Group 7
Voice Source Localization based
Camera movement Control System

Project Guides :Ms. Kavita and Dr. Jayanthi

Akanksha Baranwal (201430015)
Manan Bhandari (201431166)

AIM

To design a voice source localization based camera movement control system in auditoriums/stage.

Main part is the sound source localisation in the most optimal way and within reasonable accuracy.

Depending upon the feedback through the microphone array the degree of rotation (0-360 degree) of the camera i.e. its angle of orientation is controlled.

INTRODUCTION

This project basically contains two main parts :

1) <u>Hardware Design :</u>
➜ Sound source needs to be detected using a microphone array.
➜ The lesser the number of microphones used for the optimal level of accuracy, better is the model.
➜ Orientation of the array is important. We need to make sure that the entire 360 degree of the auditorium is symmetrically covered.
➜ The area of the model needs to be minimized. Camera will be mounted on a servo motor and its movement will be controlled based on the feedback.

2) Signal Processing:

➜ To analyze the data from the microphone array and determine the position of the sound source.

➜ A very naive approach would be to consider power of the signal received at each microphone. But in this case the degree of freedom of the camera would be limited. As we can determine the sensor with the highest power but not how deviated the source is in terms of angle with respect to the microphone. In this case the only possible ways to rotate the camera would be exactly aligned to the sensors.

➜ Various SSL algorithms are used to do this. We will be using TDOA (Time Difference Of Arrival) Algorithm. In this, cross-correlation is used to determine the time difference of arrival of the wave on two different microphones. Based upon the time difference, exactly the required point can be determined. For different points on the arc between two sensors, the time difference will vary.

MOTIVATION:

In videoconferencing systems, participants have to manually control the camera so that the far end can have a proper view of the near end talker(s). This is both burdensome and distracting to the users.In many situations, when the participant are unwilling to operate or are not familiar with camera operation, the far end will get a whole group shot during the entire meeting.

In large auditoriums it is a very common problem that every audience member is not able to see the speaker and if any views or doubts are raised by the audience everyone is not able to focus on him. That's why this model is used so that whenever the speaker moves while lecturing, the camera in the model moves in the direction of his motion so that everyone is able to see him. And similarly, the case of the audience is also resolved. This is achieved by detecting the signal by the mic. and then moving the camera in that direction.

BACKGROUND:

Sound localisation is also used in animal auditory system. It basically refers to a listener's ability to identify the origin of a detected sound in direction and distance.

The human brain uses differences in intensity, spectral, and timing for this purpose. The angle of a sound is determined by the difference in arrival time between the ears. Sound source localization has been a research topic since the seventies. Different approaches have been proposed and investigated. Phase correlation was proposed as an approach that does not cause spreading of the peak of the correlation function. Through correlation factors, the TDOA Algorithm can be applied and the nearest mic. can be detected.

APPLICATION:

1) This model can be installed in big classes of schools and colleges where the distance between the speaker and the last bench students is very much. By installing that, each member in the classroom will be able to see and listen what the speaker says.
2) This model can also be installed in the robot so that it can hear the voice of the instructor and move in that direction. Many other usages can also be found in the robot system for this model according to the code embedded in it.
3) This can also be used in many toys for kids and various board games too.
4) Can also be used in video surveillance and can be an important part in detecting crimes if already installed at the crime place.

BLOCK DIAGRAM
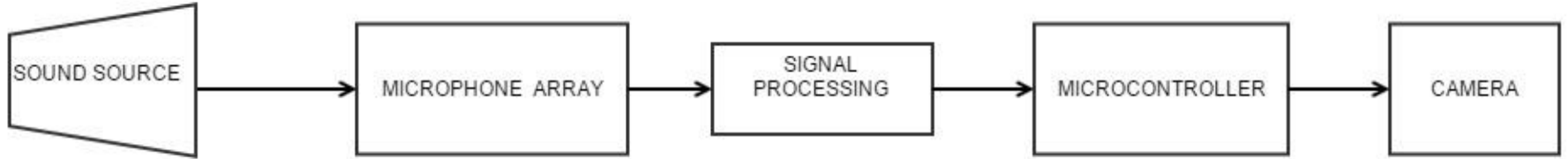
a) Microphone Array

We needed to sample data in all 360 degrees. Circular arrangement is best for this. Placing six microphones in a circular arrangement seem the best choice.
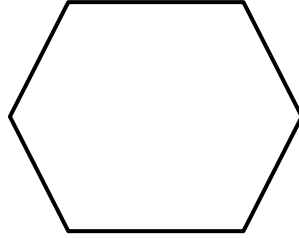
Signal Processing

➔ Signal needs to be processed.
➔ Noise has to be differentiated from the source sound. Only that signal will be processed for which a continuous stream is received.
➔ Processing speed should be faster than sampling speed
➔ Analog to digital converter needs to be used before analysing.
➔ TDOA will be implemented in matlab

Microcontroller

It is for giving feedback to camera for deciding its angle of rotation. It will control a servo motor and decide its angle of rotation based upon the coordinate detected.

Camera

Camera is placed on the servo motor.

COMPONENTS REQUIRED

➔ electret microphone
➔ servo motor
➔ resistors
➔ capacitors
➔ microcontroller
➔ adc