A Technical Seminar Report on

**Silent sound technology (SST) - an end to Noisy**

**Communication**

Submitted for the partial fulfilment of the academic requirements for the

Award of the Degree of

**BACHELOR OF TECHNOLOGY**

**IN**

**ELECTRONICS AND COMMUNICATION ENGINEERING**

Submitted By

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| MALKANNA SRIVANI | 21911A04H8 |
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**Under the Esteemed Guidance of,**

** NAME OF TECHNICAL SEMINAR INCHARGE**

**Department of Electronics and Communication Engineering**

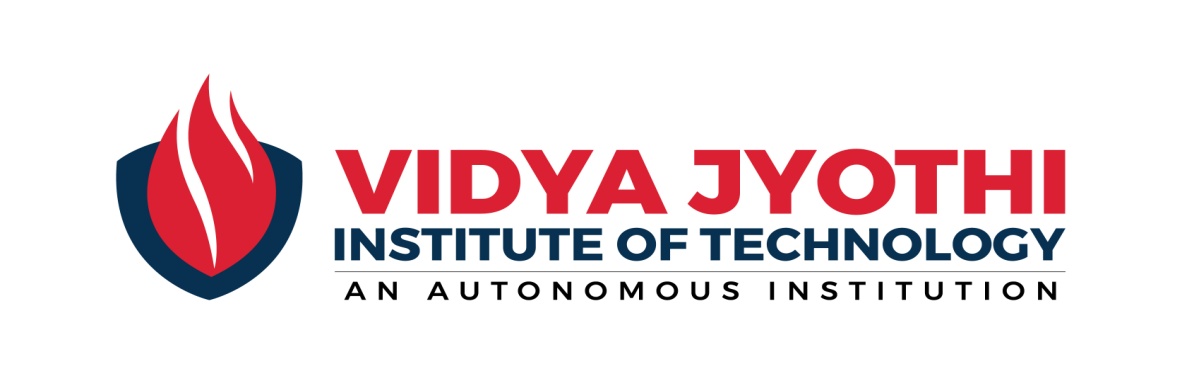
## **VIDYA JYOTHI INSTITUTE OF TECHNOLOGY**

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(Aziz Nagar, C.B.Post, Hyderabad -500075)

**2024-2025**

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**Aziz Nagar Gate, C.B. Post, Hyderabad-500 075**

**Department of Electronics and Communication Engineering**

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**CERTIFICATE**

This is to certify that the technical seminar entitled **“Silent sound technology (SST) - an end to Noisy Communication”** is being submitted by **MALKANNA SRIVANI (21911A04H8)** of IV B. Tech II Semester of **Electronics & Communication Engineering** is a record Bonafide work carried out by me. The results embodied in this report have not been submitted to any other University for the award of any degree.

**TECHNICAL SEMINAR INCHARGE HEAD OF THE DEPARTMENT**

**Incharge Name Dr**. **M.Rajendra Prasad M.E.,Ph.D.,**

**Designation Professor**

**Department of ECE Department of ECE**

### DECLARATION

This is to certify that the work reported in the technical seminar entitled **“Silent sound technology (SST) - an end to Noisy Communication”** is a record of work done by me in the Department of Electronics and Communication Engineering, Vidya Jyothi Institute of Technology, Hyderabad. The reports is based on the work done entirely by me and not copied from any other source.

**MALKANNA SRIVANI 21911A04H8**

**ACKNOWLEDGEMENT**

I extend our sincere gratitude to all those who contributed to the completion of this project. First and foremost, we express our deepest appreciation to **INCHARGE NAME with Designation**, for his / her invaluable guidance, encouragement, and support throughout the duration of this endeavour.

I would like to express our sincere gratitude to **Dr. M. RAJENDRA PRASAD M.E., Ph.D.,** Professor & HoD, Dept.of ECE for his invaluable support and encouragement throughout the duration of this work.

I deeply grateful **Dr.A.Srujana**,M.Tech., Ph.D., Principal,Vidya Jyothi Institute of Technology for encouraging us in the completion of this technical seminar.

I express our heartfelt thanks to **Faculty Members of Electronics and Communication Department,** Vidya Jyothi Institute of Technology for helping me in carrying out this technical seminar successfully.

MALKANNA SRIVANI 21911A04H8

**Abstract**

**Silent sound technology (SST) - an end to Noisy Communication**

Nowadays whenever we are talking on a cell phone in a crowd, then actually we are not talking, we are yelling because of lots of disturbance and noise around us. However, there is no need to scream to convey our message and waste our energy anymore. For this purpose, a new technology known as the Silent Sound Technology has been introduced that will put an end to the noise pollution. The Silent sound technology is a perfect solution for those people who have lost their voice but wish to speak on mobile phones. It is developed at the Karlsruhe Institute of Technology and you can expect to see it in the near future. When this technology is used, it detects every lip movement and internally converts the electrical pulses into sounds signals and sends them neglecting all other surrounding noise. It is going to be really beneficial for the people who hate talking loudly on cell phones. Silent Sound technology aims to notice every movement of the lips and transform them into sounds, which could help people who lose voices to speak, and allow people to make silent calls without bothering others. Rather han making any sounds, your handset would decipher the movements your mouth makes by measuring muscle activity, then convert this into speech that the person on the other end of the call can hear. So, basically, it reads our lips. Another important benefit of this technology is that it allows you to communicate to any person in the world as the electrical pulse is universal, it can be converted into any language depending upon the user's choice. This technology can be used for languages like English, French & German butnot for languages like Chinese because different tones hold different meanings in Chinese language. This new technology will be very helpful whenever a person loses his voice while speaking or allows people to make silent calls without disturbing others, thus now we can speak anything with our friends or family in private without anyone eavesdropping. At the other end, the listener can hear a clear voice. This device works with 99% efficiency, and can be seen in the market in another 5-10 years and once launched it will have a drastic effect and with no doubt it will be widely used.

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Pg.no

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**Chapter 1**

**Introduction**

1.1 Introduction:

Silence is the best answer for all the situations even the mobile understands. The word cell phone has become the greatest buzz word in the Cellular Communication industry. There are lots and lots of technology that tries to reduce the noise pollution and make the environment a better place to live in. This is a new technology known as Silent Sound Technology that will put an end to noise pollution.You are in a movie theatre or noisy restaurant or a bus etc where there is a lot of noise around is a big issue while talking on a mobile phone. But in the future this problem is climinated with silent sounds, a new technology unveiled at the CeBIT fair on Tuesday that transforms lip movements into a computer-generated voice for the listener at the other end of the phone.

It is a technology that helps you to transmit information without using your vocal cords. This technology aims to notice lip movements & transform them into a computer-generated sound that can be transmitted over a phone. Hence a person on the other end of the phone receives the information in audio.

Silent Sound Technology, demonstrated by the Karlsruhe Institute of Technology (KIT) in 2010, transforms lip movements into sounds, enabling voiceless communication. Using electromyography, the device monitors muscular movements, converting them into electrical pulses that become speech. This innovation aids people who have lost their voice, enables silent calls, secures sensitive information sharing, and even offers instant language translation.

According to Wand, native speakers can silently utter a sentence in their language, and the receivers hear the translated sentence in their language. It appears as if the native speaker produced speech in a foreign language. He also said, the translation technology works for languages like English, French and German, but for languages like Chinese, where different tones can hold many different meanings, poses a problem. He explained that, the engineers have got the device working to 99 percent efficiency, so the mechanical voice at the other end of the phone gets one word in 100 wrong. He also said that they were working to overcome the remaining technical difficulties. In five, maybe ten years, this will be useful, everyday technology.

Fig 1.1 Common man talking at same place without disturbance

1.2 Aim:

This seminar represents the idea of silent sound technology, about its features, applications and advantages, some practical projects that have been implemented; and also shows that it can be the future of noiseless communication.

1.3 Scope:

Silent sound technology gives way to a bright future to speech recognition technology from simple voice commands to memorandum dictated over the phone all this is fairly possible in noisy public places. Without having electrodes hanging all around your face, these electrodes will be incorporated into cell phones.

1.4 Motivation:

The need for this technology is to end embarrassing situations such as a person answering his silent, but vibrating cell phone in a meeting lecture or performance, and whispering loudly that, he can't talk to them right now. In the case of an urgent call, apologetically rushing out of the room in order to answer the call the person back. Silent Sound technology aims to notice movement of the lips and transform into sounds, which could help people who lose voices to speak, and allow people to make silent calls without disturbing others. Rather than making any sounds, your handset would decipher the movements your mouth makes by measuring muscle activity, then convert this into speech that the person on the other end of the call can hear. So, it basically reads our lips.

1.5 Literature survey:

Silent Sound technology is developed at the Karlsruhe Institute of Technology, Germany. The idea of interpreting silent speech electronically or with a computer has been around for a long time and was popularised in the 1968 Stanley Kubrick science-fiction film"2001-A space Odyssey" A major focal point was the DAPRA Advanced Speech Encoding Program (ASE) of the early 2000's, which funded research on low bit rate speech synthesis with acceptable intelligibility quality, and aural speaker recognisability in acoustically harsh environments.

1.6 Organisation of the seminar:

This section consists of 10 chapters. Chapter 1 discusses about the introduction of Silent Sound technology, Chapter 2 discusses about the need of this technology. Chapter 3 discusses about the methods used in Silent Sound technology, Chapter 4 discusses about Electromyography, Chapter 5 discusses about Image processing, Chapter 6 discusses about the architecture and working of Silent Sound technology, Chapter 7 discusses about the research Chapter 8 discusses the applications of Silent Sound technology, Chapter 9 has the conclusion, Chapter 10 contains references.

1.7 Conclusion:

In this chapter, we have discussed introduction of the seminar, aim of the seminar, scope of the

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**Chapter 2**

**Need for Silent Sound Technology**

Silent Sound Technology will put an end to embarrassed situation such as a person answering his silent, but vibrating cell phone in a meeting, lecture or performance, and whispering loudly, that he can't talk to them right now. In the case of an urgent call, apologetically rushing out of the room in order to answer or call the person back.

2.1 Need for Silent Sound:

Humans are capable of producing and understanding whisper speech in quiet environments at remarkably low signal levels. Most people can also understand a few unspoken words by lip-reading. The idea of interpreting silent speech electronically or with a computer has been around for a long time, and was popularized in the 1968.

When you add lawnmowers, snow blowers, leaf blowers, jack hammers, jet engines, transport trucks, and horns and buzzers of all types and descriptions you have a wall of constant noise and irritation. Even when watching a television program at a reasonable volume level you are blown out of your chair when a commercial comes on at the decibel level of a jet.

The technology opens up a host of applications, from helping people who have lost their voice due to ilness or accident to telling a trusted friend your PIN number over the phone without anyone eavesdropping-assuming no lip-readers are around. Native speakers can silently utter a sentence in their language, and the receivers hear the translated sentence in their language. It appears as if the native speaker produced speech in a foreign language.

We need Silent Sound technology for a better way of communication in noisy public place. It gives a better and new way of communication for those people who lost their voice. We can give confidential information over a phone without worrying about others, as the electronic pulses are universal and can be immediately converted into any other language of our choice.

**Chapter 3**

**Methods of Silent Sound Technology**

Silent Sound Technology is processed through some ways or methods. They are

1. Electromyography (EMG)

2. Image Processing

3.1 Electromyography:

1. The Silent Sound Technology uses electromyography, monitoring tiny muscular movements that occur when we speak.

2. Monitored signals are converted into electrical pulses that can then be turned into speech, without a sound uttered.

3. Electromyography (EMG) is a technique for evaluating and recording the electrical activity produced by skeletal muscles.

4. An electromyography detects the electrical potential generated by muscle cells, when these cells are electrically or neurologically activated.

5. Electromyographic sensors attached to the face records the electrical signals produced by the facial muscles, compare them with pre-recorded signal pattern of spoken words

6. When there is a match that sound is transmitted on to the other end of the line and the person at the other end listens to the spoken words.

Even by saying words without producing sound weak electric currents are sent from brain to speech muscles. This phenomenon is called electromyography. A technique for evaluating and recording the electrical activity produced by articulatory muscles. The transducers involved convert the pulses into electrical signals.

The sensors are used are Pressure sensors, Vibration sensors, Electromagnetic sensor,Motion sensor. The electrical activity is recorded. The sensors have to be placed at various locations to obtain an accurate signal. Vocoders converts these electrical signals into speech patterns. Compare them with pre-recorded speech pattern of spoken words. When there is a match, that sound is transmitted on to the other end of the line.

3.2 Image Processing:

1. The simplest form of digital image processing converts the digital data tape into a film image with minimal corrections and calibrations.

2. Then large mainframe computers are employed for sophisticated interactive manipulation of the data.

3. In the present context, overhead perspective is employed to analyse the picture.

4. In electrical engineering and computer science, image processing is any form of signal processing for which the input is an image, such as a photograph or video frame; the output of image processing may be either an image or, a set of characteristics or parameters related to theimage. Most image-processing techniques involve treating the image as a two-dimensional signal and applying standard signal-processing techniques to it.

Analog image processing is applied to hard copy data such as photographs or printouts. It adopts certain elements of interpretation, such as primary element, spatial arrangement etc. Digital image processing involves a collection of techniques for the manipulation of digital images by computers. It contains some flaws. To overcome the flaws and deficiencies in order to get the

Motion sensor. The electrical activity is recorded. The sensors have to be placed at various locations to obtain an accurate signal. Vocoders converts these electrical signals into speech patterns. Compare them with pre-recorded speech pattern of spoken words. When there is a match, that sound is transmitted on to the other end of the line.

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**Chapter 4**

**Electromyography**

Electromyography (EMG) is a technique for evaluating and recording the electrical activity produced by skeletal muscles. EMG is performed using an instrument called an electromyograph, to produce a record called an electromyogram. An electromyograph detects the electrical potential generated by muscle cells when these cells are electrically or neurologically activated. The signals can be analysed to detect medical abnormalities, activation level, recruitment order or to analyse the biomechanics of human or animal movement.

• The Silent Sound Technology uses electromyography, monitoring tiny muscular movements that occur when we speak.

• Monitored signals are converted into electrical pulses that can then be turned into speech, without a sound uttered.

• Electromyography (EMG) is a technique for evaluating and recording the electrical activity produced by skeletal muscles.

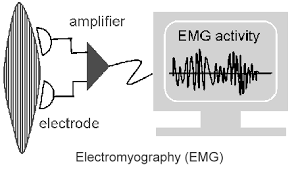
• An electromyography detects the electrical potential generated by musele cells, when these cells are electrically or neurologically activated.

Figure-4.1:Electromyography (EMG)

4.1 Electrical Characteristics

The electrical source is the muscle membrane potential of about -90 mV. Measured EMG potentials range between less than 50µV and up to 20 to 30 mV, depending on the muscle under observation.

Typical repetition rate of muscle motor unit firing is about 7-20 Hz, depending on the size of the muscle (eye muscles versus seat (gluteal) muscles), previous axonal damage and other factors. Damage to motor units can be expected at ranges between 450 and 780 mV.

4.2 History:

Electromyography (EMG) research began in 1666 with Francesco Redi’s discovery that the electric ray fish generates electricity. By 1773, Walsh demonstrated that eel fish muscle tissue could produce a spark. In 1792, Luigi Galvani showed that electricity could trigger muscle contractions. Dubois-Raymond recorded electrical activity in muscles in 1849, and Marey made the first actual EMG recording in 1890. Gasser and Erlanger used an oscilloscope to observe muscle signals in 1922, leading to steady improvements in EMG detection through the 1930s–1950s. Clinical use of surface EMG (SEMG) began in the 1960s, with Hardyck pioneering its application in 1966. In the 1980s, advancements in electrode integration and signal cables enabled commercial production of EMG devices.

Today, surface EMG is widely used in clinical and research settings. It records superficial muscle activity for kinesiological studies, while intramuscular electrodes analyze deep muscles. EMG aids in diagnosing neurological and neuromuscular disorders, gait analysis, biofeedback, and ergonomic assessments. It is also essential in biomechanics, motor control, movement disorders, postural control, and physical therapy research.

.4.3 Procedure:

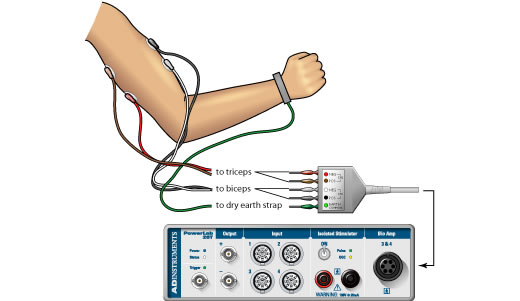
There are two kinds of EMG in widespread use: surface EMG and intramuscular (needle and fine-wire) EMG. To perform intramuscular EMG, a needle electrode or a needle containing two fine-wire electrodes is inserted through the skin into the muscle tissue. A trained professional (such as a neurologist, physiatrist, or physical therapist) observes the electrical activity while insertingthe electrode. The insertional activity provides valuable information about the state of the muscle and its innervating nerve. Normal muscles at rest make certain, normal electrical signals when the needle is inserted into them. Then the electrical activity when the muscle is at rest is studied. Abnormal spontaneous activity might indicate some nerve and/or muscle damage. Then the patient is asked to contract the muscle smoothly. The shape, size, and frequency of the resulting motor unit potentials are judged. Then the electrode is retracted a few millimetres, and again the activity is analysed until at least 10-20 units have been collected. Each electrode track gives only a very local picture of the activity of the whole muscle. Because skeletal muscles differ in the inner structure, the electrode has to be placed at various locations to obtain an accurate study.

Figure4.2-: Electromyography instruments

Intramuscular EMG may be considered too invasive or unnecessary in some cases. Instead, a surface electrode may be used to monitor the general picture of muscle activation, as opposed to the activity of only a few fibres as observed using an intramuscular EMG. This technique is used in a number of settings; for example, in the physiotherapy clinic, muscle activation is monitored using surface EMG and patients have an auditory or visual stimulus to help them know when they are activating the muscle (biofeedback).

A motor unit is defined as one motor neuron and all of the muscle fibres it innervates. When a motor unit fires, the impulse (called an action potential) is carried down the motor neuron to the muscle. The area where the nerve contacts the muscle is called the neuromuscular junction, or the motor end plate. After the action potential is transmitted across the neuromuscular junction, an action potential is elicited in all of the innervated muscle fibres of that particular motor unit. The sum of all this electrical activity is known as a motor unit action potential (MUAP). This electrophysiologic activity from multiple motor units is the signal typically evaluated during an EMG. The composition of the motor unit, the number of muscle fibres per motor unit, the metabolic type of muscle fibres and many other factors affect the shape of the motor unit potentials in the myogram.

Nerve conduction testing is also often done at the same time as an EMG to diagnose neurological diseases.Some patients can find the procedure somewhat painful, whereas others experience only a small amount of discomfort when the needle is inserted. The muscle or muscles being tested may be slightly sore for a day or two after the procedure.

4.4 Normal results:

Muscle tissue at rest is normally electrically inactive. After the electrical activity caused by the irritation of needle insertion subsides, the electromyograph should detect no abnormal spontaneous activity (i.e., a muscle at rest should be electrically silent, with the exception of the area of the neuromuscular junction, which is, under normal circumstances, very spontaneously active). When the miscle is voluntarily contracted, action potentials begin to appear. As the strength of the muscle contraction is increased, more and more muscle fibres produce action potentials. When the muscle is fully contracted, there should appear a disorderly group of action potentials of varying rates and amplitudes (a complete recruitment and interference pattern).

4.5 Abnormal results:

EMG is used to diagnose diseases that generally may be classified into one of the following categories: neuropathies, neuromuscular junction diseases and myopathies.

Neuropathic disease has the following defining EMG characteristics: Downloaded 52

1. An action potential amplitude that is twice normal due to the increased number of fibres per motor unit because of reinnervation of denervated fibres

2. An increase in duration of the action potential

3. A decrease in the number of motor units in the muscle (as found using motor unit number estimation techniques)

Myopathic disease has these defining EMG characteristics:

4. A decrease in duration of the action potential

5. A reduction in the area to amplitude ratio of the action potential

6. A decrease in the number of motor units in the muscle (in extremely severe cases only). Because of the individuality of each patient and disease, some of these characteristics may not appear in every case.

4.6 EMG signal decomposition:

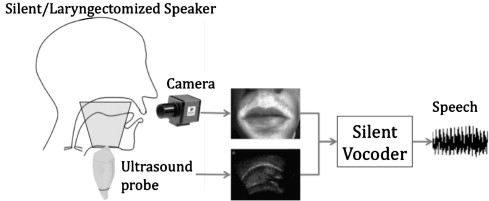
EMG signals are essentially made up of superimposed motor unit action potentials (MUAPS) from several motor units. For a thorough analysis, the measured EMG signals can be decomposed into their constituent MUAPS. MUAPS from different motor units tend to have different characteristic shapes, while MUAPs recorded by the same electrode from the same motor unit are typically similar. Notably MUAP size and shape depend on where the electrode is located with respect to the fibres and so can appear to be different if the electrode moves position. EMG decomposition is non-trivial, although many methods have been proposed.

Fig 4.4: Block diagram of EMG

4.7 Block diagram of EMG: The block diagram clearly explains the implementation of silent sound technology through electromyography. From the block diagram it is clear that the silent lip movements are captured through sensor probes or it may be through image processing technique and these movements are converted to speech through a silent vocoder. These speech signals are transmitted through a mobile and received as normal voice signals at the other end. Here the recorded electromyographic signals are converted to speech signals by comparing them with pre recorded voice signals and transmitting them over the phone if there is a match else signal is not transmitted.

4.8 Working of Electromyography:

1. A needle containing two fine-wired electrodes is inserted through the skin into the muscle tissue.

2. Normal muscles at rest make certain normal electrical sounds when the needle is inserted into them. Then the electrical activity when the muscle is at rest is observed. a match sound is transmitted on to the other end of the line and the person at the other end listen to the spoken words.

4.8 Working of Electromyography:

|  |  |  |
| --- | --- | --- |
| Articulator ID | Articulator Name | Location |
| 1 | UL | Upper lip |
| 2 | LL | Lower lip |
| 3 | T1 | Tongue lip |
| 4 | T2 | Tongue body front |
| 5 | T3 | Tongue body back |
| 6 | T4 | Tongue back |

Table 4.1 EMG articulatory muscles index

4.9 Applications of EMG:

EMG signals are used in many clinical and biomedical applications. EMG is used as a diagnostics tool for identifying neuromuscular diseases, assessing low-back pain, kinesiology, and disorders of motor control. EMG signals are also used as a control signal for prosthetic devices such as prosthetic hands, arms, and lower limbs.

EMG can be used to sense isometric muscular activity where no movement is produced. This enables definition of a class of subtle motionless gestures to control interfaces without being noticed and without disrupting the surrounding environment. These signals can be used to control a prosthesis or as a control signal for an electronic device such as a mobile phone or PDA.EMG signals have been targeted as control for flight systems. The Human Senses Group at the NASA Ames Research Centre at Moffett Field, CA seeks to advance man-machine interfaces by directly connecting a person to a computer. In this project, an EMG signal is used to substitute for mechanical joysticks and keyboards. EMG has also been used in research towards a "wearable cockpit," which employs EMG-based gestures to manipulate switches and control sticks necessary for flight in conjunction with a google-based display.Unvoiced speech recognition recognizes speech by observing the EMG activity of muscles associated with speech. It is targeted for use in noisy environments, and may be helpful for people without vocal cords and people with aphasia.a match sound is transmitted on to the other end of the line and the person at the other end listen to the spoken words.

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EMG signals have been targeted as control for flight systems. The Human Senses Group at the NASA Ames Research Centre at Moffett Field, CA seeks to advance man-machine interfaces by directly connecting a person to a computer. In this project, an EMG signal is used to substitute for mechanical joysticks and keyboards. EMG has also been used in research towards a "wearable cockpit," which employs EMG-based gestures to manipulate switches and control sticks necessary for flight in conjunction with a google-based display.

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**Chapter 5**

**Image Processing**

The simplest form of digital image processing converts the digital data tape into a film image withminimal corrections and calibrations. Then large mainframe computers are employed for sophisticated interactive manipulation of the data. In the present context, overhead perspective is employed to analyse the picture.

In electrical engineering and computer science, image processing is any form of signal processing for which the input is an image, such as a photograph or video frame; the output of image processing may be either an image or, a set of characteristics or parameters related to the image. Most image-processing techniques involve treating the image as a two-dimensional signal and applying standard signal-processing techniques to it.

Image processing usually refers to digital image processing, but optical and analog image processing also are possible. This article is about general techniques that apply to all of them. The acquisition of images (producing the input image in the first place) is referred to as imaging.

Image processing is a physical process used to convert an image signal into a physical image. The image signal can be either digital or analog. The actual output itself can be an actual physical image or the characteristics of an image.

The most common type of image processing is photography. In this process, an image is captured using a camera to create a digital or analog image. In order to produce a physical picture, the image is processed using the appropriate technology based on the input source type.

In digital photography, the image is stored as a computer file. This file is translated using photographic software to generate an actual image. The colours, shading, and nuances are all captured at the time the photograph is taken the software translates this information into an image.

When creating images using analog photography, the image is burned into a film using a chemical reaction triggered by controlled exposure to light. The image is processed in a darkroom, using special chemicals to create the actual image. This process is decreasing in popularity due to the advent of digital photography, which requires less effort and special training to product images.

In addition to photography, there are a wide range of other image processing operations. The field of digital imaging has created a whole range of new applications and tools that were previously impossible. Face recognition software, medical image processing and remote sensing are all possible due to the development of digital image processing. Specialized computer programs are used to enhance and correct images. These programs apply algorithms to the actual data and are able to reduce signal distortion, clarify fuzzy images and add light to an underexposed image.Image processing techniques were first developed in 1960 through the collaboration of a wide range of scientists and academics. The main focus of their work was to develop medical imaging. character recognition and create high quality images at the microscopic level. During this period, equipment and processing costs were prohibitively high.

The financial constraints had a serious impact on the depth and breadth of technology development that could be done. By the 1970s, computing equipment costs had dropped substantially making digital image processing more realistic. Film and software companies invested significant funds into the development and enhancement of image processing, creating a new industry.

There are three major benefits to digital image processing. The consistent high quality of the image, the low cost of processing and the ability to manipulate all aspects of the process are all great benefits. As long as computer processing speed continues to increase while the cost of storage memory continues to drop, the field of image processing will grow.

5.1 Image Processing Technique:

Analysis of remotely sensed data is done using various image processing techniques and methods that includes:

1. Analog image processing

2. Digital image processing

5.2 Analog Image Processing:

Analog processing technique es is applied to hard copy data such as photographs or printouts. It adopts certain elements of interpretation, such as primary element, spatial arrangement etc.,

The combination of multi-concept of examining remotely sensed data in multispectral, multitemporal, multiscale and in conjunction with multidisciplinary, allows us to make a verdict not only as to what an object is but also its importance. Apart from these it also includes optical photogrammetric techniques allowing for precise measurement of the height, width, location, etc. of an object.

Analog processing techniques are applied to hard copy data such as photographs or printouts. Image analysis in visual techniques adopts certain elements of interpretation, which are as follow: The use of these fundamental elements depends not only on the area being studied, but the knowledge of the analyst has of the study area. For example, the texture of an object is also very useful in distinguishing objects that may appear the same if judging solely on tone (ie., water and tree canopy, may have the same mean brightness values, but their texture is much different.Association is a very powerful image analysis tool when coupled with the general knowledge of the site. Thus, we are adept at applying collateral data and personal knowledge to the task of image processing. The combination of multi-concept of examining remotely sensed data in multispectral, multitemporal, multiscale and in conjunction with multidisciplinary, allows us to make a verdict not only as to what an object is but also its importance. Apart from these analog image processing techniques also includes optical photogrammetric techniques allowing for precise measurement of the height, width, location, etc. of an object.Image processing usually refers to digital image processing, but optical and analog image processing also are possible. This article is about general techniques that apply to all of them. The acquisition of images (producing the input image in the first place) is referred to as imaging.

Image processing is a physical process used to convert an image signal into a physical image. The image signal can be either digital or analog. The actual output itself can be an actual physical image or the characteristics of an image.

The most common type of image processing is photography. In this process, an image is captured using a camera to create a digital or analog image. In order to produce a physical picture,

using a camera to create a digital or anatog image. in order to produce a physical picture, the image is processed using the appropriate technology based on the input source type.

5.3 Digital Image Processing:

These common formats are:

1. Band Interleaved by Pixel (BIP)

2. Band Interleaved by Line (BIL)

3. Band Sequential (BQ)

Digital image analysis is usually conducted using Raster data structures each image is treated as an array of values. It offers advantages for manipulation of pixel values by an image processing system, as it is easy to find and locate pixels and their values. Disadvantages become apparent when one needs to represent the array of pixels as discrete patches or regions, whereas Vector data structures use polygonal patches and their boundaries as fundamental units for analysis and manipulation. Though vector format is not appropriate for digital analysis of remotely sensed data.

5.4 Image Resolution:

Resolution can be defined as "the ability of an imaging system to record fine details in a distinguishable manner". A working knowledge of resolution is essential for understanding both practical and conceptual details of remote sensing. Along with the actual positioning of spectral bands, they are of paramount importance in determining the suitability of remotely sensed data for a given application. The major characteristics of imaging remote sensing instrument operating in the visible and infrared spectral region are described in terms as follow:

Spectral resolution Radiometric resolution

• Spatial resolution

Temporal resolution

5.5 Digital processing steps:

Digital Image Processing involves computer algorithms to manipulate digital images, offering advantages over analog processing, such as reduced noise and distortion. As a branch of digital signal processing, it enables the application of diverse algorithms and is often modeled as a multidimensional system. A digital image is an array of numbers representing spatial distributions of field parameters like reflectivity, temperature, or elevation, with each pixel assigned a Digital Number (DN) ranging from 0 to 255, affecting detail reproduction. Reducing pixel size enhances scene detail, making digital images ideal for remote sensing applications.

Remote sensing images are captured in digital format and processed by computers for interpretation. They are available in both photographic and digital forms, where variations in scene characteristics are reflected as brightness variations. Digital satellite imagery is stored as discrete pixels, with DN values representing radiance over a small area. The level of detail depends on pixel size, with finer resolution preserving more information. These images are widely used in geospatial analysis, environmental monitoring, and scientific research.

Digital satellite data is provided to users via computer-readable formats like tapes or CD-ROMs. Although no universal standard exists for remote sensing data storage and transfer, the CEOS (Committee on Earth Observation Satellites) format is gaining acceptance. Image data is typically structured in three formats, ensuring proper alignment of spectral bands for accurate analysis. This organization helps integrate and interpret multispectral images efficiently for various applications, including environmental assessment and resource management

To overcome the flaws and deficiencies in order to get the originality of the data, it needs to undergo several steps of processing

Digital Image Processing undergoes three general steps:

• Pre-processing

Image enhancement

Information extraction

5.5.1 Pre-Processing:

•Pre-processing consists of those operations that prepare data for subsequent analysis that attempts to correct or compensate for systematic errors.

Then analysts may use feature extraction to reduce the dimensionality of the dataThus, feature extraction is the process of isolating the most useful components of the data for further study while discarding the less useful aspects.It reduces the number of variables that must be examined, thereby saving time and resources

Pre-processing consists of those operations that prepare data for subsequent analysis that attempts to correct or compensate for systematic errors. The Cigital imageries are subjected to several corrections such as geometric, radiometric and atmospheric, though all these corrections might not necessarily be applied in all cases. These errors are systematic and can be removed before they reach the user. The investigator should decide which pre-processing techniques are relevant on the basis of the nature of the information to be extracted from remotely sensed data. After pre-processing is complete, the analyst may use feature extraction to reduce the dimensionality of the data. Thus, feature extraction is the process of isolating the most useful components of the data for further study while discarding the less useful aspects (errors, noise etc).Feature extraction reduces the number of variables that must be examined, thereby saving time and resources.

Principal Component Analysis:

Principal Components Analysis (PCA) is related to another statistical technique called factor analysis and can be used to transform a set of image bands such that the new bands (called principal components) are uncorrelated with one another and are ordered in terms of the amount of image variation they explain. The components are thus a statistical abstraction of the variability inherent in the original band set. The purpose of PCA is to define the dimensionality and to fix the coefficients that specify the set of axes, which point in the directions of greatest variability. The bands of PCA are often more interpretable than the source data.

5.5.2. Image Enhancement.

Improves the interpretability of the image by increasing apparent contrast among various features in the scene. The enhancement techniques depend upon two factors mainly. The digital data (i.c. with spectral bands and resolution). The objectives of interpretation.

Common enhancements include image reduction, image rectification, image magnification, contrast adjustments, principal component analysis texture transformation and so on.

Image Enhancement operations are carried out to improve the interpretability of the image by increasing apparent contrast among various features in the scene. The enhancement techniques

result provide the user with full information concerning the source data, the method of analysis and the outcome and its reliability.

Pre-Processing of the Remotely Sensed Images

When remotely sensed data is received from the imaging sensors on the satellite platforms it contains flaws and deficiencies. Pre-processing refers to those operations that are preliminary to the main analysis. Pre-processing includes a wide range of operations from the very simple to extremes of abstractness and complexity. These categorized as follow:

1. Feature Extraction

2. Radiometric Corrections

3. Geometric Corrections

4. Atmospheric Correction

The techniques involved in removal of unwanted and distracting elements such as image/system noise, atmospheric interference and sensor motion from an image data occurred due to limitations in the sensing of signal digitization, or data recording or transmission process. Removal of these effects from the digital data are said to be "restored" to their correct or original condition, although we can, of course never know what the correct values might be and must always remember that attempts to correct data may introduce errors. Thus, image restoration

includes the efforts to correct for both radiometric and geometric errors.

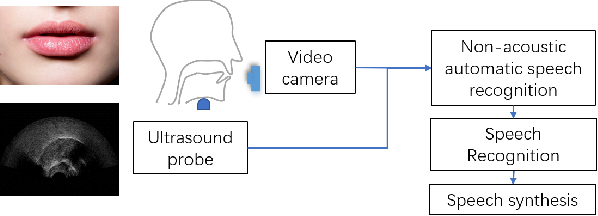
5.5.4 Histogram Equalisation:

The underlying principle of histogram equalisation is straightforward and simple, it is assumed that each level in the displayed image should contain an approximately equal number of pixel values, so that the histogram of these displayed values is almost uniform (though not all 256 classes are necessarily occupied). The objective of the histogram equalisation is to spread the range of pixel values present in the input image over the full range of the display device.

5.6 Silent sound interface:

Ultrasonic sound is a non-invasive and clinically safe procedure which makes the most possible real-time visualisation of one of the important articulators of speech production system the tongue. It is a local oscillating sound pressure wave having frequency greater than upper limit of human hearing range. Ultra sound is thus not separated from normal audible sound by difference in physical properties; only by fact humans cannot hear it.

Ultrasound device is coupled with standard optical camera is used to capture tongue and lip movements. Because of its non-invasive property, clinically safety and good resolution. The captured image of lip and tongue are given to lip reader. Lip reader detects the lip and tongue movements by comparing the earlier stored images of the spoken words with the present images of lips and tongue movement. Where there is a match in images of lips and tongue movement it generates a visual speech signal. The generated visual speech signals are given to silent vocoder. Silent vocoder converts the visual speech into human spoken words.

 Fig 5.1 Silent Sound interface using image processing

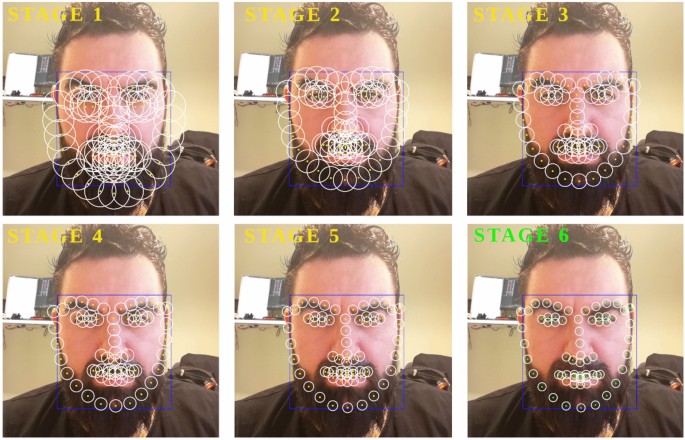


Fig 5.1 Silent Sound interface Capturing using image processing

**Chapter 6**

**Architecture and working of Silent Sound technology**

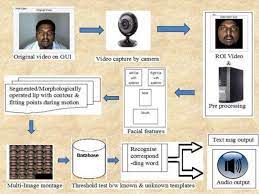
Silent Sound technology is a technology that analyse and understand every movement of the lips and facial expressions then transform them into audio and text output. The use of this technology is immense for people who are vocally challenged or have been rendered mute due to accidents. Lip tracking is one of the biometric systems based on which a genuine system can be developed. Skin segmentation and morphological operation helps to locate facial features in the interior of the face and colour coded coded perimeter with fittings on the contour of the lip.

Fig 6.1 Process model architecture and its working methodology

To proceed with this research work, the process model assumed is iterative process model since it is more adaptable for this work. Once the face detection and mouth region detection is achieved, speech analysis can be performed with the use of lip motion features strategies and emotional expression with the use of other facial parts. If efficiency with identification technique is not proper then the threshold value falls out of the defined unique index value and retrial has to be made. Those are one of the main reasons to choose the iterative process.

The extracted lip contour is refined using morphological processing, fitting key points like corners and the centroid. Lip movement is tracked across frames, creating a multi-frame montage stored in a database alongside features like eye and nose vectors. If frames pass the threshold test against known and unknown templates, the system analyzes trained and tested index values. Upon verification, the user receives a text output, followed by an audio response

**Chapter 7**

**Research**

With all of the millions of phones in circulation, there is great potential for increasing earnings by saving lost calls telephone calls that go unanswered or uninitiated because the user is in a situation in which he or she cannot speak not just in business meetings, but everyday situations. According to research, these lost calls are worth $20 billion per year worldwide. For the cellular operator, these are potential earnings that are currently being left on the table. When these 'lost calls' become answerable, and can be conducted without making a sound, there is a tremendous potential for increased profits. Now the research is going on technology that can be used in the Office Environment too.

Silent sound technology gives way to a bright future to speech recognition technology from simple voice commands to memorandum dictated over the phone all this is fairly possible in noisy public places. Without having electrodes hanging all around your face, these electrodes will be incorporated into cell phones.

Nano technology will be a mentionable step towards making the device handy. With all of the millions of phones in circulation, there is great potential for increasing earnings by saving lost calls telephone calls that go unanswered or uninitiated because the user is in a situation in which he or she cannot speak not just in business meetings, but everyday situations. According to research, these lost calls are worth $20 billion per year worldwide. For the cellular operator, these are potential earnings that are currently being left on the table.

**Chapter 8**

**Applications, Advantages and Disadvantages**

Applications:

The Technology opens up a host of application such as mentioned below:

1. Helping people who have lost their voice due to illness or accident.

2. Telling a trusted friend your PIN number over the phone without anyone eavesdropping assuming no lip-readers are around.

3. Silent Sound Techniques is applied in the Military for communicating secret/confidential matters to others.

4. Native speakers can silently utter a sentence in their language, and the receivers can hear the translated sentence in their language. It appears as if the native speaker produced speech in a foreign language. The translation technology works for languages like English, French and German, except Chinese, where different tones can hold many different meanings.

5. Allow people to make silent calls without bothering others.

Advantages:

1. Silent sound technology helps to transmit information without using vocal cords, who are suffering from aphasia (speaking disorder).

2. We can make silent calls even if we are in crowded place.

3. It is a very good technology for noise cancellation technique.

4. As we know in space there is no medium for sound to travel therefore silent sound technology can be best utilised by astronauts.

Disadvantages:

1. In this technology, from security point of view recognising who are talking to gets complicated

2. 2. In silent sound technology, languages like Chinese are difficult because different tones can hold different meanings

**Conclusion**

Thus, Silent Sound Technology is one of the recent trends in the field of information technology implements "voice without voice". It will be one of the innovations and useful technology and in the mere future this technology will be used in our day to day life.

Silent Sound technology aims to notice every movement of the lips and transform them into sounds, which could help people who lose voices to speak, and allow people to make silent calls without bothering others. Rather than making any sounds, your handset would decipher the movements your mouth makes by measuring muscle activity, then convert this into speech that the person on the other end of the call dyn hear. So, basically it reads your lips.

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