VirginiaTech
Invent the Future

# Final Project

## ECE 4564 - Network Application Design

**Dr. William O. Plymale**

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BRADLEY DEPARTMENT
of ELECTRICAL & COMPUTER ENGINEERING

# Final Project Guidelines

The project is an opportunity for you to:

- Demonstrate your knowledge of network application concepts from class
- Be creative and design your own app

Project Requirements

- Your app must have a significant network component
- Your apps must be highly dependent on network communications for the app to work
- Your project should be a networked IoT app where your Raspberry Pi is an integral part of the application you propose to build
- Projects should be challenging – more complex than assignments

# Significant Network Component

- Sockets
- Message Queues
- RESTful

# What is a Network IoT Application?

Your project needs to incorporate and demonstrate at least one of the following:

- Real-time communication with physical objects
- Sharing of physical things on the Web
- Resource and location Discovery
- Ambient Information / Calm Technology
- Adaptive Interfaces
- Event Notification
- Context Awareness (user / time / location)

# Final Project Components

Your final project can contain a mobile component:

- Android
- iOS

However, main system components written in Python3.

Suggested topic areas:

- Assistive Technologies / Medical / Aging in Place
- Cybersecurity
- Gaming
- Instructional Aids – Teaching and Learning
- Campus Life – Safety / Convenience

# Discouraged Topics

- Smart Mirrors
- Security Systems (including door bells that take your photograph)
- Lighting and/or Music Controllers
- Weather Stations
- Home Automation
- Pet Feeders
- Plant Irrigation System
- Campus Parking
- Blacksburg Transit

The above topics have mainstream implementations.
Your project ideas should be clever and innovative.

# Teams

- The final project is a team project.
  - Will consist of current 3-person assignments teams

- Teams decide on a project idea
  - Your project idea should be big enough that all team members can make a significant contribution to the project

# Final Project Grading

Final Project – 30% of final grade

Components of final project grade:

- Proposal Report (50 points)
- Class Presentation (50 points)
- Beta Demonstration (50 points)
- Final Presentation (150 points)

# Final Project Due Dates

March 25 @ 11:59pm – Project Proposal Submission (Canvas)

(Proposals reviewed by instructor and GTA)

April 12 / April 17 – Teams give proposal presentations to class

April 26 / May 01 – Beta Build Demonstrations

May 7 (Final Exam Period) – Final Project Demonstrations

2:05pm – 4:05pm

# Final Project Proposal

For the final project you'll need to write a proposal that discusses the following items:

1. Concept of operations
2. System overview
   a) System Diagram
   b) Description of system modules
   c) 4 testable requirements
3. Hardware list
4. Project Schedule
   a) Timeline with tasks and milestones
   b) Specify the tasks each team member is working on

# Concept of Operations (CONOPS)

CONOPS is a high level description of a system's purpose, goals, and how users will interact with the system to achieve goals.

Your CONOPS statement should answer the following questions:

- What is my system doing?
- What is the goal of my system? (i.e. What real-life challenge am I looking to address or solve?)
- Why is this goal meaningful and important? (i.e. why should I pay for this?)
- How will a user interact with my system?
- How will my system achieve the stated goals? (i.e. What outcomes and impact, do you as designers, expect your system to have?)

# System Overview

The System Overview is a logical breakdown of your CONOPS into discreet pieces or modules, where you describe what each module does, and how it interacts with other modules

Describe your system

- What are the major pieces?
- What is each piece supposed to do?
- How will each piece accomplish its given task?
- How do those pieces combine or couple?
- For this project, many of the pieces should be coupled via a network (i.e. a custom socket protocol, HTTP, AMQP, or another protocol)

Your proposal includes a visual diagram of your system depicting the major pieces and their interactions.

# Testable Requirements

Requirements form a set of statements that describe the user's needs and desires. Requirements statements describe what the software system should be, but not how it is to be constructed.

Evaluation your requirements is based on the following characteristics:

1. Your requirements should express what your product / application / system must do and how well it must operate. Every requirement should identify an operational function and its associated measures of effectiveness.
2. Requirements must be unambiguous. Requirements should not be expressed using language that may be vague or unclear. A properly stated requirement should be written in a manner that leads to one, and only one, interpretation.
3. When expressing requirements, many times the requirement uses the verb **"must"** to indicate that a feature is an essential requirement of a piece of software or larger system.

# Examples

- The Raspberry Pi must detect beacons that come within 15 meters of its location
- Service must report its status via a restful interface to a browser interface
- The weather server must handle 100 simultaneous requests

# Testable Requirements

In your proposal you must state at least 4 clearly defined testable requirements

- Your requirements will be used to grade your beta and final project demonstration.
- Your requirements will be reviewed as part of the proposal grading process.
- Each major component of your system should have at least one testable requirement.
- Each team member is responsible for at least one of the testable requirements.
- The instructor and GTAs may add or remove requirements based on your project description.

# Hardware List

Your report should provide a list of items that comprise the system you propose to build

- Your hardware list should include all physical items you need for the project
  - Be sure to include your Raspberry Pi kit items in your parts list
  - Include the quantity of items your project will use
  - Include part numbers, costs and website links (ex. SparkFun, Adafruit, Mouser, …)
- I will make every attempt to get you additional hardware you request.
- Requesting the hardware does not guarantee you will get what you request.

# Project Schedule

Your team needs to come up with a schedule for how you will complete your project. Your timeline should show:

1. A list of development tasks
   (e.g. Write modules, system integration)
2. Your schedule should include at least 2 milestones:
   - Beta Demonstration
   - Final Demonstration
3. For each development task, identify which team member(s) will be working on the task
4. You may wish to show your schedule as a Timeline or Gantt Chart.

# Proposal Grading Guidelines

General – 15%

Does the proposal use a major net app communication method and demonstrate an IoT component?

CONOPS – 20%

System Overview – 30%

System overview questions addressed, clear description of system modules, **system diagram**, testable requirements

Hardware List – 20%

Quantity, Part Numbers, Cost, Supplier Website Links

Schedule and Team Roles – 15%

# Proposal Submission

All proposal materials must be submitted through Canvas

- Only one (1) member of the team should submit the assignment to Canvas
- Your proposal submission is a single PDF file.
- Must be submitted to Canvas by Sunday, March 25 @ 11:59PM

# Example Proposals

- Review example project proposals on Canvas
- Files/Final Project/Example Proposals

# Project Review

- Instructor and GTA will review Final Project Proposals
- Any modification recommendations will be sent to teams prior to March 30.

# Proposal Presentation

Your team will be presenting your proposal idea and plan to your classmates during regular class meeting.

Presentation format:

- 5-7 Powerpoint slides
- Duration of presentation: 5 minutes

Presentation submitted to Canvas by April 17 @ 11:59pm as a PDF  file ( PowerPoint document converted to PDF).

# Presentation Contents

1. Your Concept of Operations
   a) What is your project?
   b) What you are trying to accomplish?
   c) Why is this idea novel and worth pursuing?
   d) Your team's approach to implementing the project

2. Your system diagram
3. The network communication mechanisms used
4. Your four testable requirements
5. Identify the role of each team member
   a) Responsible for which requirement
6. Review your schedule for the project

# Presentation Guidelines

Teams will be assigned a presentation date.

All team members must be present for their presentation.

# Beta Build Demonstration

Each team will discuss progress made toward final project completion.

Each team must demonstrate implementation and execution of one of the four system requirements.

- Each meeting will be 10 minutes during class hours.
- All team members are required to  attend

# Final Demonstration

Each team will present their Final Project during the class final exam period.

# Sample Demo Scoring Sheet

## Team 17

## Smart Garage Access

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**Testable Requirements**

- The system must be able to differentiate authorized and unauthorized users by the phone number used to connect to the Twilio API.
- The system must be able to connect to the client raspberry pi and trigger the GPIO only when requested by the webserver pi.
- The client pi must report whether it is listening to the RabbitMQ queue and the webserver must update the client state to “offline” when the client pi isn’t reporting for a set period of time.
- The webserver must provide a user interface that allows the creating and editing of both temporary and permanent users. (Users identified by phone number)
  - Permanent users have access 24/7
  - Temporary users can have 1-time use access, or time-restricted access.

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- All team members present
- Optional Video

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**Comments**

# Software Repository

Teams will store all system source code in a software repository such as GitHub.

# Closing