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An improved Artificial Electrolarynx

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Abstract-The people who have undergone a laryngectomy lose their speech and they are presented to many substantial challenges. A number of devices have been developed to assist these patients, ranging from the electrolarynx to the unidirectional valve used in tracheoesophageal speech. Although all of these devices have focussed on producing the sound from the patient's vocal tract, they were found to be less effective .This is because the speech produced by them accompanies with a noise which is probably more than the speech. This leads to the inefficient regain of the lost speech for laryngectomy patients. Hence, a new device to provide powerful and satisfactory communication to a speech lost-person has been presented.

Keywords- Artificial vocal cord, Laryngectomy, Tracheoesophageal speech, Electrolarynx

1. INTRODUCTION

The ability to communicate vocally is considered as an important skill for a human to make them feel complete. However, some people lose their ability to talk due to a laryngectomy. A laryngectomy is a surgery in which the larynx (generally known as voice box) is removed from a patient due to laryngeal, esophageal or pharyngeal cancer. This basic problem of a commoner who have undergone a laryngectomy, has been considered in our research. This to be applicable not only for a laryngectomy patient but also for a person who have lost their ability to speak due to various other reasons. A number of alternatives are available to the patient to give them a means to communicate, however these devices are produce speech with noise. So, we have proposed a solution to overcome the disadvantages of the already existing devices. The main purpose of our innovation is to contribute to the affected peoples' voice restoration, rehabilitation in a more efficient manner after losing their speaking ability.

2. REVIEW OF RELATED WORKS

It has been found in the literature that there are various solutions introduced to provide speech to the speech-lost people to attain rehabilitation. Each device with their own disadvantages makes it difficult for the users to use them. The various existing solutions and their drawbacks are discussed below.

2.1. Artificial Electrolarynx:

The main drawback of this equipment is the assembly of the magnet over a cup-shaped pole piece present in it. When the device is dropped the magnet may become dislodged and off-center from the cup-shaped pole piece. Hence, if dropped, the performance of the speech aid device will be destroyed and complete failure of the device is possible. Also, its weight is more due to the presence of the magnet and makes it difficult for the users to handle and hold it for a longer time. It also includes high amount of noise along with the speech [1-6, 13]. The pictorial view of Electro larynx and its usage are depicted in Figure 1 and Figure 2 respectively.

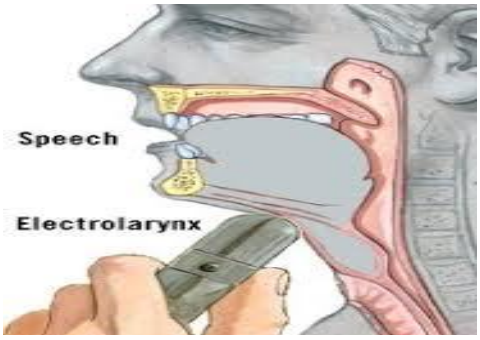


Figure 1: ElectrolarynxFigure 2: Usage of Electrolarynx
Source: www.MaxiAids.com**Source:**Anna Katharina Fuchs

2.2.Passy-Muir valve (Tracheotomy):

Tracheotomy is a surgical opening into the trachea in which a plastic or metal tracheotomy tube is placed. This Passy-Muir valve is considered as a tracheotomy speech enabling device. This device becomes difficult to be used by the people with breathing problems and non-ventilator dependent persons [14]. The pictorial representation of Passy-Muir valve and its usage are depicted in Figure 3 and Figure 4 respectively.

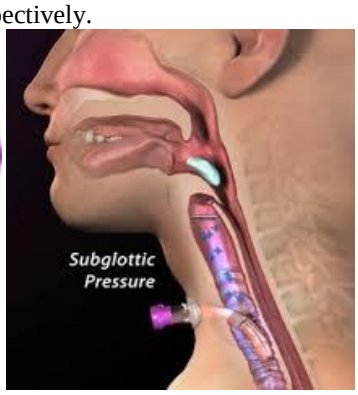
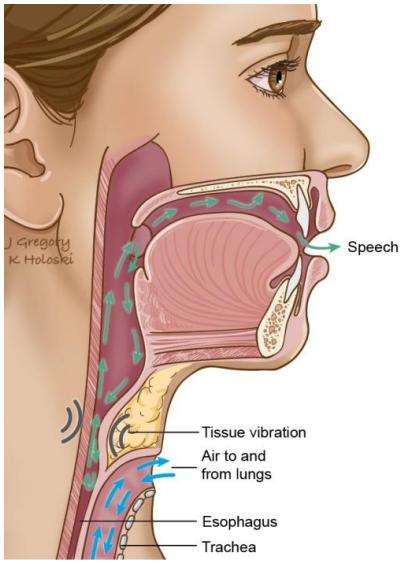


Figure 3: Passy-Muir valve
Source: www.passy-muir.com

Figure 4: Usage of Passy-Muir valve
Source: www.passy-muir.com

2.3.Esophageal Speech

Esophageal speech is a very common way people learn to speak after laryngectomy. However, it requires intense speech therapy and might take a long time to learn how to do it successfully. Speech is produced by taking air into the esophagus and letting it out so the top of your esophagus vibrates and produces sound. The sound is the manipulated as usual by your mouth, tongue and lips to create speech; however, the sound will be of a lower pitch. It's kind of like a belch, but different—the air isn't coming from the stomach. Air is inhaled right below that vibrating segment, and then it comes out. However, it is familiar only by certain pathologists and it is difficult to adopt.The other limitation also depends on whether this is the best speaking option, as it depends on the patient's post-operative healing and outcome. The other drawbacks include Time and financial commitment to learn, Pitch, loudness and intelligibility problems.



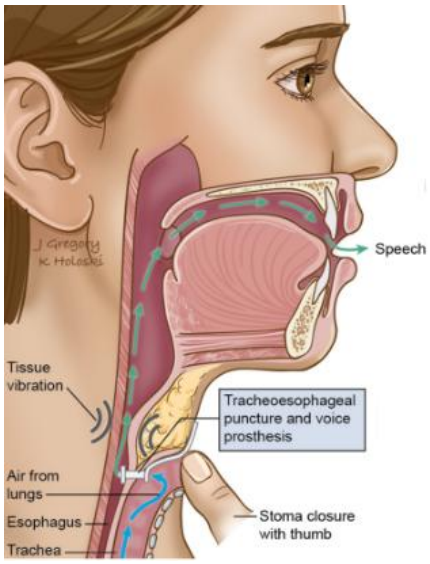


Figure 6:Speech through Esophageal Prosthesis

Source:www.headandneckcancerguide.org

Figure 7:Tracheoesophageal voice

Source: www.headandneckcancerguide.org

An important note in other devices is that those devices need proper and good handling of the device and once the usage of such device goes wrong they cannot be re-assembled and hence, it turns out to provide huge loss for the customers [12].

3. PROPOSED ARTIFICAL ELECTROLARYNX

In order to overcome the various disadvantages in different speech aiding devices, this is a new proposed concept which provides best solution and comfort for the affected people. This new innovation is designed in the form of a neckband which supports the comfort ability of the users.

3.1.Initiation of the design:

A method of solving this problem have been undertaken in which an EMG signal is picked up and an Instrumentation amplifier is used to obtain an amplified version of the input signal. Then the amplified signal is assumed to be passed through an Analog To Digital Converter (ADC) and it is converted into a digital signal and further it is processed by a DSP Processor for noise removal. Then the processed signal is sent to the Bluetooth Low Energy (BLE) and then it is received in the laptop which is Bluetooth enabled. Finally the features are extracted from the processed signal and it is mapped onto the corresponding word by using an artificial neural network (also, feature extraction can be used). During all the processes vibrations are used. Since this design includes the concept of feature extractionand mapping the uttered word with the sound it is becomes little difficult for the users to handle and also this affects the performance and quality of the product. After designing it in this way, we have found out another model which is realized to offer increased efficiency, less cost as less number of components are used with increased performance [7-11].

3.2. Proposed solution:

In this new proposed design, only less number of components are used which are easily and readily available and does not require individual design for each and every component to be used in the product.The block diagram of the proposed system is shown in figure 8.

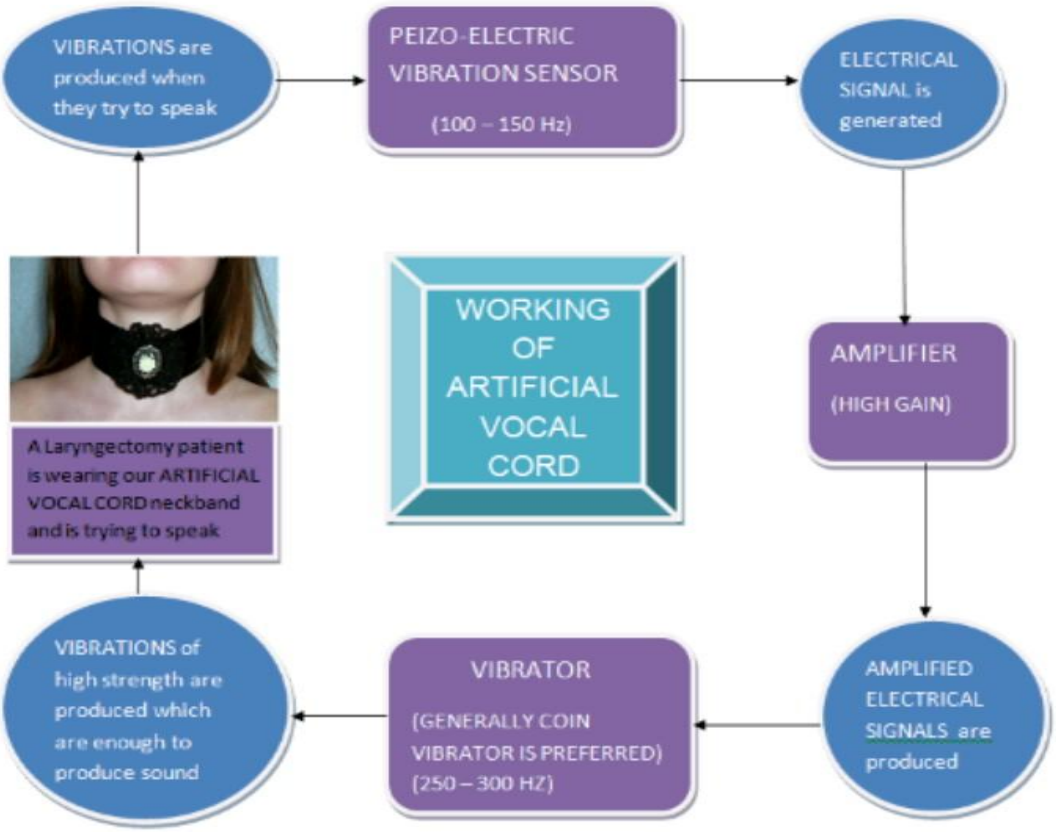


Figure 8:Block diagram of the proposed system

The various segments that are made use of in this proposal are a piezoelectric-vibration sensor, an amplifier and a coin vibrator (LRA). While using this product, when the user tries to speak, he/she produces vibrations due the movement of the tissues which are sensed by the peizo-electric vibration sensor and a certain voltage will be generated by the voltage comparator present inside of it and it guarantees an excellent measuring performance that are converted to electrical signals. These signals are passed to the amplifier where the low-power signals are strengthened and the noise is reduced. The amplified signals are received by the coin vibrator that detects the signal thus producing enhanced vibrations which is fed to neck near the voice-box and enables the user to speak casually with their own natural voice with less noise unlike the other vocalizing mechanisms which produce unnatural voice with more amount of noise. An ON/OFF Switch is attached at the exterior part of the device which ensures the easy using and handling of the product for the user. The user can speak by turning ON the switch and this induces vibrations and can be turned OFF when the user does not speak. Thus, this results to provide an extraordinary speech aid device that facilitates the production of substantially natural sounding speech by the user helping in their rehabilitation.

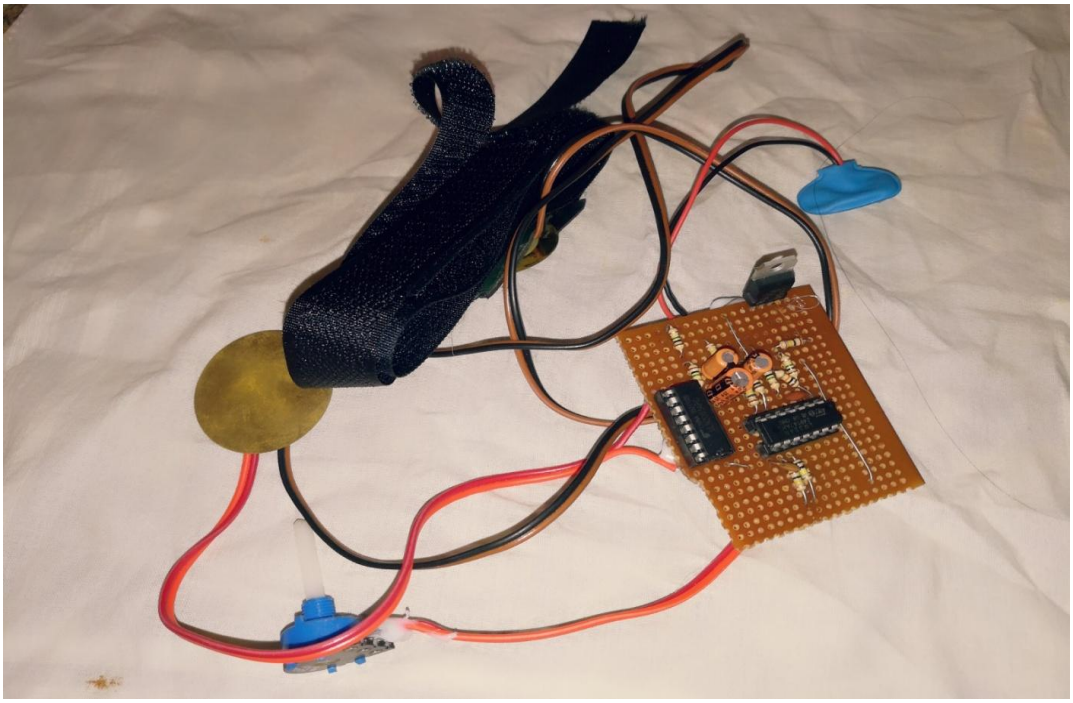
4. IMPACT OF THE PROPOSED SOLUTION

The proposed system has been realized in hardware as shown in figure 9 and its performance has been analyzed. The impact is that which creates a huge difference in the market and makes it to be more beneficial to the customers and users.

Figure 9:Circuit connected diagram of the proposed system

5. CONCLUSION AND FUTURE SCOPE

In the market, our product will create huge response because of its efficient rehabilitation by reshaping the existing devices in the market. The characteristics of our product will have a



significant impact on both the occurrence and nature of competitive reactions. Our product launch strategies on competitive reaction in industrial markets which makes to enhance our device and to fill the gap between new product strategy and the determination of market value.

One of the most important things is to satisfy the user needs by our service and to help them by making them to feel convenient and comfortable with our product. This will create more impact on our product with the marketing strategy to enable the speech aid device in world wide. Our new design, once implemented will reduce the amount of inefficient speakers in our country and it is assured to create our country_ '**a country with no speechless people**'.

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Authors Biography

DrInbamalar T M has been actively involved in teaching and research for the past 20 years. She has published 26 research papers in various International Journals, National Journals as well as international conferences. She is a reviewer of International Journals such as FEBS Letters, Journal of scientific research and reports, British journal of Applied Science and Technology, Asian Journal of Mathematics and Computer Research, Plant Cell Biotechnology, Molecular Biology, etc. She is editorial board member of International Journal of Emerging Trends in Engineering Research. She is International scientific committee member for various International conferences organized by World Academy of Sciences. She is a Lifetime member of Professional bodies such as ISTE, IACSIT, IAENG and ISRD. She has organized many National Conferences, Faculty development training programs and workshops. She has delivered lectures on various training programs related to research and publications. She has supervised over 50 UG and PG projects. She is a recognized research supervisor of Anna University. She has been teaching subjects such as Digital Signal Processing, Advanced Digital Signal Processing, Digital Image Processing, Signals and systems and Medical electronics for UG and PG students.

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