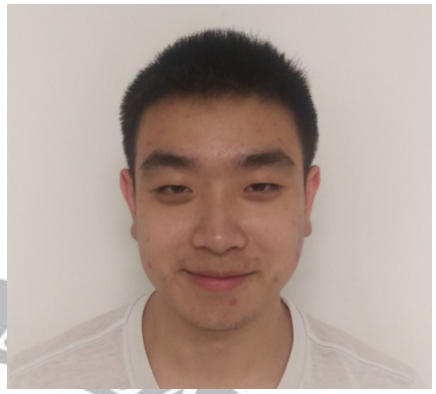
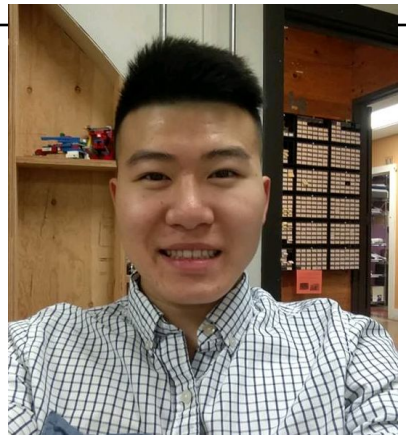
So-Lo

Team 12

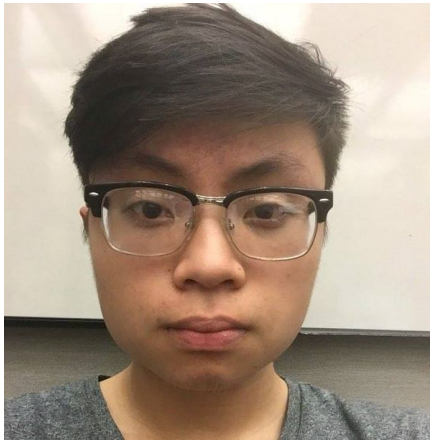


Andy Weng (CSE) ★



● Ming Shuai Chen (CSE)

Suzet Nkwaya (EE) ▬



▲ Dan-Michael Tiamzon (EE)

Presentation Overview

- Current Problems
- Societal Impact
- Our Project: So-Lo
  - System Requirements
  - Block Diagram
  - Description of Components
- Alternatives
- MDR Deliverables

Current Problem

- Recording group meetings
  - Long meetings or conferences are full of information
  - Often meetings are recorded for audio only
  - Camera is usually in a fixed position for A/V recording

Significance of Current Problems

- The purpose of meetings is to communicate essential information and solutions from person to person.
  - People may forget important details from a meeting which results in:
    - delayed or incomplete work
    - making meetings inefficient

Significance of Current Problems

- Most meetings are recorded with one camera overlooking the room
  - Fixed Position
  - Requires manual turning if needed
  - Hard to focus on the person that is speaking when multiple people are shown on the screen

Solution: So-Lo (Sound Locator)

- System that detects the location of sound and captures video and audio.
  - System takes in sound (such as voice) as input
  - System localizes the source of the sound
  - Rotating platform will turn towards that location
  - Camera mounted on rotating platform will focus on person speaking and record video and audio

Solution: So-Lo (Sound Locator)

- Desired end product
  - Automated sound localizer which directs the camera towards a source of sound
  - Designed for small to medium sized meeting rooms
  - Video and audio recording
  - Easily accessible recording

Non-Technical Alternatives

- Can use a setup involving one camera that overlooks the whole room
- Use multiple cameras
- Manually record a meeting

Technical Alternatives

- Polycom Conference Room Microphones
  - CX5500 Unified Conference Station
    - Price: $5000
    - Uses 5 cameras

- Logitech BCC950 Video Conference Webcam
  - Price: $250
  - Remote controlled
  - 180 degree pan

Impact

- Effect on Individuals
  - Give easy access to meeting content for later reference
  - Provides important information for people unable to attend the meeting.
  - Keeps everybody involved.
- Effect on Groups
  - Increase productivity

Impact

- Societal Impact
  - Increase company and workplace productivity
- Possible Implementations
  - Improved hearing aids
  - Surveillance
  - Law enforcement

Goals

- Precisely identify the source of a sound
- Automatically turn camera toward the sound source
- Take the shortest path when turning camera towards the sound source
- Store video/audio on sd card

Sound Location Techniques

Method 1: triangulation

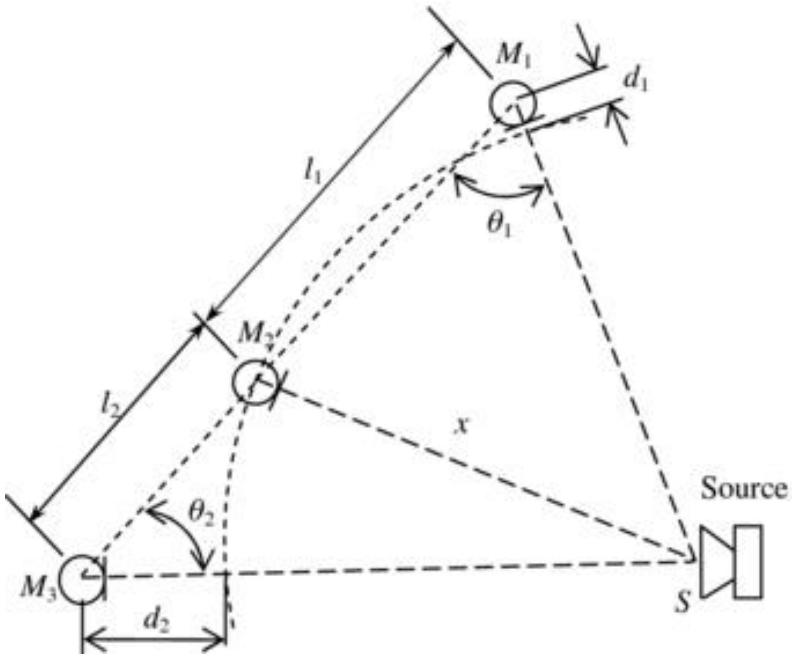
- determining the location of a point by measuring angles to it from known points at either end of a fixed baseline, rather than measuring distances to the point directly

Method 2: time difference of arrival

- use the time difference of arrival due to the distance between the microphones
- used with pressure microphones or particle velocity probes

Triangulation

- The sound source location is found using the known (fixed) position of the microphones
- We need to know the sound's angle of incidence



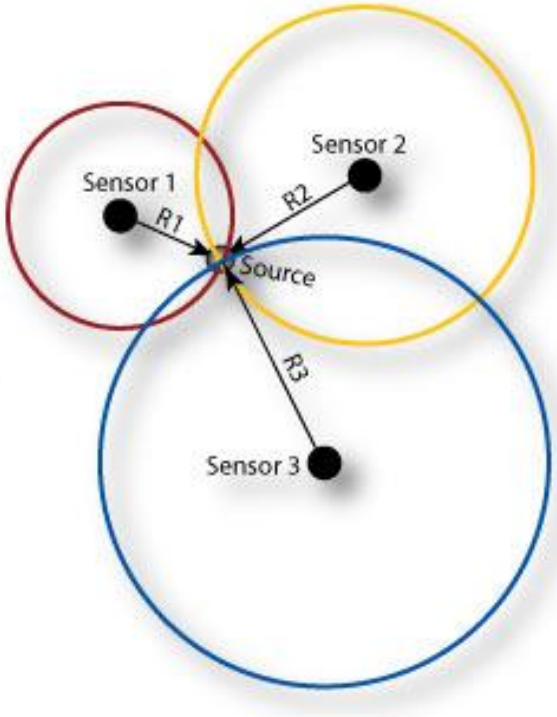
$$\cos\theta_1 = \frac{l_1^2 + (x + d_1)^2 - x^2}{2l_1(x + d_1)}$$

$$\cos\theta_2 = \frac{l_2^2 + (x + d_2)^2 - x^2}{2l_2(x + d_2)}$$

$$x = \frac{l_2\left(l_1^2 - d_1^2\right) + l_1\left(l_2^2 - d_2^2\right)}{2(d_1 l_2 + d_2 l_1)}$$

TDOA (Time Difference of Arrival)

TDOA measurements define spheres or circles as possible emitter positions



$$(a_x - x_0)^2 + (a_y - y_0)^2 = r^2$$

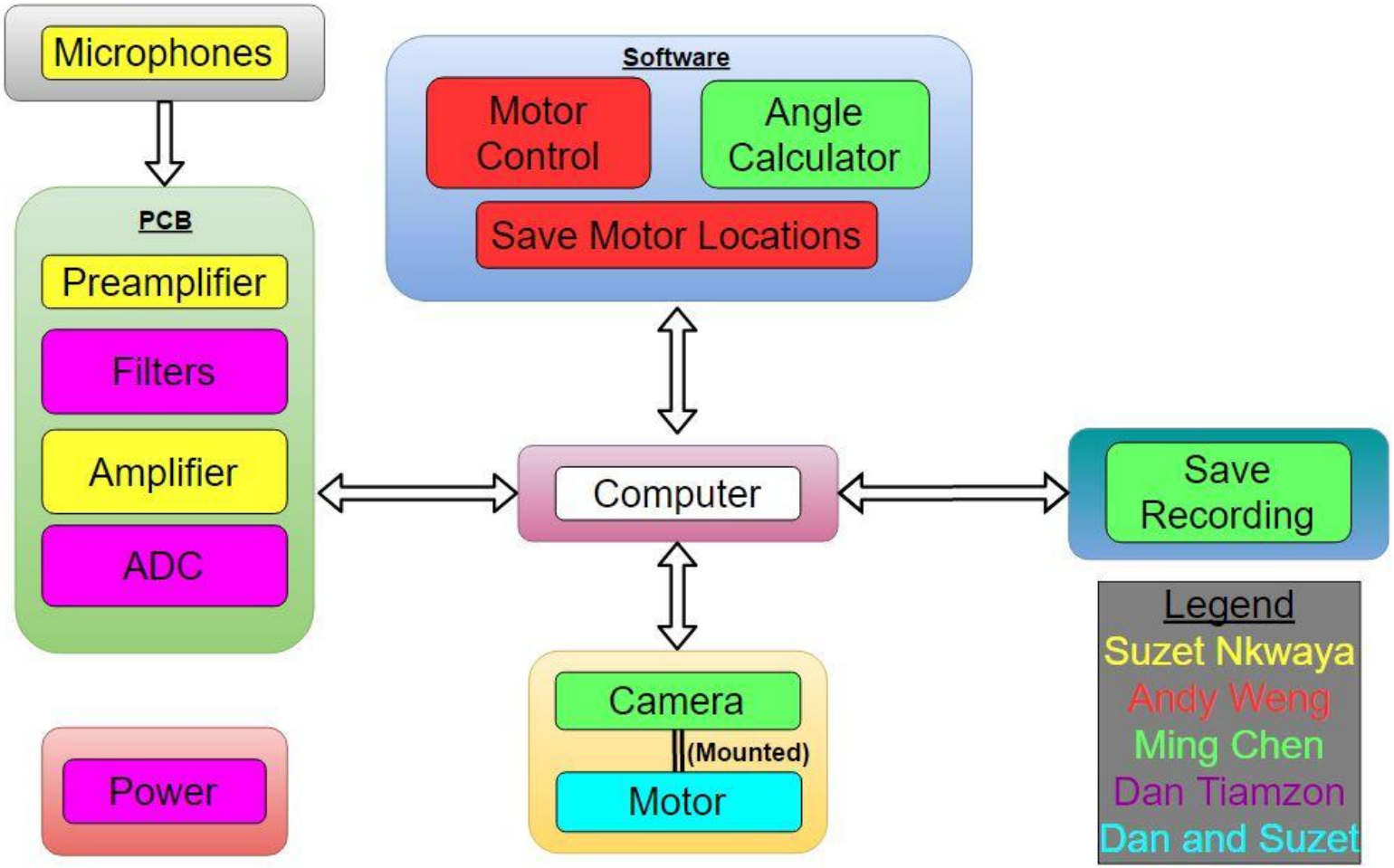
$$(b_x - x_0)^2 + (b_y - y_0)^2 = (r + 330b_s)^2$$

$$(c_x - x_0)^2 + (c_y - y_0)^2 = (r + 330c_s)^2$$

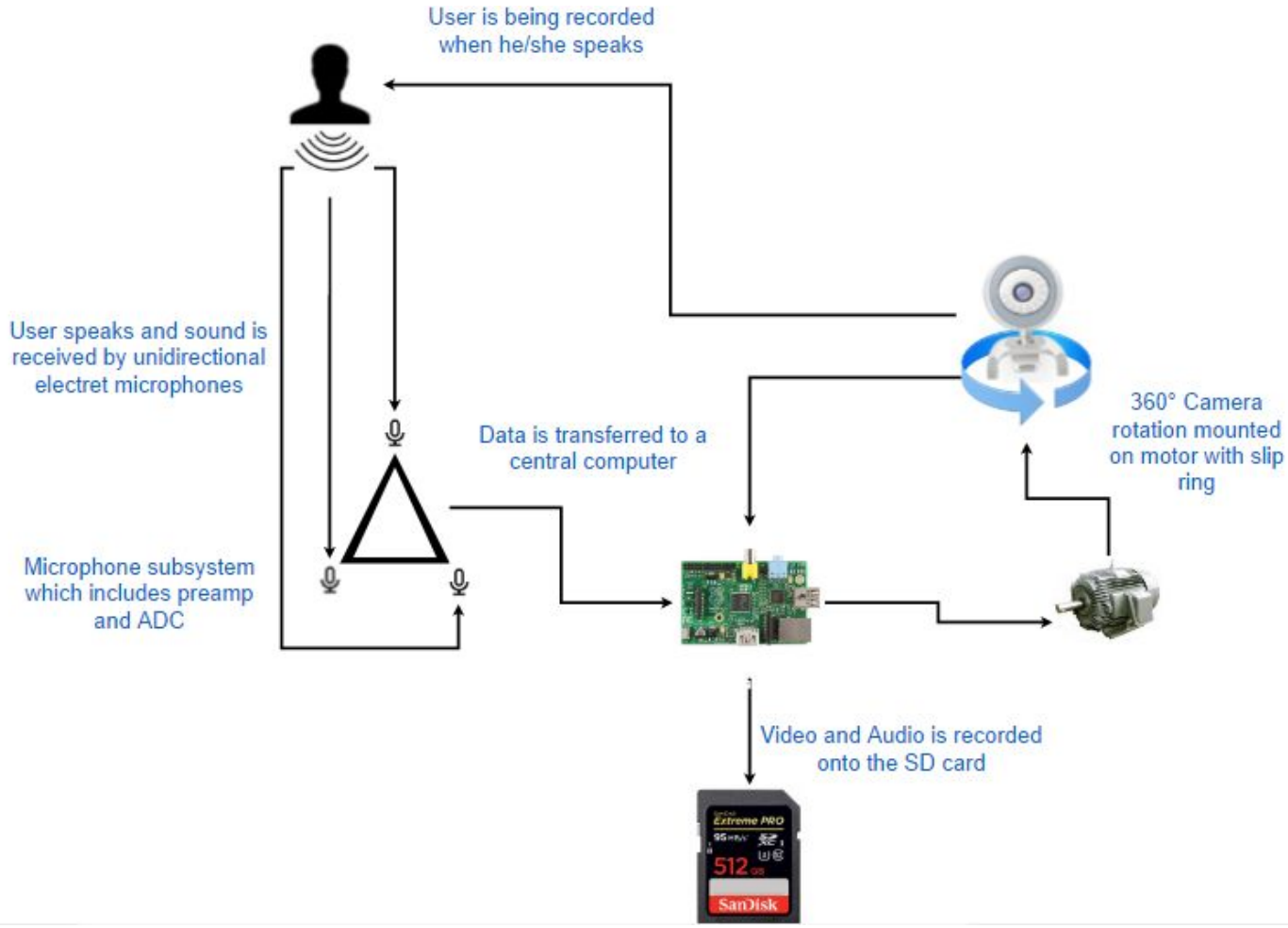
bs: time difference between mic 1 and mic 2

cs: time difference between mic 1 and mic 3

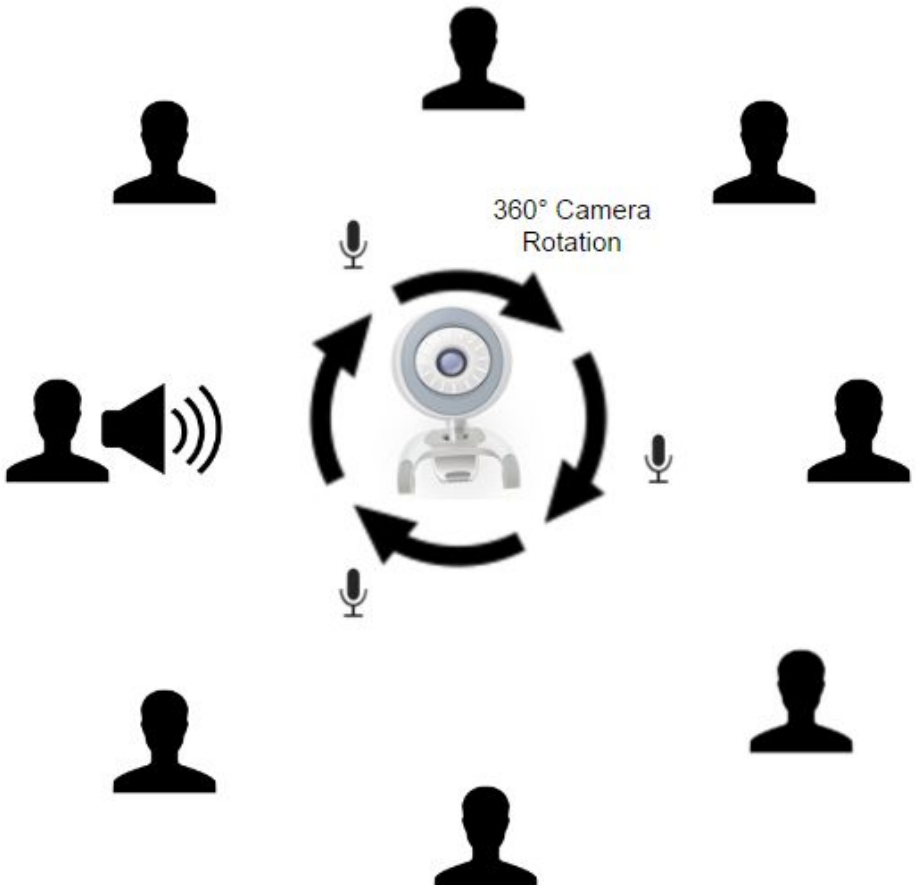
Block Diagram



Diagram


User is being recorded when he/she speaks
User speaks and sound is received by unidirectional electret microphones
Microphone subsystem which includes preamp and ADC
Data is transferred to a central computer
360° Camera rotation mounted on motor with slip ring
Video and Audio is recorded onto the SD card
512
SanDisk

Diagram



Requirements

- Real time sound locator
- Rotating stand that points almost immediately to the location of sound
- Effective for small to medium sized rooms
- Utilizing the right microphone sensitivity

Requirements: Inputs and Outputs

Input

- Sound

Output

- Source of sound
- Video and sound recording

Parts

- USB Webcam
  - Store video/audio on an sd card
  - Connect to Raspberry Pi
  - Easily mountable on motor

- Unidirectional electret microphones

- Motor with Slip Ring
  - AC620012S
  - 360 degree rotation

Software

- Python and C programming to
  - control motor
  - control camera
  - real time angle calculations

MDR Deliverables (Updated)

- Mainly present the concept of sound location
  - Set-up microphone array to sense sounds. (Suzet)
  - Raspberry Pi and Python Code to determine the order of which microphones receive signals. (Dan)
  - Code which implements TDOA using the order of microphones and estimate sound source location angle. (Ming)
  - Control rotation angle of the motor. (Andy)
- No implementation of video recording and saving.
  - Does not present the concept of sound locating.