SIGN LANGUAGE

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Abstract- **Usually a human interaction focuses on the sound world, where the communication is based on the speech and in which most information is conveyed via voice and other sounds. However, there are people who live in the world of silence. For them nothing can be heard, as they are hearing impaired. For all of them a voice communication is impossible or troublesome. Hence they have invented a sign language. The sign language consists of a grammar and a vocabulary. Usually the grammar is significantly different to the spoken and written languages. Whereas the vocabulary is composed of many hand gestures and hand movements which convey the most important information, but which are supported by the whole body movement and facial expressions. Considering the differences in the way the hearing impaired observe the world, they encounter huge difficulties while learning and using the writing language, which is so common in daily communication. Since this sign language cannot be understand by others, we are in need of systems which can understand sign language. The existing systems handle that task not appropriate and accurate. We introduce the concept of a chat for the sign language based communication, which overcomes the deficiencies of the existing approaches. In the current system there is an action sensor available, this sensor has pressure switches when any pressure is given then the pressure switch will be closed and the signal is given to microcontroller. The microcontroller senses the signal coming from the pressure switch and it understands the switch position and it sends the command signal to the computer through RS232 cable. The RS232 cable is used to convert microcontroller understandable signal to computer understandable signal. As soon as the computer gets the signal the program written in the computer will detect the particular word and it will be played at the same instant. That's how the sign language is converted in to voice language**.

I. INTRODUCTION

Sign language is the primary communication way for hearing-impaired people. As a form of non-verbal communication, sign language uses multiple visual means simultaneously to transmit meanings and emotions: hand/finger shapes, movement of the hands, arms, and body, facial expression, and lip-patterns. Sign languages are not international and not completely based

on the spoken language in the country of origin, but they vary culture-, local-, and person-specific. All these cause the difficulty in communication between hearing-impaired and hearing people and even between hearing-impaired people from different regions. Hence, the development of a reliable system for translation of sign language into spoken language is very important for hearing-impaired people as well as hearing people.

According to the research of Omer Zak[1] around one percent of people living in European Union in 1994 suffered from this disease, excluding people suffering hard hearing problems. For all of them a voice communication is impossible or troublesome. Hence they have invented a sign language[2]

The development of a sign language translation system is, however, not a trivial task[3]. A basic requirement for the system is to accurately capture the gestures that denote signs. Moreover, in addition to signing gestures, a signer also uses non-manual features simultaneously, such as facial expression, tongue/mouth, and body posture, to express affective states that are limited in sign gestures. Therefore, in order to completely understand meanings of actually signing gestures, we need to handle multimodal sensory information by fusing the information from the different channels. Since sign language is country-specific and word order of most sign languages is not the same as the spoken language in the country, there is no unique formal way to generalize the grammar of sign languages. American Sign Language (ASL), for example, has its own grammar and rules and it is not a visual form of English.

In general, fusion of multi sensory data can be performed at least at three levels: data, feature, and decision level. When observations are of the same type, data-level fusion where we simply combine raw multi sensory data might be probably the most appropriate choice. Decision-level fusion is the approach applied most often for multimodal sensory data containing time scale differences between modalities. Feature-level fusion is eligible for combining multi channel sensors that measure different types of signals within a single modality, such as gesture.

A) Overview of Sign Language:

A sign language (also signed language) is a language which, instead of acoustically conveyed sound patterns, uses visually transmitted sign patterns (manual communication, body language and lip patterns) to convey meaning simultaneously combining hand shapes, orientation and movement of the hands, arms or body, and facial expressions to express fluidly a speaker's thoughts[4].

Sign languages commonly develop in deaf communities, which can include interpreters and friends and families of deaf people as well as people who are deaf or hard of hearing themselves.

Wherever communities of deaf people exist, sign languages develop. In fact, their complex spatial grammars are markedly different from the grammars of spoken languages. Hundreds of sign languages are in use around the world and are at the cores of local Deaf cultures. Some sign languages have obtained some form of legal recognition, while others have no status at all.

A gesture in a sign language, is a particular movement of the hands with a specific shape made out of them. Facial expressions also count toward the gesture, at the same time. A posture on the other hand, is a static shape of the hand to indicate a

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sign. A sign language usually provides signs for whole words. It also provides signs of letters to perform words that don't have a corresponding sign in that sign language. So, although sentences can be made using the signs for letters, performing with signs of words is faster. The sign language chosen for this project is the American Sign Language.

American Sign Language (ASL) is the most well documented and most widely used language in the world. It is a complex visual-spatial language that is used by the Deaf community in the United States and English-speaking parts of Canada. It is a linguistically complete, natural language. It is the native language of many Deaf men and women, as well as some hearing children born into Deaf families. ASL shares no grammatical similarities to English and should not be considered in any way to be a broken, mimed, or gestural form of English.

In most drawings or illustrations of the American Manual Alphabet, some of the letters are depicted from the side to better illustrate the desired hand shape; however in practice, the hand should not be turned to the side when producing the letter.

The letters *C* and *O* are two that are often mistakenly turned to the side by beginners who become used to seeing them from the side in illustrations. Important exceptions to the rule that the palm should always be facing the viewer are the letters *G* and *H*. These two letters should be made, not with the palm facing the viewer or the speaker, but with the palm facing sideways - the hand in an ergonomically neutral position.

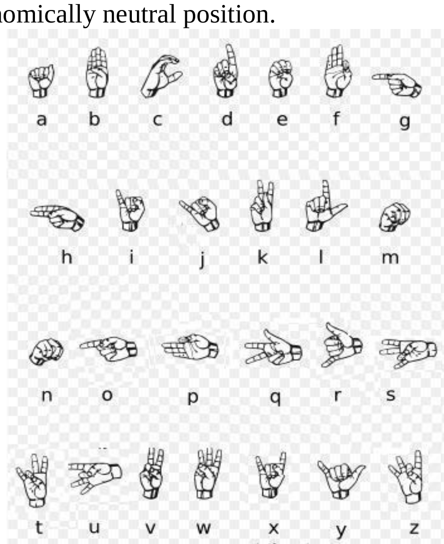

Figure 1. Sign symbols

B) Existing work:

Much of research on sign language recognition has been done by employing cameras or sensing gloves. Particularly, most work on continuous sign language recognition is based on hidden Markov models (HMMs). Using HMMs and variations of them works on automatic recognition of various national sign languages are reported, such as English, Chinese, German, Taiwanese, Greek, etc. For computer vision approach, most of previous works used colored gloves to track hand movements of signers.

Starner and colleagues developed a real-time ASL recognition system using colored gloves to track and identify left and right hands. They extracted global features that represent positions, angle of axis of least inertia, and eccentricity of the bounding ellipse of two hands. Using HMMs with a known grammar, they achieved an accuracy of 99.2% at the word level for 99 test sequences. Vogler and Metaxas used computer vision methods to extract the three-dimensional parameters of a signer's arm motions. They coupled the computer vision methods and HMMs to recognize continuous ASL sentences with a vocabulary of 53 signs. An accuracy of 89.9% was achieved. More recently, a wearable system has been developed by Brashear and colleagues. They used a camera vision system along with wireless accelerometers mounted in a bracelet or watch to measure hand rotation and movement.

Data gloves have also often been used for sign language recognition research[9]. Data gloves, such as Accel- Golves and VPL Data Glove[10], are usually equipped with bending sensors and accelerometers that measure rotation and movement of hand and finger flex angles. In the work by Gao and colleagues[11], using data glove and HMMs as classifier, a very impressive vocabulary with a size of 5177 isolated signs in Chinese Sign Language (CSL) could be recognized with 94.8% accuracy. To achieve real time recognition, they used speech recognition methods, such as clustering Gaussian probabilities and fast matching, and recognized 200 sentences with 91.4% word accuracy.

To differentiate nine words in ASL, Kosmidou et al. evaluated statistical and wavelet features based on the criterion of Mahalanobis distance. Two-channel EMG sensors are positioned at arm muscles (Flexor Carpi Radialis and Flexor Carpi Radialis Brevis) of the signer's right hand. By using discriminant analysis for classification they achieved a recognition accuracy of 97.7%. Recently, Chen et al.Reported that the combination of EMG sensors and accelerometers achieved 5-10% improvement in the recognition accuracies for various wrist and finger gestures. They used two 2-axis accelerometers and two surface EMG sensors that are attached at the single arm.

II. Proposed system design:

A) Block Diagram:

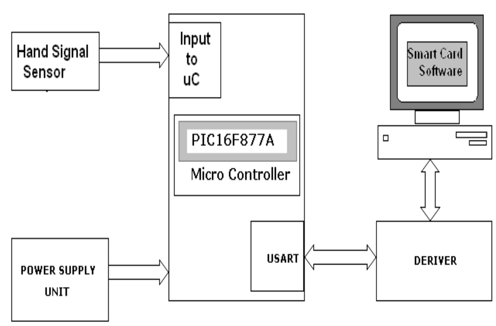

Figure 2.1 Block Diagram

1) Block Diagram Description:

The gloves consist of sensor fixed in each finger and in different parts of the hand. According to the sign symbol they make the binary data of the sensor varies. By the changes in the binary data, output to the microcontroller also varies. For each and every action all the sensor reading are analyzed. According to the analyzed data particular speech is activated. The output from the sensor is given to the controller and from the controller the speech is activated.

The Signal sensing unit is important to this project. In this unit micro DPDT Key is used to sense the hand analyzer sensor. While varying the finger moment the binary input to the microcontroller varies according to the sign language. Using the input to the microcontroller refers the data table of sign language loaded on the microcontroller that will be fetched and transmitted to the system.

The system will generate the speech according to the serial data from the microcontroller PIC16F877A. We are using PIC16F877A microcontroller to sense and interface with the system. The output of microcontroller is send to the system through USART communication. USART stands for Universal Synchronous Receiver Transmitter. In asynchronous operation, one pin can be used for transmission and another pin can be used for reception. Both transmission and reception can occur at the same time — this is known as full duplex operation. Transmission and reception can be independently enabled. However, when the serial port is enabled, the USART will control both pins and one cannot be used for general purpose I/O when the other is being used for transmission or reception. The USART is most commonly used in the asynchronous mode

2) Hand signal sensor:

Previously, sensor gloves have been used in games for creating virtual 3D environments. Players can give input to the game using the gloves. Gloves, along with other sensor devices, have also been used in making games. Actions of the experts wearing the sensors are captured and translated into the game to give a realistic look to the game. Sensor gloves have also been used in giving commands to robots. Streams of shapes of the hand are defined and then recognized to control a robotic hand or vehicle.

Sensor gloves are normally gloves made out of cloth with sensors fitted on it[4]. Using data glove is a better idea over camera as the user has flexibility of moving around freely within a radius limited by the length of wire connecting the glove to the computer, unlike the camera where the user has to stay in position before the camera. This limit can be further lowered by using a wireless camera. The effect of light, electric or magnetic fields or any other disturbance does not effect the performance of the glove.

We have used 7-sensor glove of 5DT Company. It has 7 sensors on it. 5 sensors are for each finger and thumb. One sensor is to measure the tilt of the hand and one sensor for the rotation of the hand. Optic fibers are mounted on the glove to measure the flexure of fingers and thumb. According to the sign symbol they make the binary data of the sensor varies. By the changes in the binary data, output to the microcontroller also varies. For each and every action all the sensor reading are analyzed. According to the analyzed data particular speech is activated. The output from the sensor is given to the controller and from the controller the speech is activated.

3) Software's used:

The project uses two different softwares. Visual Basic and assembly language.

a) Micro controller coding

Micro controller coding is written in assembly language. Using MPLAB the assembly coding is builded in the chip.

b) Visual Basic coding

Visual basic is used for front end application. The front end window shows the results [1].

III. Circuit Diagram and Description:

A) POWER SUPPLY:

The regulated +5V supply for the Microcontroller is derived using regulator IC 7805 (IC1). Bridge rectifier protects the circuit from reverse supply connections. Capacitor (1000µF) filters out the ripples present in the incoming DC voltage[2].

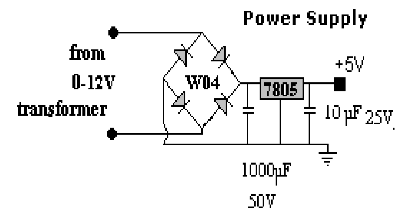

Figure 3.1 Power supply circuit

B) OSCILLATOR:

The internal oscillator circuitry of the Microcontroller generates the devices clock. The Microcontroller can be configured to work in one of the four oscillator modes:

- External resistor – capacitors
- Low - power crystal (oscillator frequency up to 200 KHz)
- Crystal / resonant (oscillator frequency up to 4MHz)
- High – speed crystal / resonant (oscillator frequency up to 10 MHz)

In this circuit, the oscillator is configured to operate in the crystal mode with a 4 MHz crystal along with two 27pF capacitors. Oscillator 4MHz is connected to 13^{th} and 14^{th} pin of the PIC16F877A Microcontroller. Two 27pF capacitors are connected to remove external fluctuations [2].

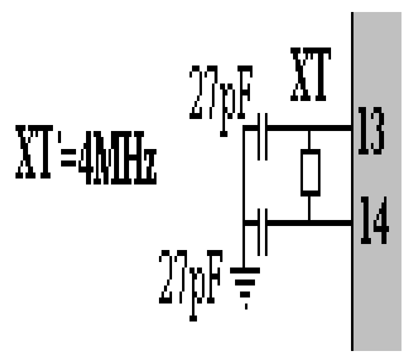

Figure 3.2 Oscillator

c) Micro Controller Power Supply:

The 5V DC regulated power supply is connected to the 11^{th} and 13^{th} pins of the PIC16F877A. The 12^{th} and 31^{st} are grounded.

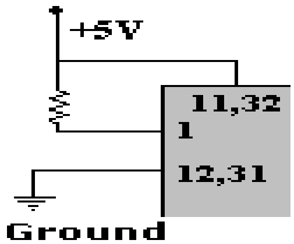

Figure 3.3 Micro Controller Power Supply

d) Serial Port Communication:

The Token Number is entered through the keypad then enter the token number it will send the token number through this serial port driver Max232 by the microcontroller pin 25 & 26.

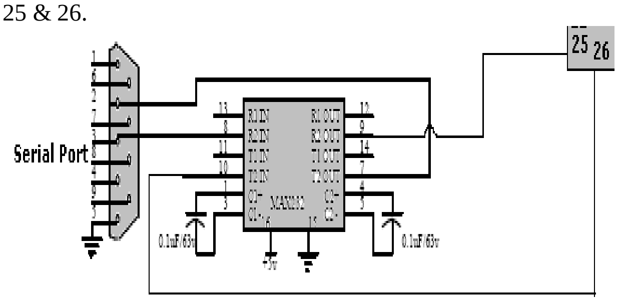

Figure 3.4 Serial Port Communication

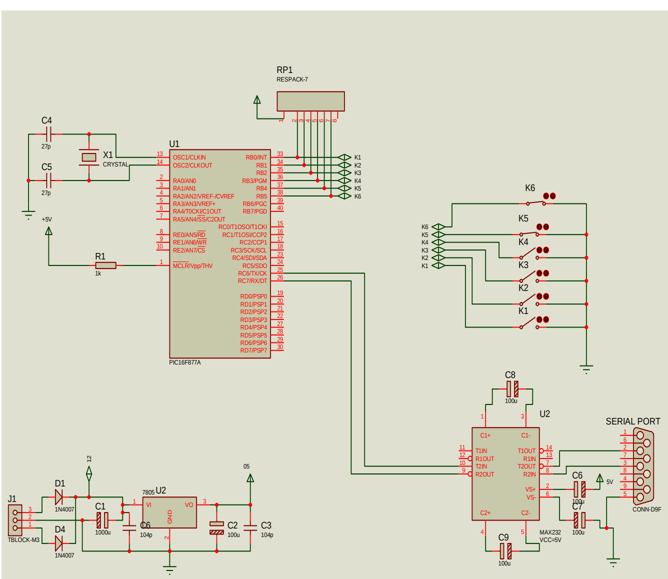

Figure 3.5 Hardware architecture

The 5V DC regulated power supply is given to the 11th and 32nd pins of the PIC16F877A microcontroller. The 12th, 31st are grounded. The 4MHz crystal oscillator is connected in 13th and 14th pins of the PIC16F877A, which is used to generate clock pulse to the microcontroller.

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