Assistance kit for blind

Project presentation for tinkering lab

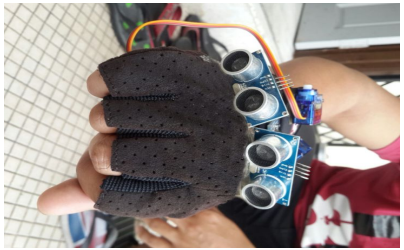
AIM :

To detect objects and recognise activity with the help of sensors and cameras by integrating Computer Vision technology in appropriate hardware to assist specially abled people.

Motivation :

The motivation comes from the fact that every person is not equally created. Certain people are deprived of the abilities that we take for granted. As students of an Institute of National Importance, it becomes our duty to address the issue. The fascinating fields of Computer Vision and Deep Learning also motivates us to harness their power for the benefit of the society.

Components:



1. Smart locket: -This locket will consist of a camera mounted on Jetson Nano , by leveraging deep learning and computer vision the images and videos taken by the camera will be processed to detect objects and/or predict the activity going on in the video. This will thus assist the blind people to blend with normal people in their day-to-day activities.

   Two different models are build one for activity recognition and the other one is for object detection in images/videos.

2. Smart Gloves: A pair of gloves equipped with various sensors and vibrating motors to aid the locomotion of the visually impaired.

Object detection Using YOLO

Traditional methods:-
1. RCNN (Region-CNN)
2. Fast RCNN
3. Faster RCNN

All of the previous object detection algorithms use regions to localize the object within the image. The network does not look at the complete image. Instead, parts of the image which have high probabilities of containing the object. YOLO (You Only Look Once) is an object detection algorithm much different from the region based algorithms seen above. In YOLO a single convolutional network predicts the bounding boxes and the class probabilities for these boxes.

Biggest Advantage of YOLO (You only look once)

- Higher Speed (45 frames per second — better than realtime)
- Network understands generalized object representation (This allowed them to train the network on real world images and predictions on artwork was still fairly accurate).
- faster version (with smaller architecture) — 155 frames per sec

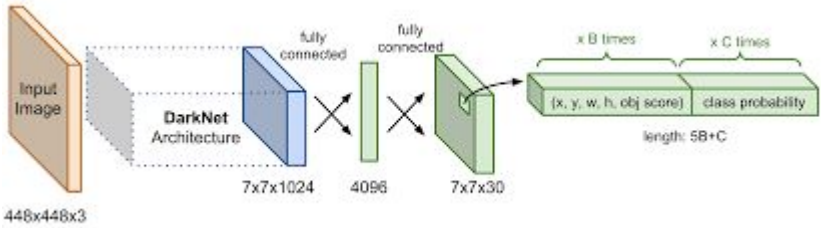


Figure 1:- YOLO Architecture

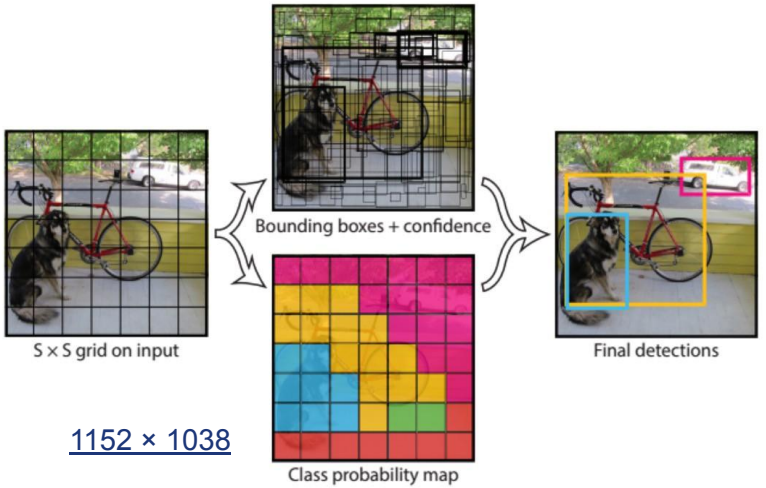
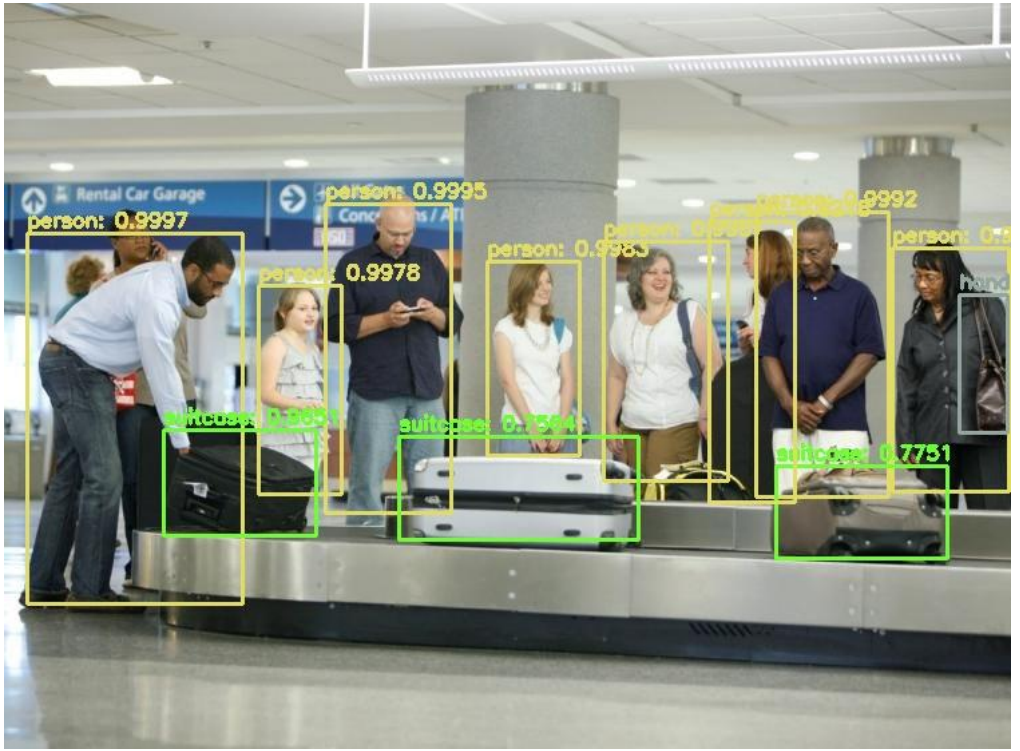
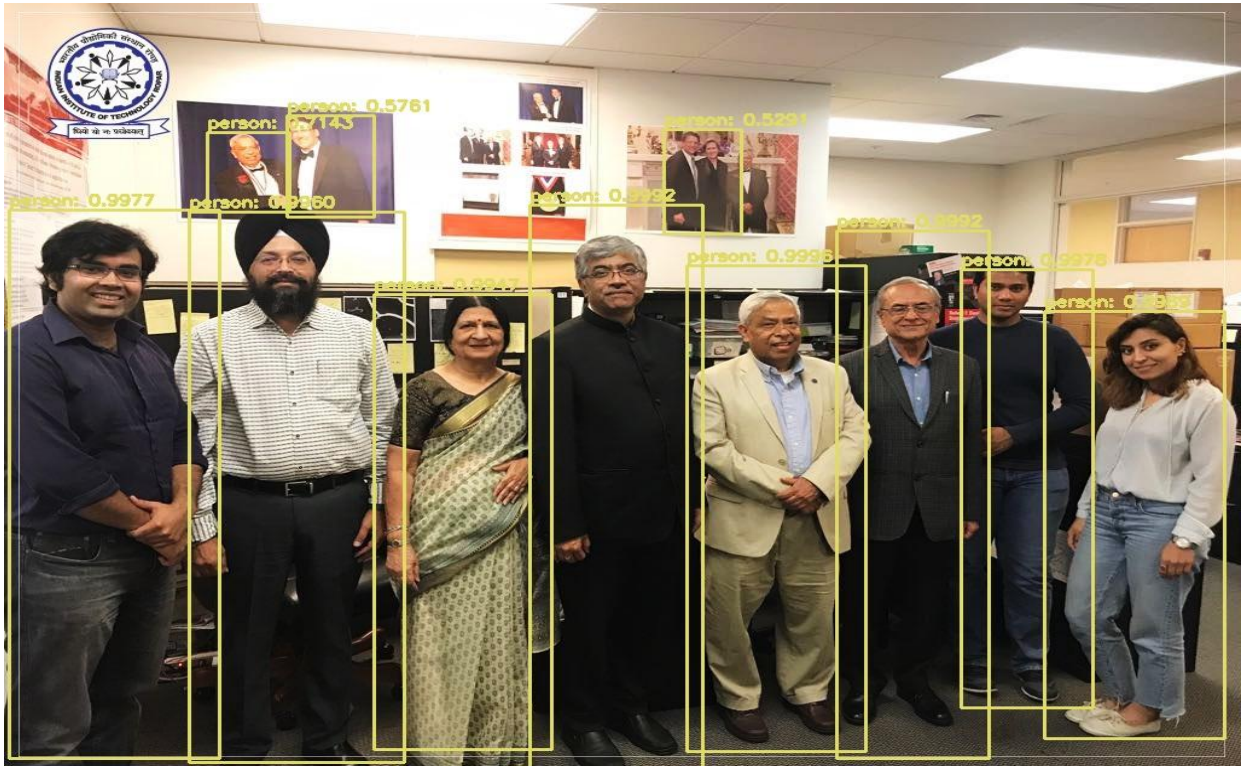


Figure 2: The Model. Our system models detection as a regression problem. It divides the image into an $S \times S$ grid and for each grid cell predicts B bounding boxes, confidence for those boxes, and C class probabilities. These predictions are encoded as an $S \times S \times (B * 5 + C)$ tensor.

Results obtained from model



Results obtained from the model

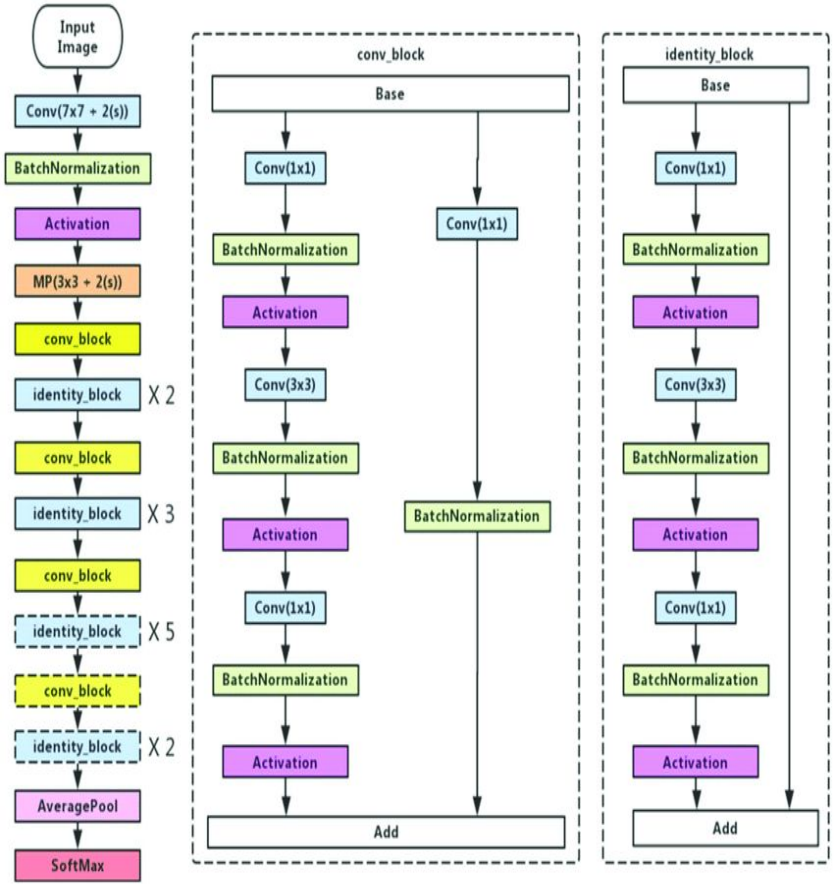


Activity Recognition :-

Input video was processed as a sequence of frames and an independent decision was made on every frame using Resnet50(pre trained CNN on image-net and was fine tuned on sports specific images).

So we focused on spatial information and completely ignored temporal information due to which we were seeing flickering in the predictions.

Generally to take temporal information into account for a sequential data we use RNN but to simplify our model we took a moving average over the predictions (previous 10 frames)

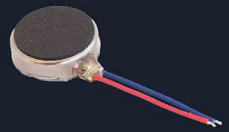


Results of our model:-

Moving on to smart gloves .....

Overall Flow Diagram

User



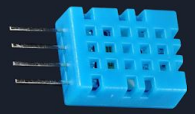
Vibration Motor

Mini Speaker

Interfacing Units

Arduino Microcontroller

Proximity Sensor



Heat Sensor

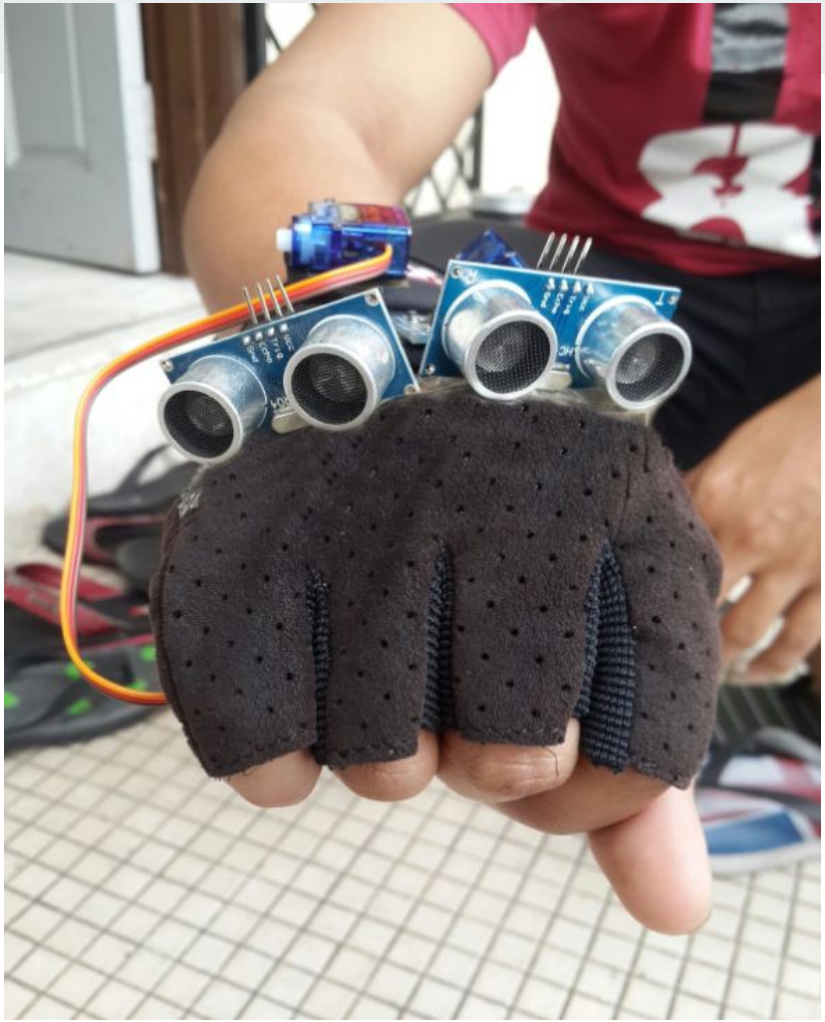
Ultra Sonic Sensor

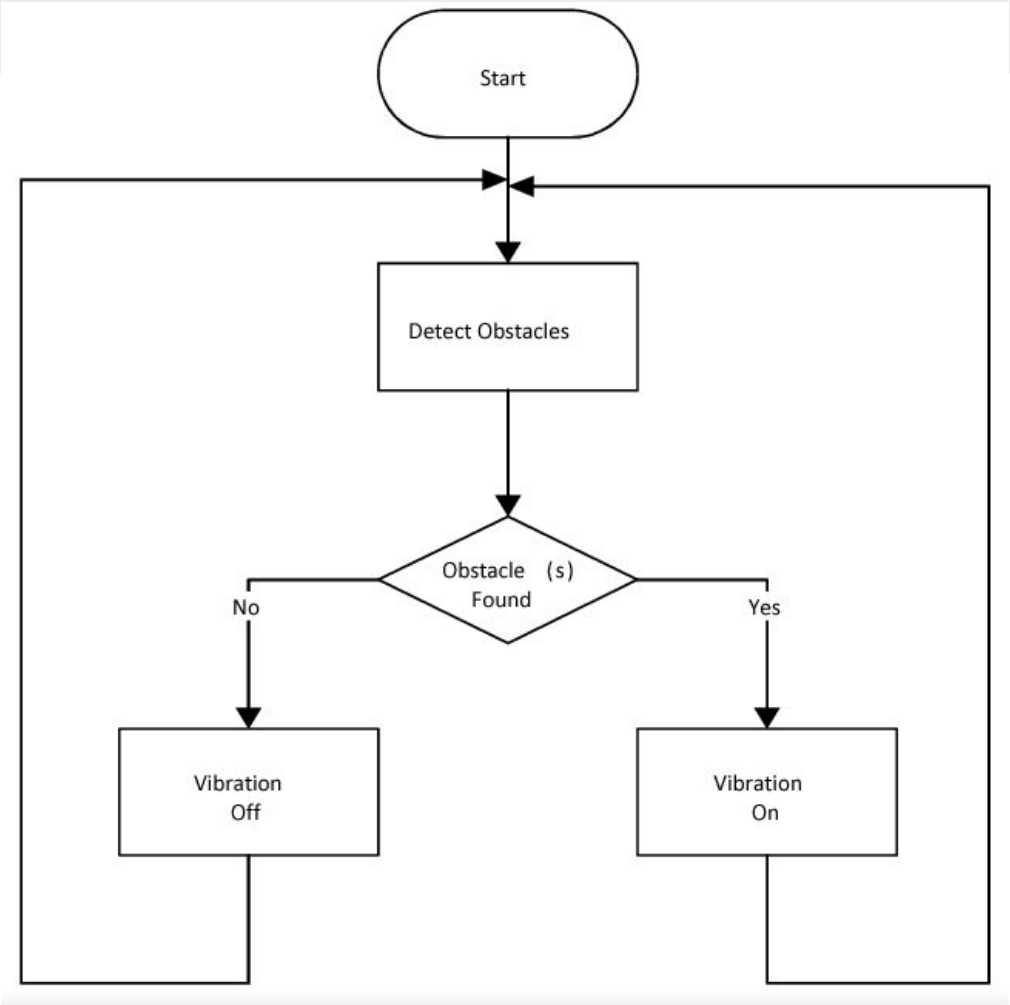
Sensors

Smart Gloves

This pair of gloves will be equipped with ultrasonic, temperature as well as passive infrared sensors which will give a feedback to the user via vibrating motors included in the gloves. This entire IOT will be controlled via a microcontroller(an arduino in our case). The microcontroller will be powered by a battery incorporated in the kit itself in order to process the data provided by the sensors in real time and give simultaneous feedback.

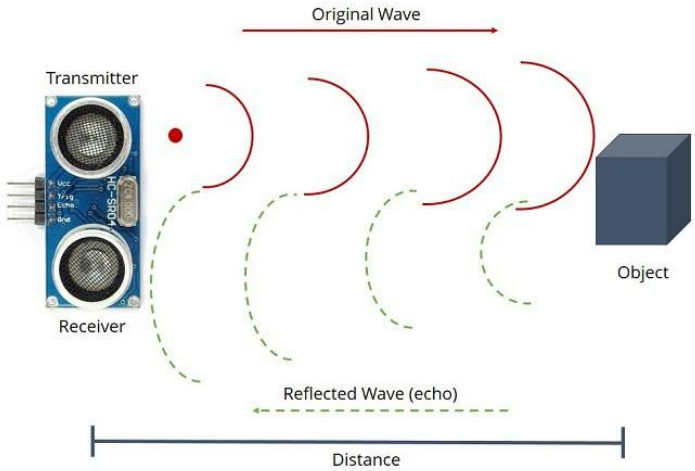
The following slides will be describing the functionalities of each sensor separately.




Start
Detect Obstacles
Obstacle (s) Found
No
Yes
Vibration Off
Vibration On

Ultrasonic Sensor

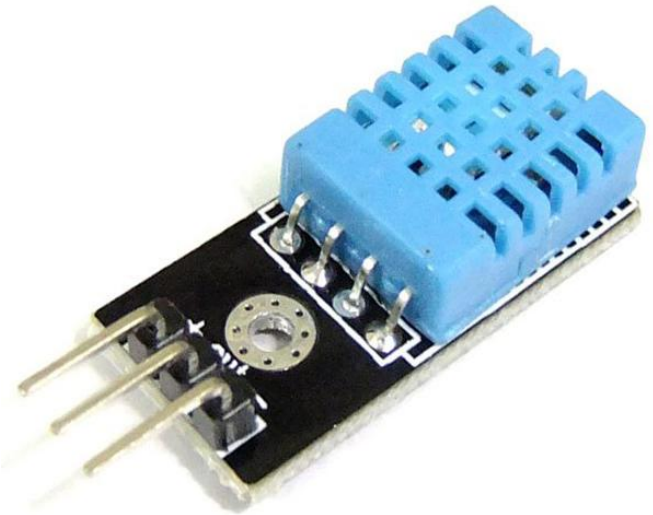
This sensor will give the distance related data, three of these sensors will be placed on the glove pointing forward, left and right. If any object comes too close to the person, the vibrating motor in that direction will provide feedback to alert the user by increasing the intensity of vibrations. By this process i.e. similar to that used by bats to locomote, the impaired person can create a mental image of his/her surroundings .



Heat sensor

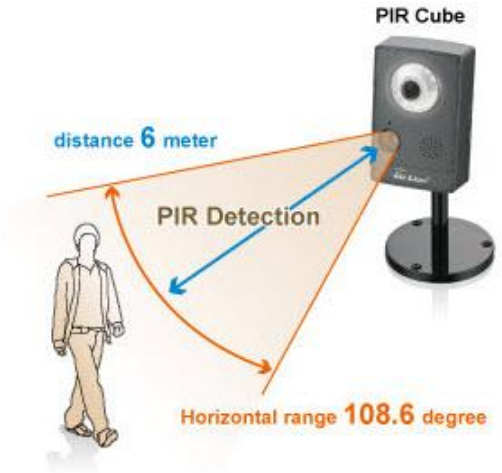
This sensor will be attached to the front side of the gloves and via a similar vibrating feedback at a different location will warn the user if he/she is about to accidentally touch something too hot or too cold.

This can help prevent many uncalled injuries to the impaired.



PIR Sensor (Passive Infrared Sensor)

This type of sensor uses infrared rays emitted from living organisms in the surroundings to detect their proximity to the sensor. This sensor will alert the presence of a person/animal in the surroundings to the user. He/she will be alerted well before the contact and hence can respond accordingly



What we will be doing next ..

1:-As we have built the models for both object detection and activity recognition and we have spent considerable time to improve their accuracy the only part that is left is to deploy our trained models on Jetson Nano so that the computing can be done then and there inside the smart locket .

2:-The whole IOT arrangement of sensors and other equipment is already planned. The only thing left is to arrange the system in a functioning setup.