

Voice recognition system

The recognition system includes the implementation of Hidden Markov Model for speech recognition and Developing a distributable version of the developed software.

The speech recognition is used to run a bot (four wheeled) in our project. In real life the use can be more extensive such as facilitate people with disabled abilities.

However in real life there exists environmental constraints and external disturbances which can influence the working of the system.

Our project is developed in MATLAB. The below part of document contains a description for the algorithms and codes used.

Description for Hidden Markov Model

A HMM implements a stochastic process. The system is considered to be in various states and there are a set of observations with each observation having a different probability of being emitted from a state. And there are state transition probabilities described by matrix A and each a_{ij} represent a probability of transition from i th state to j th state. The variable b_{ik} represents the probability of occurrence of a particular observation from a particular state. Then there exists p_i a column matrix with each element giving the probability of the states being emitted solely.

Description for the MATLAB codes

b_ik

This function returns the probability of a given observation (O in the parameter list) from a given state, given the matrix which contains the distribution functions for observations for each state (this function is represented as B matrix in the parameter list).

epilogue

final

This is the last page of GUI

giveallword

This function breaks a given speech signal (represented as dat) as obtained from the audiorecorder object of MATLAB into the constituent words present in the signal and returns the matrix containing the starting index and ending index for all words in the signal provided.

largerwords

This function sorts the word segregated from the signal (by the function giveallword) into descending order and returns the sorted matrix A (reference to same matrix as in giveallwords).

move

This contains the codes to control the RF bot. This a function which takes input as the string of

‘forward’ ‘back’ ‘right’ and ‘left’ and send proper voltages to the Arduino port for movement of RF bot

prob

This function given the mean and variance of the random variable (here the random variable is a row of random variables) calculates the probabilities of the given observation and returns it if it is greater than an epsilon (a small number) or the epsilon value.

recognition

This is the code for GUI of recognition module. It contains all the call back functions required for that.

train

This is the code for GUI of training module. It contains all the call back functions required for that.

trial

This function given the various system properties including a time and a state at that time, calculates the maximum probability for the observation sequence till that time point and being in the given state . The probabilities are calculated in this using viterbi algorithm . This function is an implementation of the viterbi algorithm.

trial_alpha

This function when supplied all system properties returns alpha matrix for the given model. An alpha matrix has its element at ith row and jth column represented as the probability of the partial observation sequence till ith time point with system in jth state at ith time.

trial_beta

This function when supplied all system properties returns beta matrix for the given model. An beta matrix has its element at ith row and jth column represented as the probability of the partial observation sequence from (i+1)th time point to end with system in jth state at ith time.

trial_eta

This function when supplied all system properties returns eta cell for the given model. An eta cell has its element at t th column as a matrix with element at ith row and jth column as probability of the entire observation sequence with ith state at time t and jth state at time t+1.

trial_feature_analysis

This is a function where the signal obtained when passed through it is converted into observation sequence form. The various process that takes place are – fir filtering , windowing and calculation of cepstral and delta cepstral coefficients . Final output of this function is a set of observations with each observation being a row of 24 elements – 12 being the cepstral and 12 being delta cepstral coefficients.

trial_gamma

This function when supplied all system properties returns gamma matrix for the given model. An gamma matrix has its element at ith row and jth column represented as the probability of the observation with state j at time ith.

trial_playwords

This function keeps finds out a the spoken word and asks the user if it has to be included for training procedure to train the model for the given word.

trial_train

This function implements the training procedure. The spoken signal is converted into observation sequence by feature analysis and then after 5 such observations the model parameters are trained so as to give high probability for that word for which the model was made. The returning variables are pi matrix, A matrix and B matrix which are discussed in model discussion.

trial_viterbi

This function calculates the best probability that could be found for the observation sequence and given a model by viterbi algorithm. Thus this function calculates the probabilities for the observation sequence to be from a given model.

try1

This function extracts a word from signal and returns start and end index.

try2_live_recording

This function keeps on listening and whenever encounters a word signal it finds out the probabilities for various HMM models for various words and declares the highest among them to be the correct word provided it is above a given threshold. Either the arduino or just display part of module is operated by it.

Walk

This function contains the codes for the motion of the biped bot. This sends the servo commands to the Arduino.

warning1

This is a page for producing warning

welcome

This has GUI for welcome page