Senior Design Project Description – COE Department Project

Department Name	*Electrical and Computer Engineering*	Date Submitted	*4/23/2019*
Project Title	*Real-time Information Retrieval from Networked Camera System using Mobile Mixed Reality Device – Phase 2* **UNCC_CAM2**	**Planned Starting Semester**	*Fall 2019*

Personnel

Typical teams will have 4-6 students, with engineering disciplines assigned based on the anticipated Scope of the Project. 250 hours are expected per person.

Complete the following table if this information is known, otherwise the Senior Design Committee will develop based on the project scope:

Discipline	Number	Discipline	Number
Mechanical		Electrical	2
Computer	4	Systems	
Other ( )			

Project Overview:

The global video surveillance market is expected to worth $71.28 Billion by 2022, at an estimated CAGR (compound annual growth rate) of 16.56%. Nowadays, video surveillance cameras are widely deployed in public places and office buildings. However, the current video analytics system relies on data centers to processing the collected video and cannot retrieve information from the camera system in a real-time fashion. In addition, mobile users are not able to interact with the camera system and obtain information from it.

In this project, a networked camera system will be developed together with an application in mobile mixed reality device to enable real-time information retrieval from the networked camera system on the mobile devices. For example, a user with the mobile mixed reality device can query the camera system about a targeted object, e.g., a red Honda Civic. The camera system will feed the video stream from the camera that captures the vehicle or provide some location information to the user. In this project, the students will learn a wide range of new knowledge including networked system design, communication protocols, software-defined network, machine-learning frameworks, and mobile mixed reality application development.

The estimated cost of the project in terms of hardware and equipment is about $25,000. However, all the required hardware and equipment have already been acquired by Dr. Tao Han using his NSF Grants, Faculty Research Grants, and startup funding. Figures 8 and 9 show the examples of the hardware and equipment that are available in Dr. Han's research lab for developing the mobile mixed reality and networked camera system. All the hardware and equipment will be provided to the students who are working on the project.

Fig. 1 Mobile Mixed Reality Device and System.

Fig. 2 Networked Camera System.
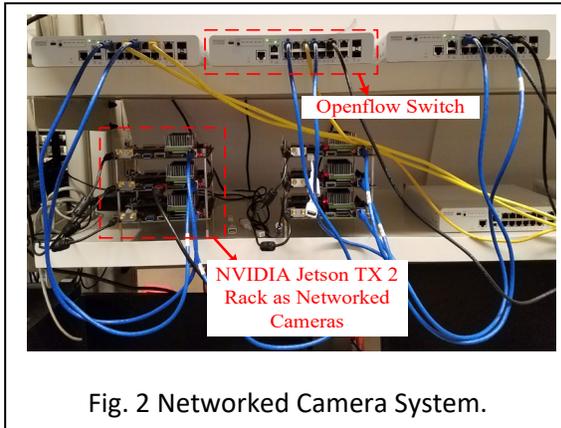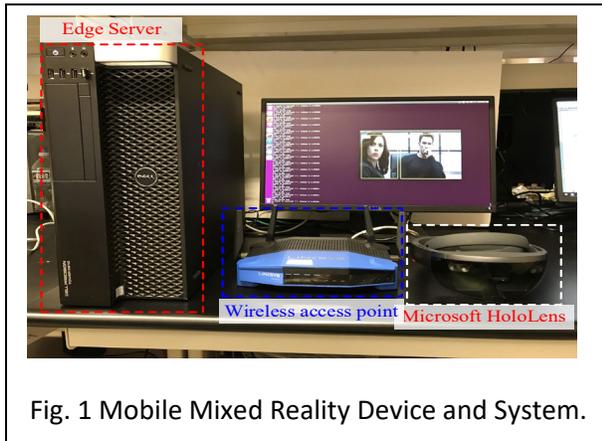
Project Requirements:

The network camera system that will be developed in the project is illustrated in the Figure 3. The

Fig. 3 The System Overview in the Project.
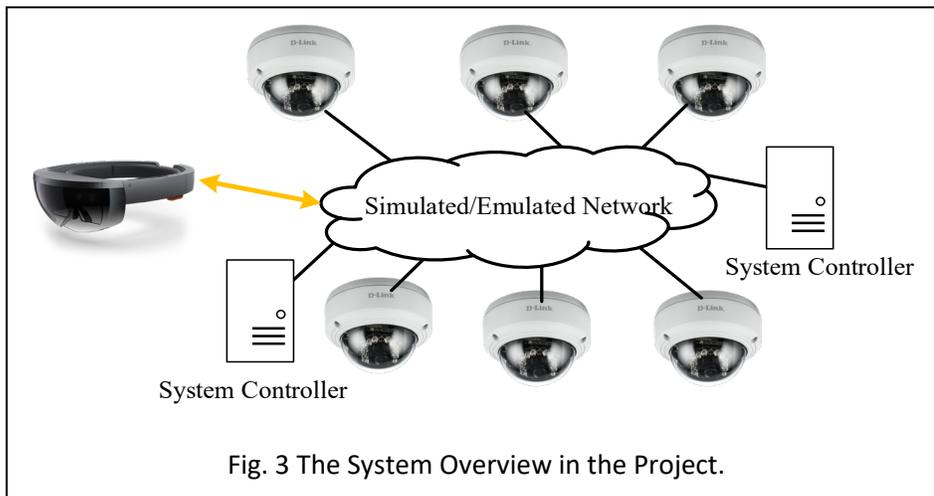
network cameras will be emulated by NVidia Jetson TX 2 embedded system development boards. The mobile user device is Microsoft HoloLens. The system controllers are Dell workstations with advanced GPUs. In the project, the application developed in Microsoft HoloLens will enable the user to retrieve information from the camera networks in real-time fashion. The information retrial will rely on new networking protocols and computer vision and machine learning algorithms.

Dr. Han and two of his Ph.D. students will work closely with the senior design team to ensure and progress of the project. Ephraim Moges, who is an early-entry Ph.D. student, will work on the senior design team. Several students from my course ECGR 3123 also show interests and aim to participate in the project.

Specific Requirements:

1. The students who are in charge of different parts of the network system should learn the corresponding skills to build the system. The skills including the network simulation using NS-3/Mininet, software-defined networks, mobile application development using Microsoft HoloLens, and computer vision and machine learning frameworks. Note that students will be assigned specific tasks and learn one of the skills (do not have to learn all the skills).
2. Complete the networked camera system design in which the cameras can talk to any of the system controllers and stream videos to the controller and mobile users.
3. Complete the application development in Microsoft HoloLens in which the application can allow users to input any queries and send them to the system controllers. The application should receive information/video streams from system controllers/cameras.
4. Design a network management algorithm to manage the networked camera system in which the performance of the camera system in terms of latency and query quality is optimized.
5. Implement computer vision or machine learning framework to analyze and retrieve information form camera videos.
6. Design a poster and demo which will be submitted to a top-tier computer network conference.

Expected Deliverables/Results:

1. *A networked camera system that interconnects multiple cameras through a simulated/emulated wireless/wired networks.*
2. *A camera network management algorithm that optimizes the network performance of the interconnected cameras with software-defined network technology.*
3. *A mixed reality application developed in Microsoft HoloLens that enables the interactions between a mobile user and the networked camera system*
4. *A simple networked machine-learning framework for retrieving information from the camera network.*
5. *A poster/demo based on results of the senior project will be published in a top-tier computer network conference.*

Disposition of Deliverables at the End of the Project:

The hardware developed in the project team will be placed in Mobile Networks and Systems at EPIC 2378.

List here any specific skills, requirements, knowledge needed or suggested (If none please state none):

Required
- Strong motivation to learn new knowledge
- Strong programming skills in C or C++
- Basic knowledge of computer networks and systems

Suggested (the following knowledge is desirable but can be developed during the project)
- Basic knowledge of network simulators, e.g., NS-3 and Mininet
- Basic knowledge of wireless communications and network

- Basic knowledge of software-defined network and Openflow protocol
- Basic knowledge of machine learning and computer vision
- Basic knowledge of mobile game developments, e.g., Unity game engine