Carnegie Mellon University
Master of
Software Engineering

# LG Architecture Training Program

## Project Technical Introduction

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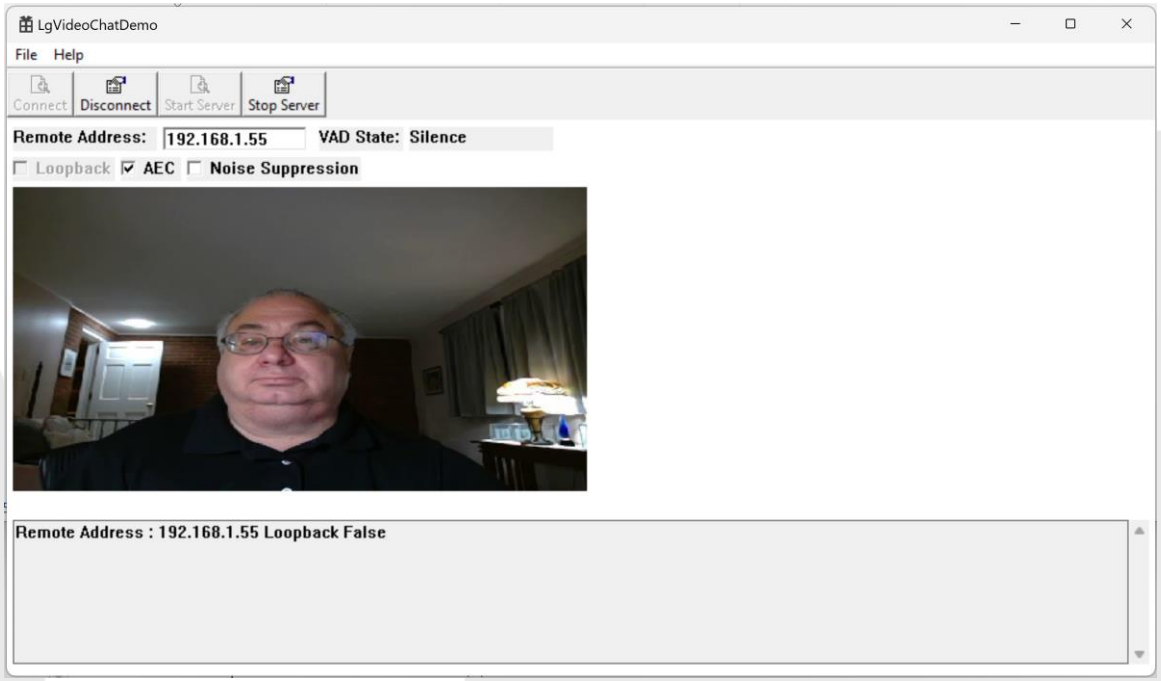
# Session Outline

- Project Purpose and Expectations
- Project Description
  - Overview the Voice over IP (VoIP) and Video Communication System
  - Project requirements and objectives

# Project Overview

Voice over IP (VoIP) and Video Communication System



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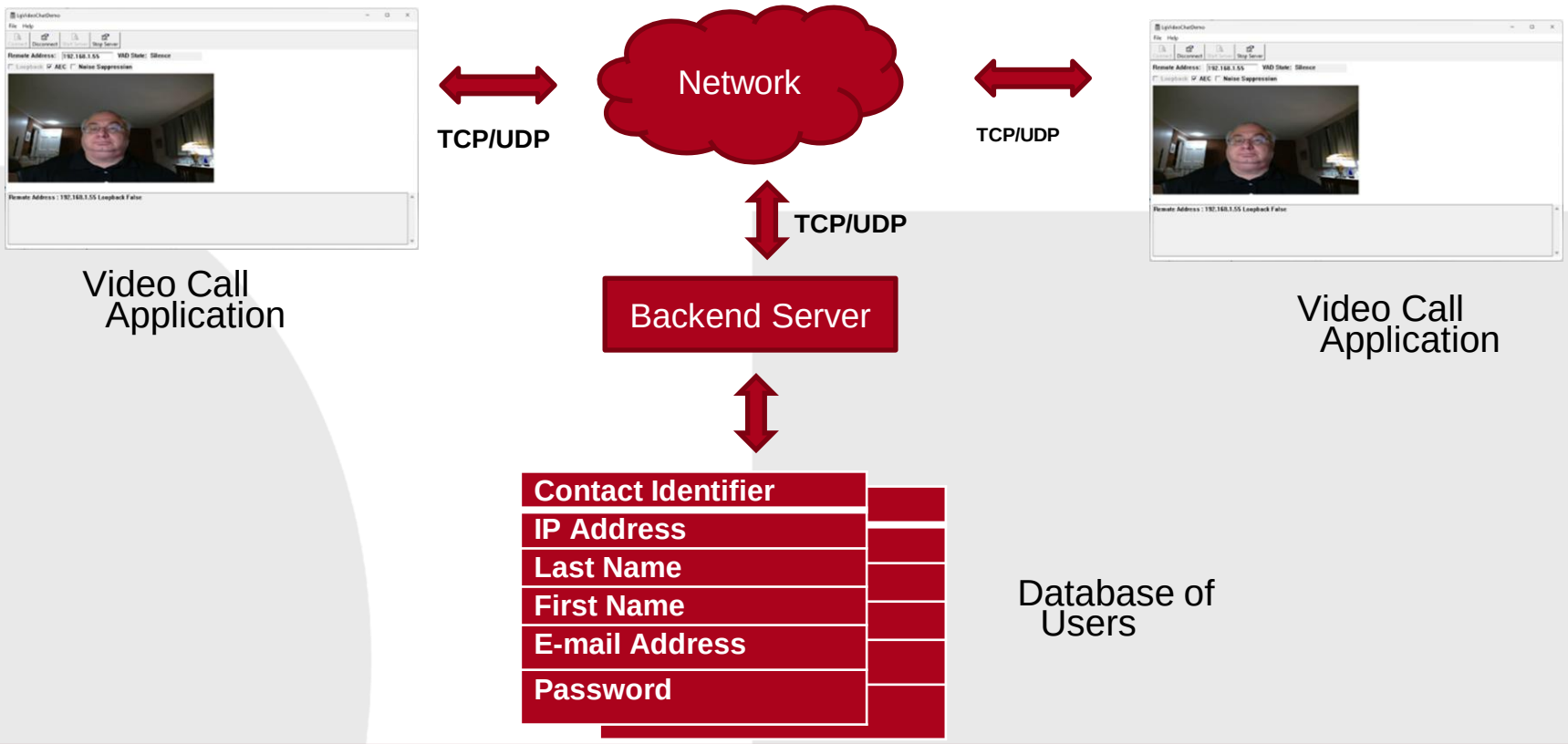
# Project Overview

- Architect a robust and secure Voice over IP (VoIP) and Video Communication System that consists of a Microsoft Windows application and a backend server that provides various capabilities
    - Ensure quality voice and video communication is secure and reliable.
    - Ensure that the system backend server and user application minimizes network bandwidth as necessary to maintain communication between the parties.
    - Provides the ability to easily add or replace codecs and/or encryption algorithms.
    - Support both point-to-point and conference calls

# Project Description – 1



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# Project Description – 2

**The Microsoft Windows user application shall provide the following functionality:**

1. The ability for the user to register with the system.
   a) The user shall provide the system their e-mail address and password. The system shall ensure that the user's password is secure.
   b) The ability for the user to update their e-mail address and password.
   c) The ability for the user to change their password or reset it in the event it is lost.
   d) After successful registration the system shall assign the user a unique contact identification name (contact identifier) this can be the users e-mail address or some other name chosen by the user if it does not conflict with other user's contact identifiers already in the system.

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# Project Description – 3

2. The ability to request a conference call identifier (like a contact identifier) for a particular date, time and duration from the server that is then distributed to participants via user application in an upcoming conference meeting list or via e-mail.

3. The ability to create a contacts list. To add a contact to the list the user can search users by last name, first name, address, e-mail, or contact identifier. When a contact is associated with a contact identifier the VoIP application shall display the contact's name instead of the contact identifier.

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# Project Description – 4

4. All communications shall:
   a) Provide high quality low latency with strategies for dealing with packet or data loss and jitter.
   b) Support a video call if there is enough available bandwidth.
   c) Adjust bandwidth use as necessary to maintain communication quality.
   d) Provide secure communication.
   e) Provide reliable signaling for both inbound and outbound calls including dropped call detection.
   f) Notify users of lost connections.
   g) Provide acoustic echo cancellation (AEC).
   h) Provide voice activation detection (VAD). The user application shall not send voice data during periods of silence when the user is not speaking.

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# Project Description – 5

5. The ability to initiate a call using a contact identifier or the contacts list. During the call initiation, the user shall be presented with call status and outcome (answered, busy or rejected). During call initiation the user shall have the ability to end the call at any time.
6. Provide the ability to accept or reject calls while not in a call. Application shall show the caller's contact identifier or contact name during an incoming call.
7. Provide the ability to terminate a call at any time while in a call. If a call is terminated by one user, the other caller shall be notified.
8. Notify the directory services component of the backend server of IP changes.
9. Provide the ability for the developer/maintainer to easily add or replace codecs and/or encryption algorithms.
10. Application shall be brought to the foreground during an incoming call.

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# Project Description – 6

The server application shall provide the following functionality:

1. Register each user's e-mail address and password. The system shall ensure that the user's password is secure.
2. The server shall provide a directory services capability that maps a device's contact identifier to its current IP address.
3. Ability to schedule and support video conference calls. Conference calls shall be scheduled with participants via a conference identifier.
4. The ability for the administrator to view user accounts and disable, enable, and delete user accounts.
5. Provide the ability for the developer/maintainer to easily add or replace codecs and/or encryption algorithms.

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# Project Description – 7

**System Software**

- Windows OS 10/11  running on multiple laptops for development and to run the client applications and backend server
- Microsoft Visual Studio Community 2022 Addition (download from Microsoft)
- Open CV 4.7.0

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# Project Description – 8

**Sample/Demo Code**

- Sample Microsoft Windows VoIP Video Application written in C++/C

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# Project Description – 9

## System Hardware

- Teams will utilize LG's Wi-Fi network for normal application development, testing and demonstrations. If desired, LG may provide teams with individual Wi-Fi routers.
- You will receive a Raspberry Pi 4 T test router with two Wi-Fi access points (AP's) that has the ability to add network jitter and randomly drop network packets at rates specified by the user. This router is controlled via ssh using the supplied shell scripts.
- Teams will use their laptop to serve as part of their development environment and possibly to run the server and its user interface. Therefore, team laptops will need to be configured to connect to LG's Wi-Fi Network or a LG supplied Wi-Fi Router and the supplied test router.

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# Project Description – 10

- You may use your laptops to assume various roles in your system in anyway you like
- You may use 3rd party, open-source SW, but please check with the owner (course instructor).

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# Project Hints -1

Get familiar with

- Secure communication techniques and encryption
- VoIP concepts
- Video and MPEG
- Codecs
- Jitter
- Techniques dealing with packet loss (voice data)
- Voice activation detection (VAD)
- Windows development environment

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# Project Hints -2

- There are numerous online resources you can take advantage of
  - The Video and VoIP Demo in C++ provides code samples to work from so that you will not have to struggle with all of low level details
  - https://en.wikipedia.org/wiki/Motion_JPEG
  - https://www.voip-info.org/qos/
  - http://mjpeg.sourceforge.net/files/mjpeg-howto.pdf
  - https://netbeez.net/blog/impact-of-packet-loss-jitter-and-latency-on-voip/
  - https://voipstudio.com/voip-how-much-jitter-is-acceptable/

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# Project Prerequisites - 1

- Install Microsoft Visual Studio Community Edition 2022 https://visualstudio.microsoft.com/downloads/
  - You will need C++ language support

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# Project Prerequisites - 2

- Download the following files from Canvas
  - ✓ opencv-4.7.0-windows.exe
  - ✓ LgVideoChatDemo05-11-23.zip
- In the same directory
  - ✓ Execute opencv-4.7.0-windows.exe and extact the files
  - ✓ Unzip LgVideoChatDemo05-11-23.zip
- Load LgVideoChatDemo Solution into Visual Studio
- Set solution to release
- Build Solution
- Ensure projects build successfully

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# Contact info

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