

## Abstract

HURO, the wheeled humanoid, was created with the vision of a robot that could interact with people and its surroundings. The following have been successfully implemented -

- Recognition of faces
- Conversation via auditory methods
- Line following
- Following of verbal commands
- Tracking of objects
- Finding out the direction of sound

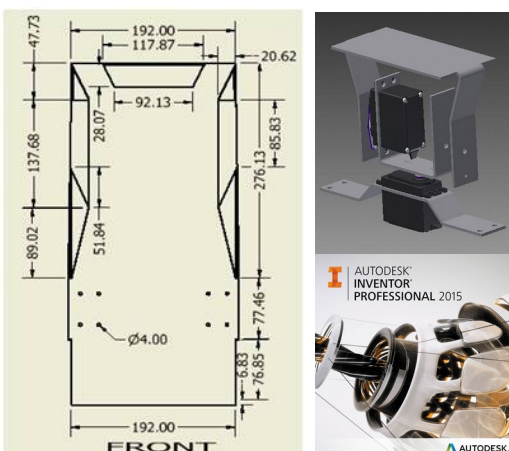


## Design

The robot was designed keeping in mind the following factors -

- Anthropometric corrections
- Torque compatibility and speed controllability
- Affordability

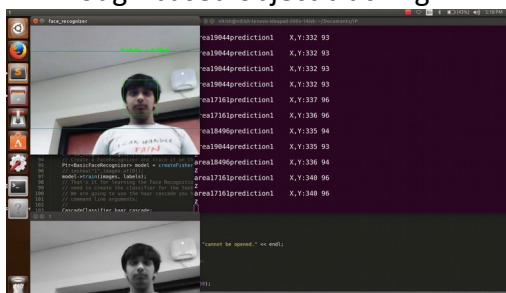
Based on all these factors, the robot stands 64cm tall and weighs 2.4 kg. It has 8 degrees of freedom, 3 in each hand and 2 in the head.



## Image Processing

In order to create some sense of vision for our robot, we made it able to recognise faces from a self-created database, follow a line and track a table tennis ball.

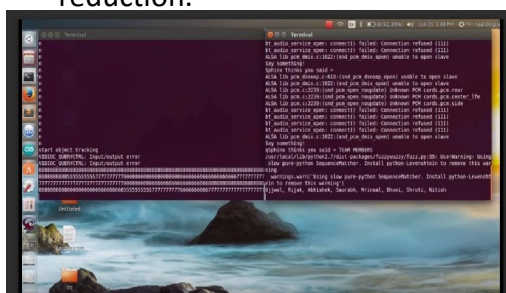
- The Fisherfaces algorithm was implemented and FaceRecognizer class in C++ was used via OpenCV 3.1.0.
- To increase speed and reliability of face recognition, face detection parameters were optimized.
- Existing databases were studied, and then our own was created.
- PID algorithm for line following.
- Hough based object tracking.



## Speech Recognition

The following were done to implement verbal communication -

- The CMU Sphinx library in Python was used. We follow Speech-Text-Speech conversion.
- Editing of the dictionary pronunciation as per Indian accent.
- Adding frequently used sentences and verbal commands to the training model.
- Training, considering noise reduction.



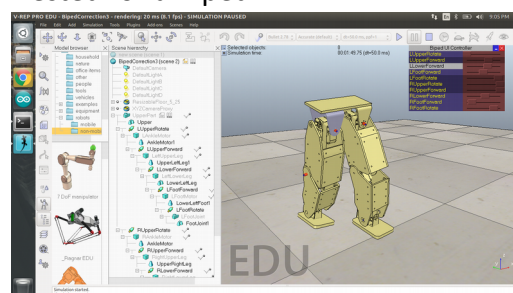
## Sound Localisation

The following were done -

- Python libraries like Numpy, Scipy and Matplotlib were made use of.
- Plotted graphs using Fast Fourier Transform(FFT) and compared using Cross-correlation.
- Used basic Trigonometry for the calculation of Azimuthal angle.

## Simulation

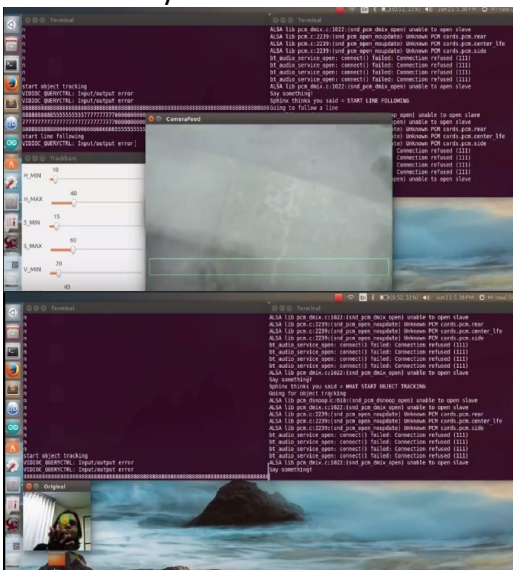
Done using V-REP.  
Tested for a Biped.



## Integration

A Python script was used for integration.  
The bot could -

- Detect a face and stop, then recognise it.
- Start chatting on the recognition of a face.
- Follow verbal commands for its movements.
- Get the direction of the sound, whether from left or right, and face that way.



## Challenges Faced

- Due to unavailability of acrylic material, aluminium had to be used, which increased the weight of the bot.
- Also, it led to the short-circuiting of the circuitry twice.
- An appropriate buck converter with the necessary current requirement for the Odroid XU4 wasn't locally available.
- Experienced problems with the detection of the mics on the Odroid board.

### Team Members

Saurabh Ranjan (Design)  
Nitish Pant (Vision)  
Shruti Joshi (Vision)  
Bhuvi Gupta (Speech)  
Mrinaal Dogra (Speech)  
Rijak Khanuja (Sound Localisation)  
Ujjwal Varshney (Sound Localisation)  
Abhishek Gupta (Simulation)

### Sources of Help

- Funding  
Robotics Club
- Tools & Equipments  
Robotics Club, 4i Laboratory
- Coordinators  
Ankit Kumar, Anvesh Jadon, Hemant Kumar, Mayank Mittal
- Evaluators  
Prashant Kumar, Arpit Agarwal, Abhishek Attal, Shubham Patel