SIGN LANGUAGE RECOGNITION

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Abstract—**The sign language used by physically challenged, but sign language remains a sixth position in languages. This language when translated into words such that everyone can understand, improves the communication between people and they lead to many other application. The main objective is to develop an electronic device that can translate the sign language into text. The sign language translator we have developed uses a glove fitted sensors that can interrupt the basic words of the differently abled sign language. The glove uses a sliding potentiometer and 3- axis accelerometers to gather information about the finger's position and hand's motion to differentiate the words. This will give an opportunity for physically disabled people to communicate with ordinary people.**

Index Terms—**Sign recognition, Movement recognition, Human Machine Interface, ANFIS.**

I. INTRODUCTION

Communication brings people together. In a society people communicate with the help of a language. But what about the people who don't speak! Sign language is the only way for their communication. The world has been shrunk because of the developments of science and technology in the field of communication.

Sign language is a communication skill that uses gestures instead of sound to convey meaning – simultaneously by the orientation and movement of the hands, arms or body, and facial expressions along with combining hand shapes to express fluidly a speaker's thoughts. Sign languages are commonly developed in deaf communities and often used by their interpreters, friends and family as well as people who have difficulty hearing themselves.

Though Sign Language shares some similarities with the spoken language, it is independent on the spoken languages. Some countries have two or more languages in practice but will have only one sign language. The gesture language of the Americans and the British differ from each other. Thousands of sign languages are there in practice all around the world. Among those sign languages some of them have obtained some legal recognition.

"The greatest obstacle to international understanding is the barrier of language". – Christopher Dawson.

Sign language is a boon to the dumb community. Sign language is a language through which communication is possible with the mute people that is without any acoustic sounds. Sign language relies on the expressions, hand gestures and orientation and also on the movement of the arm.

II. SYSTEM DESIGN AND IMPLEMENTATION

The aim of this project is to develop a sign language recognition module that uses a sensory glove that can interpret 10 basic words of a differently abled person who communicates with sign language. The glove has sliding potentiometer sensors and 3-axis accelerometers to gather data on each finger position and the hand movements and orientation to differentiate the sign. The gesture can then be classified with ANFIS and the phrase can be displayed.

A. Structural Representation

Sliding Potentiometer and accelerometer is mounted on a glove. The same is connected to a USB 6008 DAQ. The accelerometer is used for the movement and orientation detection [1]. The gestures are classified based on the posture, position orientation and movement [2]. Specific hand movements are the only way to differentiate the words thank you, please and fine. Sliding potentiometer is used to find the variation in the hand movements [3]. The DAQ module is connected to the PC with LabVIEW and data acquisition is done. From the acquired data the gesture can be classified based on the movement and orientation.
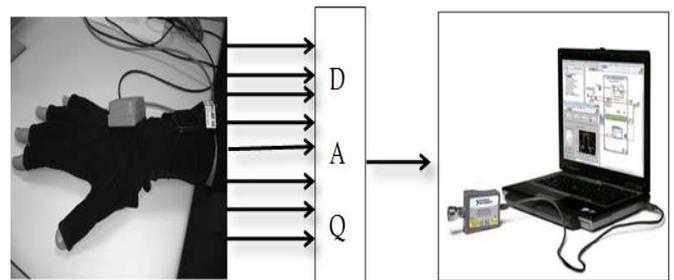

Figure 1: Block Diagram of Sign Language Recognition

B. Sliding Potentiometer and Accelerometer

A potentiometer is a three – terminal resistor with a sliding contact that forms an adjustable voltage divider. If only two terminals are used, one end and the wiper, acts as a variable resistor or rheostat. A potentiometer is essentially a voltage divider unit that is used for measuring electrical potential. Accelerometer is a small, low power device to measure the static acceleration of gravity in the tilt sensing applications. The accelerometer is used for movement and orientation detection. Specific hand motions are the only way to differentiate the words thank you, please and fine. The 3-axis

accelerometer, x, y and z axis accelerometer, has ground, Vcc and three outputs.
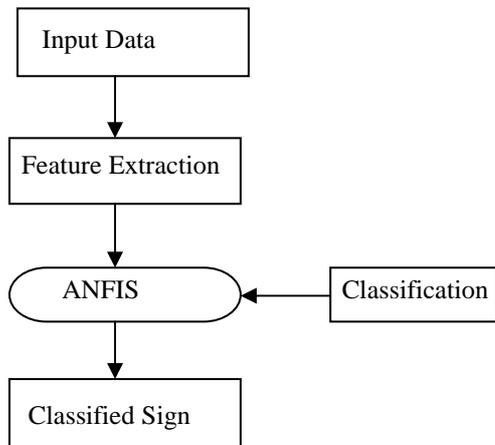
C. System Overview

Figure 2 System Overview

III. TRAINING AND RECOGNITION

The data acquisition module is developed in a PC with LabVIEW. The signals from the sliding potentiometer and the accelerometer are recorded for the 10 signs under observation, and are compared with the signals of various signs.
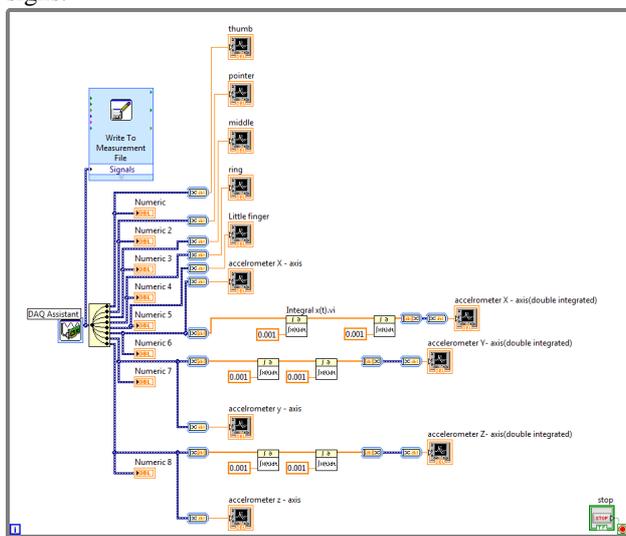

Figure 2 Data Acquisition Module

A. Gesture Identification with Potentiometer

Signs like sleep, no, washroom, thirsty and hungry can be differentiated with the sliding potentiometer readings itself. And other signs like yes, sorry, please, fine and thank you these signs cannot be differentiated with the potentiometer readings hence the accelerometer reading is also necessary to classify this sign.

B. Gesture Identification with Accelerometer

The sign that cannot be differentiated with the sliding potentiometer readings are found by using the accelerometer readings by the maximum and minimum technique. An array

was created for each reading from the accelerometer and from there maximum and minimum was calculated. From the maximum and minimum the threshold was calculated with that the classification was done.
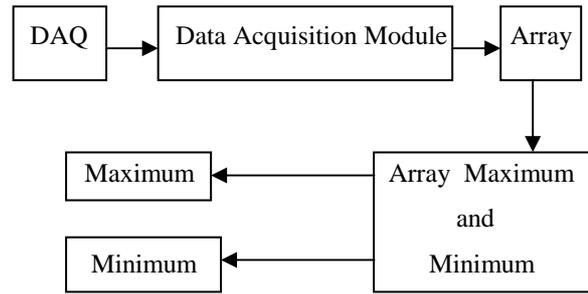

Figure 4 Maximum and Minimum for thresholding

C. Training

The main purpose of learning phase is to create database for the recognition engine. 20 samples of each sign are collected. For this project, only one signer is used for creating signer dependent system. Signer dependent system usually offers higher accuracy compare to signer independent system.

The sequence of data acquired from the gestures has to be trained with ANFIS. Adaptive neuro fuzzy inference system (ANFIS) is a kind of neural network that is based on Takagi–Sugeno fuzzy inference system. ANFIS integrates both fuzzy logic principles and neural networks; hence it has potential to capture the benefits of both in a single framework. It applies a combination of the least-squares method and the back propagation gradient descent method for training FIS membership function parameters, to emulate a given training data set [4]. In other words to start ANFIS learning, first a training data set is required that contains desired input/output data pairs of the target system to be modeled. Its inference system corresponds to a set of fuzzy IF–THEN rules that have learning capability to nonlinear functions. IF –THEN rules will make use of either 'and' or 'or' operator [5]. The input data will be given a membership values and a shape. Here Gaussian Membership is used and the data will be partitioned with respect to the membership values given and the rule base will be created. The membership values of the output layer comprise the output.
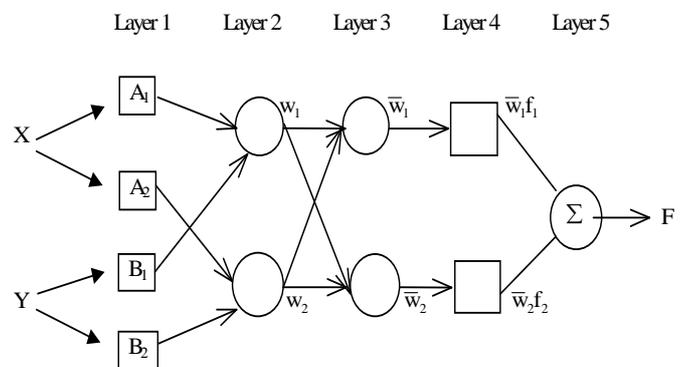

Figure 4 ANFIS structure

The layer 1 of the ANFIS structure is the Fuzzification layer. The parameters used in this stage is called premise

parameters and rearranged according to output error in every loop. Layer 2 is the fixed layer. In the 3rd layer, all firing strengths are re-arranged again by their own weights and this layer is referred as normalization layer. The next layer is the defuzzification layer. This layer has adaptive nodes and it is expressed as functions. The fifth and the last layer is the summation neuron, that has s a fixed node, which computes the overall output as the summation of all incoming signals

D. Real time evaluation

The real time recognition takes place when the user wearing data glove performs a certain sign and it is able the get the output text immediately.

When the user performs a sign language, it will only go through the same process of training phase without creating the database. After the model evaluation, the system will get the model score as the output of evaluation. Once the score is matched then the result of that particular sign will appear as output in text form.

Figure 5 Gesture Recognized as Thank you

IV. CONCLUSION

Sign Language is a useful tool to ease the communication between the deaf, mute community and even the normal people who understand the language. Yet there is a communication barrier between these communities with the normal people as most of them do not learn or know the language. Therefore there is a need to develop an electronic device that can translate the sign language in a way that everyone can understand in order to make the communication take place. With this project, the deaf or mute people can use the gloves to perform sign language and the gestures will be converted into text so that normal people can understand their expression.

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