

Development of an Assistive Aid for Speech Impaired

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Abstract- Speech impairment refers to the inability to produce normal speech. Dysarthria is a kind of speech disorder where there is a difficulty in producing the normal speech. The proposed system makes use of an acoustic plate that senses the vocal cord vibrations. When a set of unpatterned words are spoken by the user, the words are compared with the preprogrammed words in the speech IC where it is analysed and corresponding audio output is heard through the speaker. This system can be implemented in realtime to express the basic needs of speech impaired.

Index Terms- Vocals, Acoustic plate, Speech impaired.

I. INTRODUCTION

Speech impairment is a communication problem in which the normal speech is disrupted due to articulation problems. Difficulties in pronouncing the sounds and sluttering are some examples of speech impairment. Speech difficulties can also be associated with cerebral palsy, hearing impairment and brain injury. People with speech disabilities have difficulty in understanding and expressing their ideas.

Speech disorders affect the content of speech and the function of language in communication. The disorders associated with speech are articulation deficiency, speech disturbances, dysfluency, aphasia, dysphonia and dysarthria. People with the nerve or brain disorder have the inability to control the larynx and the vocal cords, which causes a condition known as dysarthria. Dysarthria is a common speech disorder which is found among the verbally challenged people. People with dysarthria have weak and impaired speech muscles, resulting in the improper pronunciation.

People with complex communication needs often struggle with verbal language and require an Alternative and Augmentative communication (AAC) strategy. These aids can be used for the people with communication defects. These aids are categorized in two types namely, low tech and high tech communication aids. Low tech communication aids are non-electronic form of communication by means of books, words and letters. High tech communication aids are in the form of electronic communication which permits the storage and retrieval of electronic messages.

Recognition systems can be broken down into two main types. Pattern Recognition systems that compare patterns to known/trained patterns to determine a match and Acoustic Phonetic systems use knowledge of the human body (speech production, and hearing) to compare speech features (phonetics such as vowel sounds).

II. RELATED WORK

To facilitate an easy communication for a verbally challenged people an electronic speaking glove is designed in which the gestures from the gloves are converted into a synthesized speech to convey an audible message to others. The glove is internally equipped with multiple flex sensors that are made up of bend-sensitive resistance elements [1].

A system consisting of AG-500 articulograph sensor which is placed on the lips of the user was developed [2]. The sensor calculates the distance between the various reference points assigned to the mouth. The distance is mapped with equivalent SAMPA code which is fed as an input to the voice generating software and output is obtained in audio form.

A vocal cord vibration switch [3] was developed which uses accelerometer sensors to detect the vibrations from the vocal cord. The vocal cord vibration due to speech are considered as high periodic signals and the vibrations produced due to coughs and swallows are considered as low periodic signals. These low periodic signals are filtered and the high periodic signals are allowed to activate the switch which can be connected to computers, or communication devices for further processing.

The digital speech aid [4], which is an electronic device developed for elimination or reduction of stuttering, which uses digital signal processing circuitry, to elicit the desired response characteristics of the feedback signal.

The speech impaired people have difficulty in using the communication systems and devices described in the literature which are not portable and more susceptible to noise. Thus we have proposed a portable and convenient embedded controlled assistive device for speech impaired people.

III. PROPOSED SYSTEM

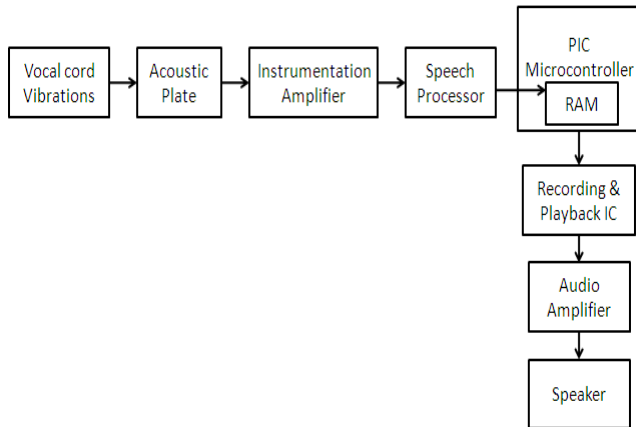


Fig.1. Block diagram of the proposed system

The proposed system is a user dependent system in which the speech IC is trained by the individual who will be using the system. It employs an acoustic plate to sense the vocal vibration. These vibrations are amplified and processed by the speech IC. The speech IC is trained with certain words. When the trained words are spoken by the user, the vibrations produced are recognized and compared by the speech IC. The output of the HM2007 is given as input to the PIC controller. The PIC controller is interfaced with recording and playback IC. The recording and playback IC is capable of recording up to 8 messages. The PIC controller is programmed in such a way it directs the output of the speech IC to the corresponding pins of the playback IC and audio output is produced by means of speaker.

Operation of HM2007

To use the HM2007, the user must train their voice prints on the chip. For each word that is to be recognized, the microcontroller asks the user to speak that word. Because the user may say the word differently. For each time the user says the word, the HM2007 integrates this word into a neural network (this network is stored in the off-chip SRAM). Later, in recognition mode, the HM2007 tries to match the spoken word against other words in its neural network. If a match is made, the index of that word in the vocabulary is returned.

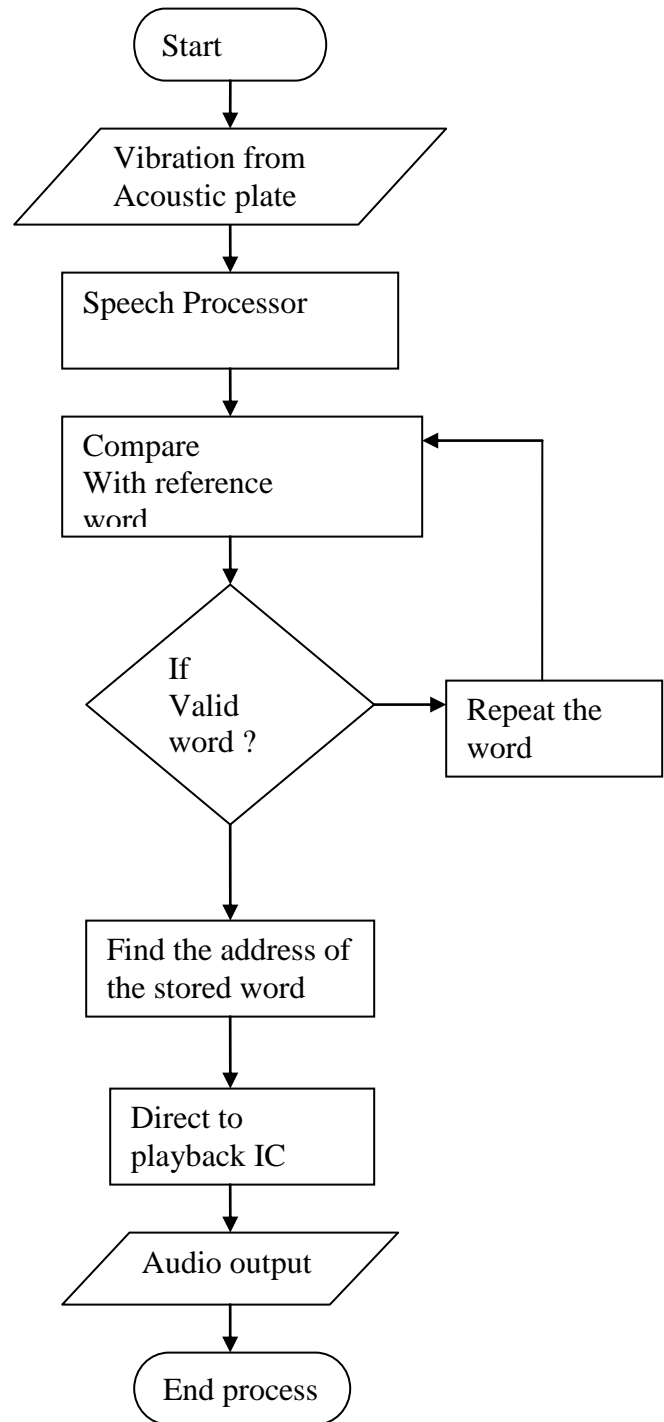


Fig.2. Flowchart for the proposed system

A. Hardware identification:

1. Acoustic plate:

An acoustic plate is a basic electronic sound component with its simple structure. It produces the stable performances and high

reliability. This consists of the ceramic plate with electrodes on both the sides of 20mm diameter and the metal plate of 30mm diameter. The diaphragm is designed to expand and bend in fixed direction. When the diaphragm shrinks, voltage is applied across the electrodes; sound waves are produced in air.

2. Instrumentation amplifier:

The differential input single-ended output instrumentation amplifier is one of the most versatile signal processing amplifiers available. It is used for precision amplification of differential dc or ac signals while rejecting large values of common mode noise. By using integrated circuits, a high level of performance is obtained at minimum cost. The instrumentation amplifier AD0620 is used in this project for amplifying the signals.

3. Speech IC:

HM2007 provides the options of recognizing either forty words of 0.92 seconds or twenty words of 1.92 seconds. It operates in two modes manual mode and CPU mode. Manual mode is chosen because it doesn't require a host computer and can be integrated into other devices to utilize speech control. HM2007 involves two main process, training and recognition. The training process involves the storage of the targeted words in HM2007 and the recognition process for the comparison and matching of the trained words.

4. Microcontroller:

A microcontroller is used to execute a single task within one application. The peripheral interface controller (PIC) 16F877A is used in this project. The PIC16F877A features 256 bytes of EEPROM data memory, self programming, an ICD, 2 Comparators, 8 channels of 10-bit Analog-to-Digital (A/D) converter, 2 capture/compare/PWM functions, the synchronous serial port can be configured as either 3-wire Serial Peripheral Interface or the 2-wire Inter-Integrated Circuit (I²C) bus and a Universal Asynchronous Receiver Transmitter (USART).

5. Playback and recording IC:

The obtained output from the microcontroller is recorded by using the APR 9600 integrated circuit. The device supports both random and sequential access of multiple messages. Sample rates are user-selectable, allowing designers to customize their design for unique quality and storage time needs. The APR9600 device offers true single-chip voice recording, non-volatile storage, and playback capability for 40 to 60 seconds. It can provide recording and playback of maximum 8 messages.

5. Speaker:

For the audio output in this proposed system is 50mm audio speaker with 8 ohms is used.

IV. RESULT

The assistive aid that was developed resulted in providing an user friendly approach to the speech impaired people. The user dependent system provided 90 percent accuracy

V. CONCLUSION

This system helps the speech impaired people and for the bed-ridden deaf and dumb people to express their need and announce their requirements.

VI. FUTURE ADVANCEMENTS

This project can be extended using high efficient voice circuit which comes with the option of recording more messages. Further advancement include making the device wireless and using high efficient sensors for sensing the vocal vibrations.

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