**Design Report:**

The algorithm that was developed is able to take a DTMF sound with noise and then determine which buttons were pressed after filtering the signal through a Goertzel algorithm. The DFT size for the filter was selected to be N = 205 samples. This is because this value minimizes the error between the original frequencies and the points at which the DFT is estimated. In addition, the window size, based on the appropriate DFT N size, is set to be 0.0026 seconds.

The detection algorithm, after applying the Goertzel DFT to the signal, detects the changes in tones based on the power values from the DFT. The average of the power values for each DTMF frequency is determined across the entire length of the DFT. Afterwards, the standard deviation is calculated along the same dimensions. This allows the threshold values along each DTMF frequency be able to remove extraneous errors or absent DTMF frequencies in the DTF values. The algorithm sets any DTF value below the threshold to zero and values above the average power level to 1. The data would result in only two 1 for each column that has a DTMF tone. This method allows noise to be easily filtered out since the power level for noise is significantly lower than that of the actual tone.

In order to detect when the dialing starts and stops, the conditional statements go through each column and determines which columns have pairs of 2. Whenever the dialing ends, the sum of the columns will always result in a zero. This signals the end of the dial. This process goes through the entire DTF values and records in the indices of each 1. These indices will correspond to specific DTMF frequencies. The corresponding frequencies can then be interpreted into the correct dial numbers. Any anomalies that appear as a result of a where low SNR can be negated by setting the minimum threshold of consecutive 1 to at least 2. The string of the dialed number is properly formatted and outputted. The

Input Dial Tone

Normalize Signal

Goertzel DFT with size N

Remove outliers and missing DFTs

Set Highest Power Values to 1

Determine Length of Each Dial Tone

Save the Indices that equal 1

Determine Corresponding Dial Numbers

Output Dial Number