DES 130 - Introduction to Engineering Design

GESTURE-BASED COMMUNICATION

Hand Gesture Recognition Using Kinect

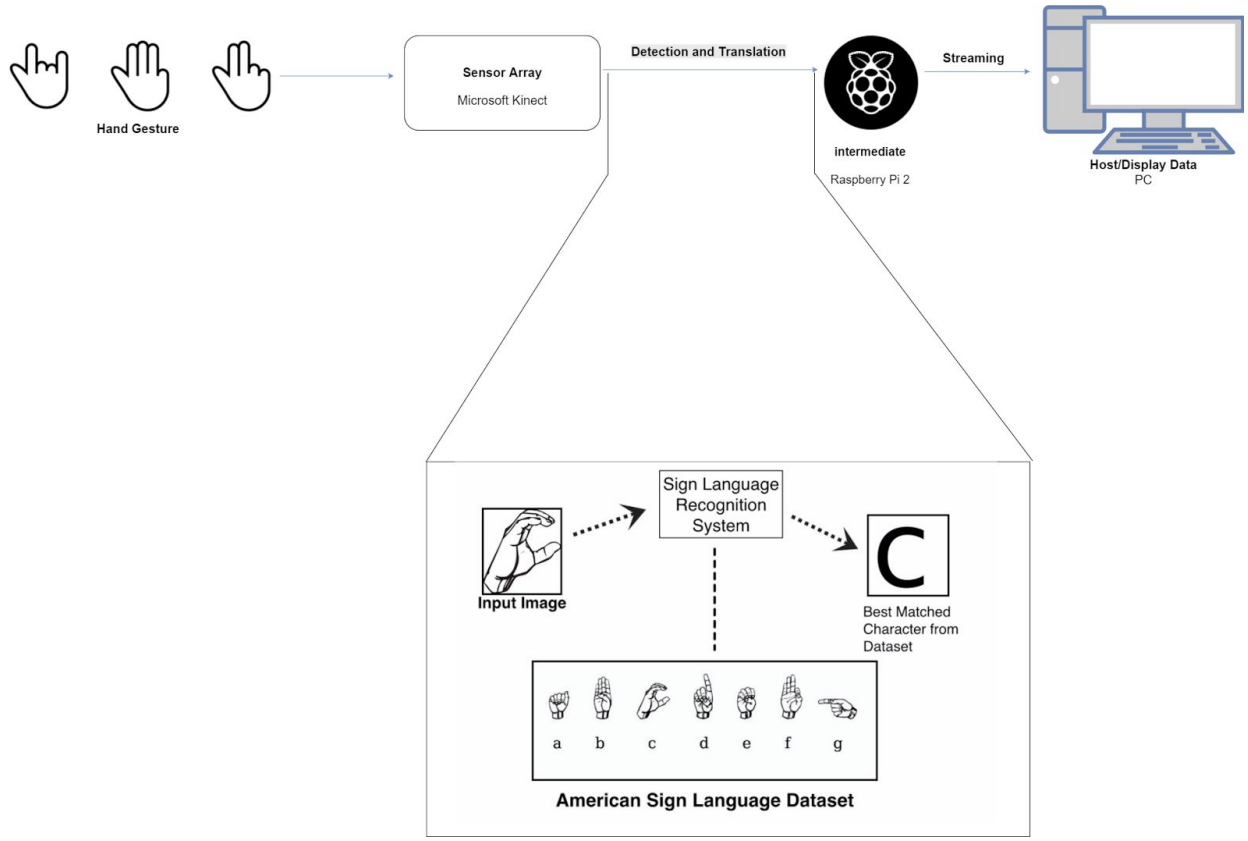
Abstract

Hand Gesture Recognition (HGR), although has been explored for many years, is still a challenging problem for real practice. The complex background and illumination conditions affect the hand tracking and make the HGR recognition very difficult. Fortunately, Kinect is able to provide depth and color data simultaneously, based on which the hand and body action can be tracked more accurate and easier. Therefore, 3D motion trajectory of each sign language vocabulary is aligned and matched between probe and gallery to get the recognized result. This demo will show our primary efforts on sign language recognition and translation with Kinect.

Project Scope

We are planning to make a device to read and identify American Sign Language gestures. We will be using Kinect SDK for interfacing between the kinect sensor and the desktop.The device primarily comprises of Microsoft™ Kinect which will detect the trajectory of the movement of the hands in order to identify the sign. The gestures will be pre-installed as classifiers in the system so as to match with the detected image. Our project focuses on how easily a person can communicate with dumb and deaf people . We believe that our work will expand horizons in communication and increase the accessibility enjoyed by people.

Block and Functional Diagram



Components

- Microsoft™ Kinect Sensor for Xbox 360 (Arranged for)
- Raspberry Pi 2 (to be purchased, ~4000 INR)
- Connecting Wires (to be purchased or borrowed, ~200-300 INR)
- Desktop (Already owned)
- Miscellaneous (if any, ~500)

Approximate cost : ~4800 INR

Initial Approach

The Hand Gesture Recognition System can be divided into three parts according to its processing steps: had detection, finger identification, and gesture recognition. The system has two major advantages. First, it is highly modularised, and each of the three steps is capsuled from others; second, the edge/contour detection of hand as well as gesture recognition is an add-on layer, which can be easily transplanted to other applications.

Depth data will be generated and converted from the raw image data of Kinect by an open-source framework called OpenNI (Natural Interaction)[1].

This system is capable of capturing images even in the dark because Kinect uses an infrared camera for depth image.

To detect the presence of a hand would be using k-means clustering[2] to group the pixels together and Graham Scan Algorithm[3] to detect the convex hull as well as the contour of the hand.

Fingerprints shall be detected by checking the three-point alignment relationship.

Once fingers are identified with their names, we are ready for gesture recognition. Gestures are recognized by passing them through a set of classifiers. The classifiers shall be organised in three layers: finger counting, finger name collecting and vector matching.

References

- [1] OpenNI - http://com.occipital.openni.s3.amazonaws.com/OpenNI_Programmers_Guide.pdf
- [2] K-means Clustering - http://www.onmyphd.com/?p=k-means.clustering&ckattempt=1
- [3] Graham Scan Algorithm for Convex Hull Approach - http://www.personal.kent.edu/~rmuhamma/Compgeometry/MyCG/ConvexHull/GrahamScan/grahamScan.htm
- Sign Language Recognition and Translation with Kinect - http://bit.ly/KinectPaper
- Tracking of Fingertips and Center of Palm using Kinect - http://arxiv.org/pdf/1304.4662.pdf
- Candescent NUI - http://candescentnui.codeplex.com