A picture containing text, clipart

Description automatically generatedProject Scope document

January 23, 2024

# Project Objective

Develop an Arduino-based platform that has the versatility for multiple sensors, motors, and expansion for use in the the Engineering Fundamentals class as well as future ET/ENGR classes. The development project should be completed by June 30th, 2024 at an overall per unit cost to the department to provide the platform kit at no more than $200. The project development budget is $8,000 inclusive of labor costs.

# Project Scope description

The completed project will result in an Arduino-based platform capable of multiple types of projects including a mobile robot capable of autonomous sensing, color detection, gyro capturing for positioning, touch sensors and remote control using an RC controller or laptop without tether – all controlled using a MATLAB toolbox for Arduino control. The project platform should be relatively inexpensive, utilizing as many COTS technologies in order to reduce costs and simple to asemble and modify for the addition of a variety of student design kits that can be used in subsequent courses in ET and ENGR courses.

# JUStification

This is a replacement platform to replace the Lego EV Mindstorm Robotic Kit that has been discontinued and the kits are slowly being cannabalized as parts go missing. The Arduino-based platform will be less costly and can be utilized in subsequent classes and for a longer planning horizon.

# Deliverables

* Early Concept Design Alternatives
  + Select criteria for evaluation of alternatives and rank weighting of criteria
  + Select end-product capabilities and flexibility for add-on components (consider other classes in the curriculum that could utilize the platform given the proper sheilds and input/output devices such as LED, Speakers, Op Amps, etc.) – finalize a product specification “wish list” and minimum product requirements.
  + Product search of existing COTS Arduino platforms (i.e. <https://www.waveshare.com/product/arduino/robots/mobile-robots/alphabot-ar-basic.htm>); Order multiple (2 -3), pre-developed platforms as a beginning point for testing and capability analysis;
  + Develop pros and cons of existing COTS alternatives;
  + Consider, hats/shields/sensor options, derivatives of designs, and ground-up options;
  + For each platform and major derivatives of each platform, consider the variety of student creative experiments that can be completed and level of difficulty;
  + **MILESTONE #1 – Select 1 or 2 platforms for continued consideration (February 23, 2024)**
* Testing of candidate platforms
  + Testing using C-Sharp for the Arduino
  + Testing using the MATLAB toolbox for Arduino
  + Test alternative shields, sensors, motor drivers, robot grippers, etc.
  + Test MATLAB limitations for the Arduino-based platform
  + Develop a capability analysis that is mapped to the Product Specifications “wish list” and Product Requirements.
  + **MILESTONE #2 – Demonstration to decision makers of testing pros and cons and overall recommendations** **(March 29)**
* Engineering Fundamentals Course Development Modules
  + Introduction
    - Arduino fundamentals
    - Platform functionality and organization
    - Safety orientation and potential risks (battery safety, pinch hazards, incorrect voltage and pin connectors, etc.).
  + MATLAB Toolbox for Arduino
    - I/O addressing
    - Variable definitions
    - Collection and manipulation of sensor data
    - Controls of motors and positioning
  + MATLAB feedback and use of:
    - Optica/IR sensor
    - Touch Sensor
    - Gyro positioning
    - Motor control
    - Color sensor
    - Sound output
    - LED output
  + Sample Project Codes and Demonstrations
  + **MILESTONE #3 – Demonstration to decision makers of Sample Project Ideas and Codes** **(May 3)**
* Extensions to other ENGR Electronics classes – Collecting Feedback
  + ENGR 3520 (Digital Circuits)
  + ENGR 3530 (Electronics and Instrumentation)
  + ENGR 3540 (Intro to Feedback Loop Control)
  + **MILESTONE #4 – Write a brief report on additional shields and common products that students could select from to create a specialized project** **(June 30)**

# Technical Requirements

* Cost (Rank High)
* Ease of Use (Rank High)
* Fun to use and program (Rank Medium)
* Learning Objectives wrt Team Building Met (Rank High)
* Extends student understanding of MATLAB (Rank Medium)
* Reinforces student understanding of the engineering design process (Rank Medium)
* Flexibility and use with other motor drivers and I/O devices (like a helium floatilla with quad motors (Rank Low)

# Limits and Exclusions

* No more than $2,000 in materials and supplies
* No more than $6,000 in labor
* First priority is a platform that will work with Engineering Fundamentals; If time and costs allow include suggested add-ons for other Mechatronics Engineering classes;

# acceptance and criteria

Acceptance criteria are a set of conditions that must be met before the deliverables are accepted. For example – All tasks and milestones are complete, prototype or proof of concept works as proposed with less than 1 percent downtime or defects, industrial sponsor certification, and industrial sponsor inspection required.

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| --- | --- | --- |
| Name | Title | Date |
|  | Project advisor (Currie) |  |
|  | Associate project advisor (TBD) |  |
|  | Digital Circuits advisor – (TBD) |  |
|  | Electronics & Instrumentation – (TBD) |  |
|  | Feedback Loop Control – (TBD) |  |