CS 682-01: Software Development Lab Projects
Fall 2023

1 Drone Mesh Communication Network

Admin: Tomas Materday, UMass Boston Engineering Department, Tomas.Materdey@umb.edu

Description: This project teaches students how to set up a mesh communication network that can relay sensor data and the drone's telemetry information, which influences the following action of the drone through a flight computer - flight controller communication. Students will learn about balancing part functionality, weight, drone payload, and power management. They will use machine learning to predict if the sensor temperature and humidity data are consistent with fire/no fire situation. A web dashboard to visualize output will be helpful.

Skills and Technologies Required:

- Web application development.
- Machine Learning.
- Experience with APIs.

Resources: Resources can be made available upon request

2 Autonomous Drone

Admin: Tomas Materday, UMass Boston Engineering Department, Tomas.Materdey@umb.edu

Description: This project teaches students how to create a flight computer to interpret lidar/stereoscopic camera depth images, learn about the environment, and create a flight path without GPS information. The flight computer will then communicate the flight path to the flight controller, which commands the drone through obstacles to its destination autonomously. A web application to visualize drone paths will be helpful.

Skills and Technologies Required:

- Web application development.
- Experience with APIs.

Resources: Resources can be made available upon request.

3 Compact Aerial Mapping System

Admin: Tomas Materday, UMass Boston Engineering Department, Tomas.Materdey@umb.edu

Description: This project teaches students how to use ground control software to design a flight path for a UAV to image a large area, then stitch images together with referenced locations to generate an accurate map. It also teaches students how to plan a large operation in stages, manage risks, and obtain flight permission in a restricted airspace like our campus while following all FAA safety regulations.

Skills and Technologies Required:

- Experience with API

Resources: Resources can be made available upon request.

4 A Portal for Managing Students Capstone Projects

Admin: Kenneth Fletcher, UMass Bosont, kenneth.fletcher@umb.edu

Description: I am looking for a web-based application to manage projects for my software engineering/ development courses. The application should have the following functionalities:

- Prospective clients should be able to post projects.
- Students should be able to review the projects posted.
- Students should be able to submit their project preferences.
- The application should be able to put students in groups based on an algorithm I will provide.
- Have a nice user interface.

Skills and Technologies Required: TBD

Resources: Resources can be made available upon request.

5 AR Assistant for Astronauts

Admin: Tomas Materday, UMass Boston Engineering Department, Tomas.Materdey@umb.edu

Description: This project teaches students how to deploy a wireless network of sensors that can send data wirelessly to an AR device for display. This device operates on a specific software platform. Students will use machine learning to predict heart rates and assist the astronaut with an alert if an anomaly is detected for a given activity level.

Skills and Technologies Required:

- Networking.
- Machine Learning.
- Augmented Reality.

Resources: Resources can be made available upon request.

6 Smart Recharging Platform for Drones and Ultracapacitors

Admin: Tomas Materday, UMass Boston Engineering Department, Tomas.Materdey@umb.edu

Description: This project teaches students how to apply circuitry, electronics, communication, and programming skills to design a multi-component electro-mechanical system that works together to achieve a specific goal. It requires using CAD and animations to design a proper sequence of events to communicate its readiness to the drone, release the battery once it is landed, put it to charge, and replace it with a fresh one.

Skills and Technologies Required:

- CAD

Resources: Resources can be made available upon request.

7 Artificial Intelligence Animal Gates

Admin: Tomas Materday, UMass Boston Engineering Department, Tomas.Materdey@umb.edu

Description: This project teaches students how to create a set of two intelligent and autonomous gates that operate 24/7 with minimum solar energy use. They will label many animal images, use them to train a computer algorithm to recognize the right one and load it onto an embedded system attached to a camera, light, ultrasonic sensor, and motor to operate the gates independently. The two gates will communicate to each other their state for safe opening and closing operations for the right animal to pass through.

Skills and Technologies Required:

- Machine learning

Resources: Resources can be made available upon request.

8 Structure Digital Twins

Admin: Tomas Materday, UMass Boston Engineering Department, Tomas.Materdey@umb.edu

Description: This project teaches students to geolocate inside a building, sense, process, and transmit data wirelessly 24/7 to a central server. The server will integrate these data with a 3D model of a structure, which they scan with a drone, to create a digital twin. Students will learn to plan a large operation in stages, manage risks, and obtain flight permission in a restricted airspace like our campus while following all FAA safety regulations.

Skills and Technologies Required:

- Networking.
- Experience with API.

Resources: Resources can be made available upon request.

9 Meeting App and OCR

Admin: Brian Beauford, Grace Church Avon, kenneth.fletcher@umb.edu

Description: Subscription-based access to an application that would allow an organization to run better meetings at all levels. I do coaching about how to run meetings and I'd like to be able to let people run meetings using my meeting system. Here are some features:

- Schedule future meetings
  - Choose a meeting type (8 types)
  - Invite others
  - Include agenda
- Take notes in that meeting,
  - Assign tasks to people
    - Task title
    - Description
    - Due date
    - Priority (low, normal, high)
  - Notify people of tasks
  - Notify people of upcoming tasks that are due
  - Allow people to mark as complete. (https://help.zoho.com/portal/en/community/topic/how-to-include-a-link-response-in-email-to-update-a-field-in-record)
  - Store meeting details, notes, and tasks for review.
- Dashboard
  - Number of active tasks
  - Number of tasks due this week
  - Calendar with upcoming meetings and task due dates
  - List of upcoming meetings
  - List of upcoming tasks
  - List of past meetings filter by:
    - Meeting type
    - Date
    - People invited
    - Search by title or notes
  - Notify/ping people about a task (assignment and dues date) https://help.zoho.com/portal/en/community/topic/tip-15-how-to-schedule-a-task-that-runs-at-specific-time-intervals
- Subscription / User Management
  - Each Org would have a "CEO" who could see everything in their org.
  - CEO could add "Leaders" that are able to schedule/run meetings
  - Leaders can also see their meetings and the tasks associated with those meetings.

* An initial version of this app has already been built. Students will extend this app and include new functionalities.

Skills and Technologies Required: TBD

Resources: Resources can be made available upon request.

10 Web Application for an Author - By the fireside Stories

Admin: Esi Adeborna, kenneth.fletcher@umb.edu

Description: This project requires that students develop a web application for a book author. The book series, by the fireside stories (https://www.amazon.com/Fireside-Stories-Ananse-Mysterious-Stone/dp/1725611821/ref=sr_1_1?crid=3K2XQSX5H7UYP&keywords=esi+adeborna&qid=1694482669&sprefix=esi+adeborna%2Caps%2C92&sr=8-1), is designed for kids. Although this project may seem straightforward, it requires a great deal of kid-friendly UI/UX designs and e-commerce. Example web application is: https://perbicubs.com/

Skills and Technologies Required: TBD

Resources: Resources can be made available upon request.

11 Guidepoint Global

Admin: Saumil Shah, GuidePoint, sshah@guidepoint.com

Description: About Guidepoint: Guidepoint is a global leader in the 'Expert Network' industry; connecting clients with subject matter experts (Advisors) that enable clients to make informed decisions with precision through one-to-one expert calls, scalable surveys, and in-person events. We've diversified into ancillary businesses, such as live events, audio/transcript libraries, surveys, legal witness services, and medical therapeutics data.

Area of focus: In our core expert network business, Guidepoint must conduct vetting of Advisors to ensure candidates meet and/or exceed the qualifications to speak to the client on the matter of interest. One of the methods of vetting is client-supplied screening questions. Questions are captured on a customized application after accepting a unique project invitation. Invitations are sent to a short list of candidates sourced via keyword and semantic search through our network of 1.5 million vetted and onboarded Advisors. Our custom question platform delivers dynamic question and answer capturing capabilities, supporting various question types (yes/no, multiple choice, matrix/likert, open ended, etc).

Use Cases: The first use case optimizes client-expert matching by leveraging advisor expertise and historical screening questions, ensuring accuracy and efficiency. In the second use case, we aim to eliminate redundant questions previously addressed by experts. Both scenarios prioritize enhancing advisor engagement and streamlining interactions. These use cases harness cutting-edge AI technologies, including Large Language Models, Embeddings, SQL and Vector databases, ElasticSearch, and the Azure cloud platform, alongside web application development, to deliver their intended outcomes.

Opportunity for Students: Engaging in this software development project offers students the chance to translate their classroom knowledge into practical solutions, employing state-of-the-art AI/ML techniques. It provides valuable real-world experience collaborating with seasoned professionals, including architects, engineers, product development managers, quality assurance experts, and DevOps teams, all within an Agile Scrum framework on a Cloud Platform.

Resources:

- Resources can be made available upon request.

12 Gamification Web Application for SAP

Admin: Kenneth Fletcher, UMass Boston, kenneth.fletcher@umb.edu

Description: The gamification web application (GWA) aims to improve user motivation and engagement while using SAP GBI case studies. GWA has been designed based on a three-tiered (client-server-database) architecture. The database layer stores user login accounts, the server serves as dynamic pages for GWA, and the SAP View provides an interface between GWA and a custom SAP OData service (API) from Fiori. The opportunity here will be for the student team to extend the existing GWA to include new functionalities. In addition, students will develop a web extension that displays some of the game elements directly on the SAP web interface.

Skills and Technologies Required:

- C# ASP.Net
- Web Extension Development

Resources:

- Resources can be made available upon request

13 Mobile Application Development

Admin: Brian Beauford, Grace Church Avon, kenneth.fletcher@umb.edu

Description: This project is to develop a mobile application using RockRMS (https://www.rock-rms.com/). RockRMS is an open-source cloud software specifically designed for church management. The is currently building a website using RockRMS as a foundation but would like students to develop a mobile app as well.

Skills and Technologies Required: TBD

Resources: Resources can be made available upon request.