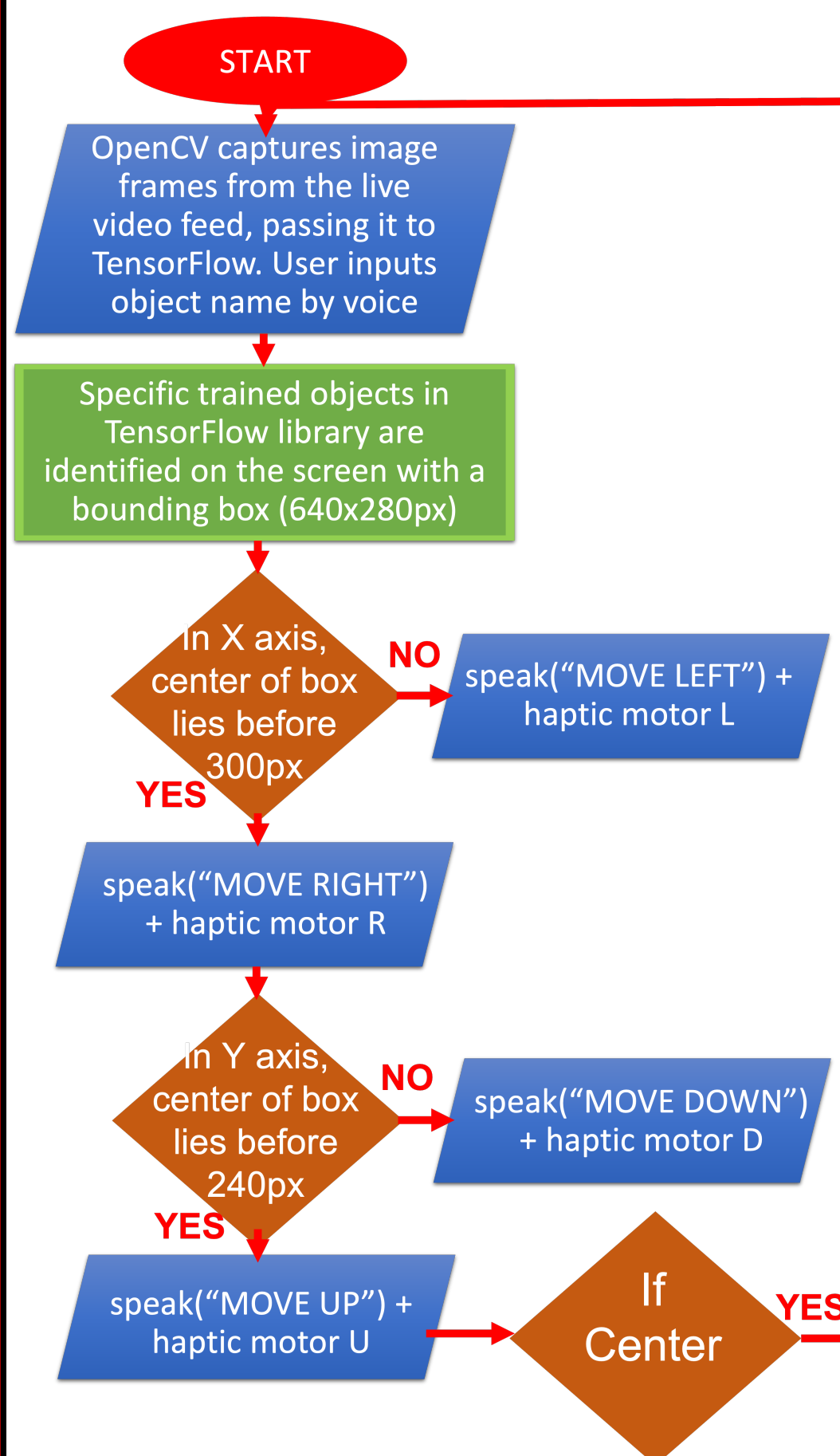
- First Prototype – bulky 720p Webcam, Speakers, Ras-pi 3, no buttons
- Second Prototype – 3D CAD Model made in Fusion 360
- Third Prototype – Minute 5MP camera, 3D printed enclosures, Ras-pi 4, buttons for Master-Interface-Program, headphones, haptic feedback motors
- Design Thinking Process followed throughout the development of prototype.

## CREATIVITY AND INNOVATION



- **AR/VR** – Augmented Reality and Virtual Reality Technology used to visualize LAKSHYA in real time 3D space
- **Haptic Feedback Motors** – used to align hand w.r.t the object to be searched. The 4 motors indicate MOVE LEFT, RIGHT, UP or DOWN
- LAKSHYA uses **Google's Teachable Machine**, **TensorFlow** and **OpenCV** to identify persons/objects and figure out where they are in the frame. Thus using **voice commands** to help the user align their hands

## OBJECT ALIGNMENT FLOWCHART



## ENGINEERING SKILL AND COMPLETENESS

- **Custom 3D printed parts** have been skillfully designed to create LAKSHYA enclosure
- **Safety** – Thermal Heatsink to radiate excess heat. Soldering and sealing loose wires.
- Iterate prototypes with **CAD – Autodesk Fusion 360**, an industrial engineering software
- Final design is a **Compact** handheld device
- **DESIGN THINKING** iterative development process followed during R & D to develop a complete working device
- Using a **custom PWM algorithm** to control the haptic feedback motors based on distance of object from the center of frame
- **Ergonomics principles** were followed when designing user interface (voice + haptic)

## HAPTIC MOTOR FEEDBACK FLOWCHART

